

**Determinants of the Relationship Between Greenhouse Gases
Emissions Disclosure Assurance and the Quality of Auditor
Professional Judgment on Materiality: An Experimental Study**

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Abstract

This research aims to study and examine the impact of the auditor's professional assurance regarding the disclosure of greenhouse gases emissions (GHGE) on the quality of their professional judgment regarding materiality. Additionally, it examines the influence of the auditor's professional experience and registration with the Financial Regulatory Authority (FRA) as determinants of this relationship. The study employs both theoretical and experimental approaches.

Based on the basic analysis conducted, this research concludes that the auditor's professional assurance concerning the disclosure of greenhouse gases emissions has a **positive** and **significant** impact on the quality of their professional judgment regarding materiality. Furthermore, the research highlights that the nature of this positive and significant effect varies depending on the auditor's professional experience and their registration with the FRA.

Furthermore, through **additional analysis**, this research reveals that both the auditor's professional experience and their registration with the FRA have a positive and significant impact on the quality of their professional judgment regarding the materiality within the main relationship under investigation, when these factors are treated as control variables. Finally, the **sensitivity analysis** demonstrates a substantial level of agreement between the results of the hypothesis test under the sensitivity analysis and those obtained through the basic analysis.

Keywords: Greenhouse Gases Emissions Disclosure Assurance; Materiality; Auditor's Professional Experience; Financial Regulatory Authority.

محددات العلاقة بين التوكيد المهني لمراقب الحسابات على الإفصاح عن انبعاثات غازات الاحتباس الحراري وجودة حكمه المهني على الأهمية النسبية: دراسة تجريبية

ملخص البحث

استهدف البحث دراسة واختبار أثر التوكيد المهني لمراقب الحسابات بشأن الإفصاح عن انبعاثات غازات الاحتباس الحراري على جودة حكمه المهني على الأهمية النسبية، بالإضافة إلى أثر كل من الخبرة المهنية لمراقب الحسابات وقيده لدى الهيئة العامة للرقابة المالية كمحددين لهذه العلاقة، وذلك من خلال دراسة نظرية وتجريبية.

وقد توصل البحث، في ظل التحليل الأساسي، إلى أن التوكيد المهني لمراقب الحسابات بشأن الإفصاح عن انبعاثات غازات الاحتباس الحراري له تأثير إيجابي ومعنوي على جودة حكمه المهني على الأهمية النسبية، وأن هذا التأثير الإيجابي والمعنوي يختلف باختلاف كل من الخبرة المهنية لمراقب الحسابات وقيده لدى الهيئة العامة للرقابة المالية.

كما توصلت الدراسة في ظل التحليل الإضافي إلى أن كلاً من الخبرة المهنية لمراقب الحسابات وقيده لدى الهيئة العامة للرقابة المالية يؤثران تأثيراً إيجابياً ومعنوياً على جودة حكمه المهني على الأهمية النسبية في سياق العلاقة الرئيسية محل الدراسة، وذلك عند معالجتهم كمتغيرين رقابين. وأخيراً توصلت الدراسة، في ظل تحليل الحساسية، إلى اتفاق نتائج اختبار الفروض في ظل تحليل الحساسية مع نتائج اختبار الفروض في ظل التحليل الأساسي، وهو ما يشير إلى أن نتائج تحليل الحساسية تدعم بدرجة كبيرة نتائج التحليل الأساسي.

الكلمات المفتاحية: التوكيد المهني لمراقب الحسابات على الإفصاح عن انبعاثات غازات الاحتباس الحراري، جودة أحكام الأهمية النسبية، الخبرة المهنية لمراقب الحسابات، قيد مراقب الحسابات لدى الهيئة العامة للرقابة المالية.

Introduction

The external audit process goes through a series of decisions and **professional judgments issued by the auditor**, beginning with accepting or continuing with the client, passing through his professional judgments that are required by planning and performing audit procedures and evaluating evidence, and ending with the formulation of the opinion and the preparation of his report on the annual financial statements. In turn, the quality of these judgments is reflected in audit quality (West & Buckby, 2023). Many studies (Salehi et al., 2022; Francis, 2023; Sulaiman et al., 2023) focused on the final result and outcome, which is the quality of the audit without focusing on the reasons that led to it, which is represented in the series of judgments and professional decisions made by the auditor (Sharifi et al., 2023).

The concept of materiality is one of the main pillars of the financial reporting process. Assessing the relative importance of errors is a critical step in the audit process since correcting errors is supposed to affect the informational content and credibility of the financial statements (Aprile et al., 2023). Materiality judgments affect all stages of professional engagements, especially the planning and evaluation stages. There are many professional standards concerned with the concept and application of materiality in the field of auditing annual financial statements, such as the International Standard on Auditing (ISA) No. 320. Additionally, there is a tendency for the auditor to defend his professional judgement in front of stakeholders by disclosing materiality thresholds in the new audit report (Goh et al., 2023).

It is worth noting that there are many attempts to develop interpretations of the **concept of materiality** and its application in the field of assurance on the disclosure of greenhouse gases emissions, in the form of unprofessional attempts such as the guidelines of the Global Reporting Initiatives Organization (GRI, 2022), and what is stipulated in the assurance standard AA No. (1000) issued by the Accountability Organization (ASB, 2020), but those attempts, especially the guidelines of the Global Organization for Reporting Initiatives, have dealt with materiality in a way that may differ from financial auditing by developing

guidelines for the important components of greenhouse gases emissions disclosure to make it more reliable and appropriate through the involvement of stakeholders (Hoogerbrugge et al., 2023). The SEC has only focused on the financial impact when determining the materiality of the elements of non-financial reports, but sometimes there are some elements without any financial impact that disclosing leads to more informative investor's decisions (Moubayed, 2023).

The quality of the auditor's professional judgment¹ is the cornerstone of accounting and auditing, as it is necessary to carry out the audit process to interpret ethical standards and requirements, which requires the need to use and apply knowledge and experience to the surrounding facts and circumstances. Therefore, the personal characteristics of the auditor, especially the extensive professional experience and knowledge, have an important role to play when making professional judgments (Soe et al. 2022). That is, the auditor has different mental models that depend on previous experience to use any new information (Bucaro, 2019). Given materiality as a judgmental concept, the auditor specifies the level of materiality for any detected difference between his professional judgment and what is disclosed is a matter of professional judgment affected by the professional experience of the auditor and his perception of the information needs of users (Deliu, 2020).

Recently, there has been an increase in the trend towards preparing reports for the **disclosure of greenhouse gasses and providing assurance** on these reports by the auditor, as a result of stakeholders' interest in environmental performance, and investors' reliance on these reports as an indicator of corporate risks and operational performance (Koutoupis et al., 2023). At the level of these reports, materiality is considered one of the accounting concepts which has been adopted and applied in the field of reporting on greenhouse gases emissions (GHGE) disclosure (Edgley et al., 2015). Attention has been paid to the effects of assurance on the disclosure of greenhouse gases

¹ The researchers use the term "quality of professional judgment" instead of "accuracy", "relevance", and "correctness" on the grounds that the quality of judgment is more comprehensive and directly supports the quality of auditing.

emissions, and it is more directed toward stakeholders, and the fierce competition faced by auditors in this assurance field makes it a more complex task than financial auditing, which may cause some differences that must occur to the concept of materiality, depending on the context in which professional judgment is formed by moving from the field of traditional financial auditing to professional assurance on the disclosure of GHGE (Turner & Weirich, 2023).

Concerning **the effect of the auditor's professional assurance regarding the disclosure of GHGE on the quality of his professional judgment regarding materiality**, several studies (e.g., Doxey & Sealy, 2022; Thai et al., 2022; Appelbaum et al., 2023) agreed that the auditor's professional assurance on disclosing GHGE and sustainability reports and the level of disclosure of environmental, social and governance practices related to the firm's sustainability has a positive and significant effect on the quality of the auditor's professional judgment on the relative importance, as the nature of the assurance on GHGE disclosure may impose a different meaning and role of materiality than what is the case in the audit of the annual financial statements.

On the other hand, many previous studies (e.g., DeZoort et al., 2019; Hegazy & Salama, 2022; DeZoort et al., 2023) pointed to the difference in the **quality of the auditor's professional judgment on his judgment on the materiality according to his professional experience and his registration with the FRA**. The aforementioned studies agreed on the positive and significant impact of the auditor's professional experience on the quality of his professional judgment on the materiality, as a result of the reflection of that experience on raising the perceived level of audit quality, by increasing the efficiency and effectiveness of the performance of the audit process and then increasing its ability to reduce the opportunistic behavior of the management, as well as contributing to lowering the actual level of information risk, supporting the financial stability of the firm, and lowering the level of information asymmetry which is reflected in increasing the quality of the auditor's professional judgment regarding materiality.

Based on some studies (e.g., Mala & Chand, 2015; Setiawan & Iswari, 2016; Jackson et al., 2017) that dealt with the determinants or **factors influencing the quality of professional judgments**, whether they relate to the characteristics of the audit firm, the personal and technical characteristics of the auditor, the characteristics of the professional practice environment, the nature of the field of professional judgment, and the characteristics and nature of the audit client firm, and in light of the supposed direct relationship between the auditor's professional assurance regarding the disclosure of GHGE and the quality of materiality professional judgments: **The research problem can be formulated in the following questions:** Does the auditor's professional assurance regarding the disclosure of GHGE affect the quality of his professional judgment about the materiality?, and, Does that effect differ according to the difference in each of the professional experience of the auditor and his registration with the FRA?

The main objective of this research is to study and examine the impact of the auditor's professional assurance regarding the disclosure of GHGE on the quality of his professional judgment regarding materiality. In addition, this study tests the impact of each of the auditor's professional experiences and registration with the FRA as determinants of this relationship.

This research gains **scientific importance** because it is moving in the direction of narrowing the expectations gap in auditing, by supporting the ability of the professional auditor to estimate his judgment on the materiality. This study also contributes to the previous studies related to professional assurance regarding the disclosure of GHGE and improving audit quality, by searching for narrowing the gap resulting from not giving enough attention in previous studies to the impact of each of the professional experience of the auditor and his registration with the FRA on the relationship between the auditor's professional assurance on the disclosure of GHGE and the quality of his professional judgment regarding materiality. Additionally, this paper adds to accounting research by being applied in Egypt.

The practical importance of this research lies in its endeavor to test its hypotheses through an experimental study, which can reach results that contribute positively to improving the ability of the auditor to improve the quality of his professional judgments in general, and his judgment regarding materiality in particular, and thus increase his ability to persuade the community to trust the audit profession and reduce the risk of litigation. In addition, this study tested the effect of each of the auditor's professional experience and his registration with the FRA as moderating variables on this relationship in the Egyptian professional practice environment, which is a research field that suffers from relative scarcity.

Despite the many motives for this research, the most important of them is the scarcity of experiment research in the field of the auditor's professional assurance regarding the disclosure of GHGE, to the best of the researchers' knowledge, and to keep up with the international and Egyptian trend toward sustainability issues. In 2022, the Prime Minister's Decision No. 4664 has been issued to amend some provisions of the executive regulations of the Capital Market Law issued by the Minister of Economy and Foreign Trade's Decision No. 135 for the year 1993, where two new articles were added regarding the establishment of the Egyptian Stock Exchange, a voluntary market for trading "certificates of reducing carbon emissions." These Certificates are tradable financial instruments, and they mean greenhouse gases emission reduction units. In addition to the establishment of a committee to supervise and control carbon emissions reduction units. Also, the Board of Directors of the Egyptian FRA issued Decision No. 107 for the year 2021 regarding the controls for firms operating in the field of non-banking financial activities to disclose environmental, social, and governance practices related to sustainability and the financial effects of climate change, according to the latest amendment dated 12/28/2022, where among the environmental practices is the extent to which firms are committed to setting goals related to reducing GHGE, and the extent to which firms are committed to **calculating the total percentage of carbon emissions annually**. Finally, the researchers try to keep pace with the

trend of relevant research applied to foreign countries, by conducting a basic and additional analysis, as well as a sensitivity analysis, in order to overcome a deficiency that is almost frequent in many Egyptian researches in this regard.

This research is limited to examining and investigating the impact of the auditor's professional assurance regarding the disclosure of GHGE on the quality of his professional judgment regarding materiality. In addition, this study tested the effect of each of the auditor's professional experience and his registration with the FRA as determinants of this relationship for a sample of auditors in the accounting and auditing firms located in Cairo and Alexandria. Thus, it is out of the scope of the research auditors of the accounting and auditing firms of the rest of the other governorates of the Arab Republic of Egypt. In addition, this study is limited to the positive emphasis on the disclosure of information on GHGE by listed firms on the Egyptian Stock Exchange (EGX) without addressing the performance of environmental consulting services and other assurance services related to the disclosure of listed or unlisted firms on the EGX, regarding emissions of greenhouse gasses, emissions of any gases other than greenhouse gases, or projects and efforts adopted to reduce these emissions. Moreover, **the main focus of this research is on judgments of materiality at the level of traditional financial statements plus a GHGE statement**, and this has been taken into account in the two experimental cases that were presented to the participants. Finally, the generalizability of the research results is conditioned by the criteria for defining the study population and sample.

In order to achieve the aim of this research and address its problem in light of these limits, **the remainder of this research will be divided as follows**: The **second section** includes a literature review and hypotheses development. The research methodology is presented in the **third section**, while the **fourth section** presents the research hypotheses testing results. Moreover, the additional analysis is dealt with in the **fifth section**, and sensitivity analysis is dealt with in the

sixth section. Finally, the research findings, recommendations, and suggested future research are addressed in the **seventh section.**

1. Literature Review and Hypotheses Development

In order to achieve the objective of this paper, the researchers address in this part the following aspects; analyzing the relationship between the auditor's professional assurance regarding disclosure of GHGE and the quality of his professional judgment regarding materiality, and analyzing the impact of the auditor's professional experience on the relationship between the auditor's professional assurance regarding disclosure of GHGE and the quality of His professional judgment regarding materiality, as well as the analysis of the impact of the auditor's registration with the FRA on the relationship between the auditor's professional assurance regarding the disclosure of GHGE and the quality of his professional judgment regarding materiality.

2.1 GHGE Disclosure Assurance and the Auditor Professional Judgment Regarding Materiality

2.1.1 GHG Concept

In terms of what are the greenhouse gasses? the main greenhouse gases according to the Kyoto Protocol² are methane (CH₄), carbon dioxide (CO₂), nitrous dioxide (N₂O), pyro fluorocarbons (PFCs), hydrofluorocarbons (HFCs), and Sulfur hexafluoride (SF₆). The US Environmental Protection Agency (EPA) classified the energy sector, the industrial sector, and the transportation sector as the main sectors that contribute to the emission of GHG (Hickmann et al., 2021).

2.1.2 Professional Assurance on GHG Disclosure

Regarding the nature of professional assurance in general, from the analysis of professional standards, the International Standard on Assurance Engagements (ISAE) No. 3000, ISAE No. 3410; and the Egyptian Standard for Professional Assurance Services No. 3000, the

² The Kyoto Protocol is a treaty stemming from the United Nations Framework Convention on Climate Change (UNFCCC) and aims to combat global warming.

professional assurance service can be defined as an independent three-party professional service performed by the auditor through obtaining and evaluating sufficient and appropriate evidence in order to reach a neutral conclusion regarding the field of the engagement with a reasonable, not absolute, level of assurance to add confidence and improve the quality of information for the purposes of serving the various decision-makers (IAASB, 2012, 2013). In the same vein, Arens et al. (2023) indicate the possibility of considering professional assurance services as the general framework that includes assurance services on various types of information, whether financial or non-financial information and under it falls the traditional annual financial external audit process, which is considered a special type of attestation services.

As for the nature of the auditor's professional assurance regarding the disclosure of GHGE, it is clear from the analysis of ISAE No. 3410 and previous studies (e.g., Kim et al., 2016; Zhou et al., 2016; Green et al., 2017; Ekasingh et al., 2019; Akbas et al., 2020; Ryan & Tiller, 2022; Hay et al., 2023; Koutoupis et al., 2023) there is no agreement regarding a definition of the professional assurance service for the disclosure of greenhouse gases emissions, in general, but this service can be defined as a three-party assurance service aimed at expressing a neutral conclusion regarding the compatibility of the management assertions regarding the disclosure of GHGE statement with appropriate measurement criteria and communicating this conclusion to the various decision-makers to enhance their confidence in those assertions and help them rationalize the process of making their various decisions.

The researchers believe that the professional assurance service for the auditor regarding the disclosure of GHGE can be defined as an organized process for the collection and objective evaluation of the evidence of the management's assertions regarding the disclosure of the GHGE statement, according to its various dimensions in a way that enables the auditor, as a head of the assurance process team, to reach a positive conclusion regarding the truthfulness and fairness of these assertions, in accordance with the applicable measurement standards,

and communicating his conclusion to the various stakeholders, including management.

With regard to the objective of the auditor's professional assurance service regarding disclosure of GHGE, the auditor, as the performer of this service, aims to reach a reasonable, not absolute, conclusion on management assertions about whether the GHGE statement is free from material misstatement, by verifying the extent of the truth and fairness of these assertions, as well as the adequacy of the disclosure of GHGE contained in the greenhouse gases statement, based on the applicable measurement standards, which is reflected accordingly in reducing the level of information asymmetry, increasing the relevance and reliability of the information contained in the greenhouse gases statement, and thus improving the level of information quality (Ryan & Tiller, 2022).

Regarding the one who can perform the GHGE professional assurance service, according to the Global Reporting Initiative (GRI), there is a possibility of performing this service by (1) auditors belonging to accounting and auditing firms, (2) consulting engineers working in engineering consulting offices, and (3) consultants working in sustainability services offices (GRI, 2013). As pointed out by Green et al. (2017) the person in charge of the professional assurance service regarding the disclosure of GHGE should have a set of professional characteristics, ethical values, and principles, including; integrity, objectivity, independence, industrial specialization, efficiency and due professional care in applying the related professional standards. In addition to the availability of technical and professional expertise necessary to perform that assurance service, and exercise professional skepticism and professional judgment. Likewise, the study of Hay et al. (2023) indicates the difficulty of performing the assurance service regarding greenhouse gases statement by the auditor alone, and the need to form a work team for the assurance service that includes: (1) the auditor as head of the work team, (2) a specialist in environmental matters, (3) a specialist in chemical aspects, (4) a specialist in corporate governance, and (5) a specialist in information technology.

According to the definition of the GHGE disclosure assurance service, this service can be viewed as an integrated professional service that has scope, measurement criteria, and professional standards. As for the scope of the GHGE disclosure assurance service, many studies (e.g., Ekasingh et al., 2019; Ryan & Tiller, 2022; Koutoupis et al., 2023) indicated that this service's field includes management assertions prepared by the firm's management regarding greenhouse gases emissions and that those assertions must be identifiable and quantifiable, or consistently evaluated, according to a defined set of measurement criteria, and information about them must be subject to sufficient and appropriate evidence-gathering procedures to qualify them as relevant. Such assertions should be about the quantification of GHGE for the period subject to the assurance and about the presentation and disclosure of GHGE statement. Management's assertions about the firm's GHGE should be subject to evaluation in light of the reference to applicable measurement criteria, and the performance of this service is limited only to independent persons who are qualified and worthy to perform it. Finally, both reasonable assurance and limited assurance are considered appropriate levels of this service.

Regarding the criteria for measuring the validity of management assertions in the greenhouse gases statement, Ekasingh et al. (2019) suggest that there are three sets of measurement criteria. The **first group** concerned accounting for emissions at the **level of the firm as a whole**, regardless of the industrial sector to which this firm belongs, this group can be dealt with as appropriate general standards for measuring and disclosing emissions, as it meets the requirements stipulated by professional standards that it must be available in the measurement standards that can be based on when formulating management assertion regarding emissions disclosure. The **second group** was issued to account for emissions according to the sector to which this firm belongs.

The **third group** is concerned with defining the requirements and standard specifications for all equipment and procedures used to quantify the firm's emissions, this group includes measurement criteria

that are used when operating and maintaining fuel, energy, and/or GHGE metering equipment, managing and maintaining information technology systems used for emissions data flow activities, energy use data metering devices, and taking fuel and raw materials samples for analysis and identification of their chemical properties, periodic testing of the accuracy of the sampling process, evaluation of the testing laboratories of these samples, the periodic performance of verification procedures for measurement devices, and information technology systems used for emissions data flow activities. In light of the foregoing, the researchers conclude that the attention of previous studies was limited to the first group of measurement criteria only, in addition to their lack of agreement on a specific set of measurement criteria that belong to that group to deal with them as appropriate criteria for measurement.

Regarding the appropriate professional standards for the auditor's professional assurance service regarding the disclosure of GHGE, the ISAE No. 3410 was issued regarding assurance engagements on greenhouse gases statements, and this standard explains how auditors perform this service in a better manner, as this standard specifies the requirements that must be taken into account during the performance of the four stages of this service, starting from the stage of accepting the service, ending with the stage of reporting on the service output, and going through the two stages of planning and implementing the service related procedures (IAASB, 2012).

Firstly, the requirements of the stage of accepting the engagement of the assurance service of disclosing GHGE. The auditor must understand the nature of the firm's operations and its sources of GHGE, assess the risks of accepting this engagement, and make a decision of acceptance, approval of the fees, identification of the assurance team members, and identification of their responsibilities. Also, the auditor must determine the need for the use of one or more external experts to help complete the engagement, sufficient knowledge of the measurement criteria in force, obtain an acknowledgment from the firm's management that it understands its responsibility regarding the GHGE statement, and be assured of ensuring that team members can

reach the concerned parties and obtain data and documents. Finally, sending a letter of acceptance to the general assembly of shareholders, fulfilling all its formal and professional elements (IAASB, 2012).

Secondly, the requirements of the planning phase of the assurance service for the disclosure of GHGE. The auditor must ensure a full understanding of the firm and the industry to which it belongs, the relevant legal, regulatory and official controls, the approved plan for monitoring emissions, and the applicable measurement criteria, emissions reporting policies, and business objectives and strategies relevant to the service area. The auditor must also ensure that the applicable measurement criteria are appropriate for the service area, assess the reliability of the internal audit function relevant to the service area, and the internal control structure over the process of preparing the statement of GHGE, appropriately applying the concept of materiality, identifying and evaluating the inherent risk at the level of GHGE disclosure statement and the level of management assertions, the final assessment of the level of internal control risk, planning the level of detection risk, and finally preparing the assurance plan (IAASB, 2012).

Thirdly, the requirements of the implementation phase of the assurance service work regarding the disclosure of GHGE. The auditor must take into account that the GHGE statement contains and assign assurance on a sufficient scale for the target user of this statement, assess the suitability of the service field for the target user of the statement, and evaluate the validity of management assertions regarding GHGE, whether those related to the quantification of GHGE or those related to the presentation and disclosure of the statement of GHGE, in light of the reliance on the applicable measurement criteria. Also, the auditor must examine and evaluate various elements of quantitative-based monitoring approaches for determining GHGE and adhere to the same evidence-gathering considerations as those for traditional positive assurance engagement (IAASB, 2012).

Fourthly, the requirements of the reporting phase on the work of the assurance service regarding the disclosure of GHGE, the auditor must direct the assurance report to the shareholders, the board of

directors and the interested authorities, take into account the formal aspects of the report, provide positive assurance on the GHGE statement with the appropriate conclusion reached based on collected evidence, and as clarified in the paragraphs of the ISAE No. 3410 related to the content of the assurance report (IAASB, 2012).

Regarding the requirements of the assurance service on the disclosure of GHGE, the auditor must apply his professional judgment to determine the materiality level using the financial and non-financial determinants. The auditors must also evaluate the risks associated with the greenhouse gases statement, and then collect evidence to verify the **management assertions**, which include the following: (1) Existence: The auditor must verify that the GHGE disclosed in the Greenhouse Gas statement actually exist (ii) Completeness: The auditor must verify that all disclosures that should have been included in the GHG statement are included, (iii) Accuracy and Valuation: the auditor must verify that the amount of GHGE and related information included in the GHGE statements has been appropriately measured, and (iv) Presentation and Disclosure: the auditor must verify that disclosure of the amount of GHGE correctly displayed in the greenhouse gases statement, and whether the disclosure was sufficient to measure the amount of GHGE, and they were recorded in the correct reporting period (IAASB, 2012).

With regard to the disclosure of GHGE in Egypt in terms of the legal and legislative background, the Prime Minister's Decision No. 4664 was issued in the year 2022 to amend some provisions of the executive regulations of the Capital Market Law issued by the Minister of Economy and Foreign Trade's Decision No. 135 in the year 1993, as it adds two new articles, one stipulating that a voluntary market shall be established on the EGX for the trading of "certificates for reducing carbon emissions." These certificates are tradable financial instruments, and they are intended for units of reducing greenhouse gas emissions. It is issued for the benefit of any entity that implements projects to reduce greenhouse gas emissions after obtaining the approval of the concerned authorities, and each unit represents a ton of reduced carbon dioxide equivalent. All government agencies, the

public business sector, the private sector, and all project developers are obligated to notify both the FRA and the Ministry of Environment of all projects for which carbon emission reduction certificates will be issued. The entities that issue carbon emission reduction certificates are obligated to disclose any events or changes, given the approvals issued to them by the relevant authorities throughout the issuance period.

The other added article stipulates that, by a decision of the Board of Directors of the FRA, in coordination with the Ministry of Environment, a committee shall be formed that includes in its membership representatives of the concerned authorities, called the Committee of Supervision and Control of Carbon Emissions Reduction Units. The FRA prepares a database for registering projects for which carbon emission reduction certificates have been issued, and it provides the Ministry of Environment with these projects every month. The EGX issues the rules and procedures for trading on these certificates, provided that they are not valid until after they are approved by the FRA.

Finally, the Board of Directors of the Egyptian FRA issued Decision No. (107) in the year 2021 on 5/7/2021 regarding the controls for firms operating in the field of non-banking financial activities to disclose environmental, social, and governance practices related to sustainability and the financial effects of climate change. According to the latest amendment, on 12/28/2022, among the environmental practices is the extent to which firms are committed to setting goals related to reducing GHGE and the extent to which firms are committed to calculating the total percentage of carbon emissions annually.

2.1.3 Auditor's Professional Judgment

With regard to the concept of professional judgments for auditors, it can be said that there are different concepts of professional judgments, as some studies (Wedemeyer, 2010; Setiawan & Iswari, 2016) agree that professional judgment is a personal evaluation process that is taken initially as a pre-action, or procedure, and that would affect the process of auditing the financial statements or their outputs. Heyrani et al. (2016) defined the concept of professional judgment as

the application of relevant expertise, knowledge, and appropriate training, in the light of what was determined by professional standards, professional behavior legislation, and ethical standards, which is reflected in making the appropriate decision on a case, in proportion to the circumstances surrounding the assignment, in light of the existence of alternative procedures can choose between them. The concept of professional judgment according to some studies (Schmutte & Dumanu, 2009; Jackson et al., 2017; Deliu, 2020) agrees with what was presented by the Canadian Association of Certified Public Accountants, from the perspective of focusing on procedures and decisions, that it is the decision-making process to conclude the possible alternatives under conditions of uncertainty. Hence, it can be said that the previous concepts of professional judgment focused their content on the determinants of professional judgment. The concept of Deliu (2020) focused on the procedural aspects of issuing professional judgments and defined it as the process necessary to reach a specific decision or conclusion when there are several alternatives available, and then it can cover three aspects: evaluation of evidence, assessment possibilities, and choice between more than one alternative.

The researchers conclude from the foregoing that the concept of professional judgment is characterized by several characteristics that begin with the existence of an engagement that includes a set of limits that include risk, uncertainty, and complexity, and there is no accurate criteria for measurement, which requires a personal assessment and mental operation by a professional person who has sufficient experience, knowledge, and skill to ensure that due professional care is exercised through awareness, discrimination and comparison between alternatives ends with a conclusion, and follow-up in line with the circumstances that required the issuance of a professional judgment, within the framework of professional, behavioral and ethical standards, and relevant legislation and laws.

Among areas of professional judgment that auditors have to make in the planning stage, the auditor issues his judgments at that stage which requires him to understand the entity and its environment and assess the risk of material misstatement, as well as determine the

level of materiality, whether the total at the level of the financial statements or the level of balances and assessing the audit risk and evaluating the effectiveness of the internal control structure in terms of design and operation.

While the implementation phase requires the auditor to implement the planned audit program, assess the adequacy and relevance of evidence which is the most important professional judgment at that stage in particular, and evaluate the reasonableness of accounting estimates and assumptions, the appropriateness and adequacy of disclosure and accounting policies applied, as well as the appropriateness of management's application of the going concern assumption, and the evaluation of evidence related to key audit matters and other information. The professional judgments related to the report are also the most important professional judgments, as they are the final product of the outcome of the professional judgments since the professional judgment is issued regarding the audit report and the paragraphs that must appear in it based on an assessment of the extent, materiality, and prevalence of material misstatements in the financial statements (Kaawaase et al., 2016).

Concerning the determinants of the quality of auditors' professional judgments, many previous studies (e.g., Adil et al., 2022; Javadi et al., 2023; Salehi et al., 2023; Utami, 2023) dealt with the determinants of the auditors' professional judgment quality which can be classified into three groups (a) determinants related to the auditor's personal characteristics and his firm, (b) determinants related to the characteristics of the audit client and the nature of his industry, (c) determinants related to the characteristics of the professional practice environment.

Concerning the determinants of the quality of professional judgments that are related to the personal characteristics of the auditor and his firm, they include the following: (1) the professional experience of the auditor in influencing the quality of his professional judgments, and (2) the volume of information that is processed by the auditors, (3) the registration of the auditor with the FRA in Egypt, and (4) the

effectiveness of the quality control system within the audit firm, as it is a guarantee for improving the quality of the professional judgment of the auditors (Adil et al., 2022; Javadi et al., 2023; Salehi et al., 2023; Utami, 2023).

Concerning the nature of the audit client's business and industry, and the related risks as one of the determinants of the quality of professional judgments, they include the following: (1) the nature of the industries in which the client works and the similarity of repeated errors in them, and the possibility of predicting material misstatements in similar industries reasonably, where the accuracy of professional judgments and the consensus of auditors is higher in the industrial firms, compared to the banking industries, (2) the integrity of the client and the nature of the risk factors of his business individually or collectively, (3) corporate governance, and the effectiveness of the audit committee. With regard to the determinants of the quality of professional judgments related to the environment of professional practice, they include government interference through legislation on the professional judgments issued by auditors and the global financial crises that have an impact on the behavior of auditors and their professional judgments regarding continuity (Adil et al., 2022; Javadi et al., 2023; Salehi et al., 2023; Utami, 2023).

The researchers conclude from the foregoing that the professional judgments issued by the auditors are a function of many determinants, whether at the level of the characteristics of each of the auditors, the auditor's firm, the audit client and industry, or the professional practice environment. Despite the multiplicity of these determinants, the real impact of these determinants may not appear except in light of their integration and association with other supportive determinants in an interactive effect that gives a more integrated picture of these determinants.

2.1.4 Materiality Judgment

With regard to the concept of materiality in the areas of financial and non-financial reporting, Edgley et al. (2015) indicated that there is a difference between the field of auditing and the field of

environmental disclosures including disclosure of GHGE. The traditional definition of materiality is based on two foundations. The first is the market perspective which focuses on the benefit of the shareholders. The second is the professional perspective, meaning identifying important information based on the professional judgment of the auditor, which is consistent with the process of reviewing the financial statements. In the case of environmental disclosures and the report on disclosure regarding GHGE, the perspective of the stakeholders has emerged, due to the diversity of parties that may be interested in the information provided.

In the field of financial reporting, the Financial Accounting Standards Board (FASB) defines it as the amount of the magnitude of deletion or distortion of accounting information, which in light of the surrounding circumstances makes the judgments of the average person who relies on that information affected or changed as a result of that deletion or distortion (Legoria et al. 2013). The previous definition was similar to the definition of the International Federation of Accountants (IFAC), which described misstatements, including omissions, as significant if they were individually or collectively and could reasonably be expected to affect the economic decisions of users who made their decisions based on the financial statements. The judgment of materiality depends on the circumstances surrounding the misstatement, the magnitude or nature of the misstatement, or both (IAASB, 2009).

At the international level, the ISA No. (320) indicated that materiality is a professional judgment affected by the auditor's awareness of the needs of stakeholders, and he is assumed to have reasonable knowledge of the audit client's firm and has the desire to collect sufficient evidence on what came in the financial statements with reasonable diligence and to realize that the financial statements have been prepared, presented and auditing at certain materiality levels (IAASB, 2009).

Concerning the materiality in the field of the disclosure of GHGE, the volume is not a complete indicator of the materiality. There are two dimensions of materiality, the first is related to influencing the decisions of stakeholders, and the second is related to the materiality of this influence (Turner & Weirich, 2023). Several non-professional organizations, led by the Accountability Standards Board (ASB) and the Global Reporting Initiative (GRI), have been concerned with the materiality as determining the suitability of the subject for the firm and its stakeholders so that important issues are identified from those that are related to stakeholders, the performance of competitors, or those that have a short-term financial impact, and then a priority must be set for each topic in order to appear in the disclosure of GHGE statement. As for the Global Reporting Initiative (GRI), it has indicated that the report on the disclosure of greenhouse gas emissions should cover topics and indicators that reflect important environmental impacts. Therefore, materiality should not be limited to issues only that have a substantial financial impact but must also include matters that have a material impact on stakeholder evaluation and decisions.

According to the stakeholder theory, the appropriate concept of materiality for the disclosure of the GHGE statement should be based on the assumption of diversity among stakeholder groups (Moroney & Trotman, 2016). It is noted that in the field of reporting on the GHGE, the materiality assessment does not focus on errors in the data or omissions, as is the case in the financial reporting process, but on what topics must be disclosed in the GHGE statement which should focus on the most important aspects of environmental disclosure.

Regarding the quality of the auditor's professional judgment on materiality, the concept of materiality saturates the two stages of planning the engagement and the stage of evaluating its results. Based on the acceptable or maximum number of misstatements that are considered insignificant, the auditor determines the extent, timing, and size of the tests and the size of the sample. In the evaluation stage, materiality is evaluated based on comparing the detected misstatements with the acceptable level or the maximum level of non-significant misstatements to decide the misstatements that must be corrected based on determining their impact on the fairness of financial reporting representation (DeZoort et al., 2023).

The researchers conclude from the foregoing that the concept of materiality with its various definitions left a wide space for the auditor

to form his professional judgment without setting specific guidelines with categorical limits to separate between the important and the unimportant for stakeholders. On the other hand, there is confusion in the process of reporting on the disclosure of GHGE between the appropriateness and importance of the information. Some firms may disclose some appropriate and relevant information, although in reality, it is not important simply because it reveals a positive performance in the field of disclosure of GHGE and vice versa, which may pose a problem for the auditor to prevent the use of greenhouse gas emissions disclosure reports as a tool for communicating the good news and withholding bad ones.

2.1.5 Development of H₁

Regarding the impact of the GHGE professional assurance on the quality of the auditor's professional judgment regarding materiality, many studies (e.g., O'Dwyer et al., 2011; Edgley et al., 2015; Jones et al., 2015; Jones et al., 2016; Moroney & Trotman, 2016; Canning et al. 2019; Doxey & Sealy, 2022; Thai et al. 2022; Appelbaum et al. 2023) indicated the quality of the auditor's professional judgment regarding materiality varies with the auditor's professional assurance regarding the disclosure of GHGE and sustainability reports and the level of disclosure of environmental, social and governance practices related to the firm's sustainability. The aforementioned studies agreed that the professional assurance of the auditor on the disclosure of GHGE and sustainability reports and the level of disclosure of societal, environmental, and governance practices related to the sustainability of the firm has a positive and significant impact on the quality of the auditor's professional judgment regarding materiality. It turns out that the professional judgments of materiality in the context of assuring the disclosure of GHGE and sustainability reports are largely intuitive, although terms from financial auditing such as the limits of materiality and the term of permissible error are relied upon just to justify that judgment, where the nature and complexity of the professional service affects the quality of the professional judgment regarding the materiality of the differences or misrepresentations discovered during the professional assignment.

The researchers conclude from the analysis of these studies that there is an agreement that the professional assurance of the auditor regarding the disclosure of GHGE affects positively and significantly the quality of his professional judgment on the materiality. By analyzing these studies from a methodological point of view, it is clear that they depend on the experimental study method through experimental treatments and experimental comparisons, which justifies the researchers' tendency to choose the experimental study to test the effectual relationship under study, as it is the most reliable and most appropriate. It is also clear that there is no difference in the field of the experimental study of these studies, as this relationship was tested and the experimental study was conducted on auditors and master's and doctoral students in developed countries, while the study of this relationship may be more important in developing countries. This supports the researchers' tendency to test this relationship in the Egyptian professional practice environment, as one of the developing countries, in addition to the relative scarcity of research in this regard. Also, the period in which these studies were conducted makes it clear that they were conducted recently, in the year 2023, which confirms the novelty of this relationship and the importance of its study.

Based on the aforementioned, the researchers believe that the professional assurance of the auditor regarding the disclosure of GHGE may affect the quality of his professional judgment on the materiality, based on what has been concluded that the professional assurance of the auditor regarding the disclosure of greenhouse gas emissions leads to a difference in the quality of his judgment. This is what justifies the researchers' tendency not to adopt a specific direction for this relationship in consistency with previous studies in this regard. Thus, **the first hypothesis of this study can be derived as follows:**

H₁: The auditors' professional assurance regarding the disclosure of GHGE significantly affects the quality of their professional judgment regarding materiality in Egypt.

2.2 The Auditor's Professional Experience, GHGE Assurance, and the Auditor's Professional Judgment Regarding Materiality

2.2.1 Auditor's Professional Experience

Several studies (e.g., Putra et al., 2019; Arifuddin & Indrijawati, 2020; Widodo & Chariri, 2021) have highlighted the significance of the auditor's professional experience and industry specialization concerning their clients. These factors play a crucial role in enhancing the auditor's professional competence, and capabilities, and ultimately improving the quality of their performance. This improvement is evident in the auditor's ability to exercise professional judgment effectively, particularly in matters of materiality, ultimately leading to an enhancement in the overall quality of the audit process.

Regarding the concept of the professional experience of auditors, it becomes evident from the analysis of numerous previous studies (e.g., Cahan & Sun, 2015; Ahmad et al., 2016; Elaoud & Jarboui, 2017; Neisiani, 2019; Verwey et al., 2021) that professional experience can be viewed as the timeframe that reflects the extent of auditors' familiarity with the components of the accounting and auditing profession. It also encompasses a deep understanding of the nature of the audited client's industry, the operational challenges faced by that industry, and how various accounting treatments are applied within it. The effectiveness of an auditing firm's performance and its level of industry specialization are influenced by its accumulated experience in performing audits.

As for measuring the professional experience of auditors, according to the analysis of several previous studies (e.g., Cahan & Sun, 2015; Ahmad et al., 2016; Elaoud & Jarboui, 2017; Neisiani, 2019; Verwey et al., 2021), this experience can be measured using two approaches. The first approach is the experience gained from the auditor's familiarity with performing auditing tasks, which can be measured by the extent of the auditor's experience in performing the same auditing task for a specific client or the number of years the auditor has been working with the same audit client. This can also be measured on a graduated scale that increases from one year to another.

The second approach is the experience gained through industry specialization, which refers to the reduction in time and effort required by the auditor to perform the audit due to the knowledge and deep understanding of the nature of the audited client's industry. This can be measured by the degree of industry specialization of the auditing firm using market share as an indicator.

2.2.2 Development of H₂

Regarding the impact of professional experience on the performance of auditors, and based on numerous previous studies (e.g., Cahan & Sun, 2015; Ahmed et al., 2016; Elaoud & Jarboui, 2017; Neisiani, 2019; Verwey et al., 2021), it can be said that professional experience has the potential to enhance the efficiency and effectiveness of the auditing process. This is achieved through the auditor's ability to select, apply, and adapt audit procedures that are tailored to the risks associated with the nature of the client's industry and the operational challenges it faces. This efficient and effective approach contributes to reducing the likelihood of audit failure and increasing the perceived quality of the audit. Furthermore, it enhances the auditor's ability to assess the materiality accurately.

Regarding the impact of professional experience on the professional judgment of auditors regarding materiality, many previous studies (e.g., Bhattacharjee & Moreno, 2002; Asare et al., 2009; Martinov-Bennie & Pflugrath, 2009; Manita et al., 2011; Adam & Dacunha, 2019; DeZoort et al., 2019; Hegazy & Salama, 2022; DeZoort et al., 2023) have indicated that the quality of auditors' professional judgment regarding materiality varies based on their professional experience. These studies agreed on the positive and significant influence of auditors' professional experience on the quality of their professional judgment regarding materiality. This is due to the reflection of experience in enhancing the perceived level of audit quality, through increasing the efficiency and effectiveness of the auditing process, thereby enhancing the auditor's ability to mitigate management opportunistic behavior. Additionally, professional experience contributes to reducing the level of information risk,

supporting the financial stability of the company, reducing information asymmetry, and mitigating ethical and adverse selection problems. Consequently, this results in an improvement in the quality of auditors' professional judgment in assessing materiality.

Accordingly, the professional experience of auditors, given the conditions required by such experience, would have an impact on the quality of their professional judgments. The professional experience of auditors is considered one of the influencing factors in their assessment of materiality. Auditors with low experience would exhibit significant differences in their professional judgment when presented with negative information about an audit client, unlike auditors with high experience. As a result, this affects the relationship between auditors' professional assurance of GHGE disclosure and the quality of their professional judgment regarding materiality. Based on this, **the second hypothesis (H₂) can be derived as follows:**

H₂: The significant impact of auditors' professional assurance regarding the disclosure of GHGE on the quality of their professional judgment regarding materiality in Egypt varies according to their level of professional experience.

2.3 Registered Auditor with the FRA, Greenhouse Gas Emissions Assurance, and the Auditor's Professional Judgment Regarding Materiality

2.3.1 Auditor's registration with the FRA

The registration of auditors with the FRA supports the quality of the auditor's professional judgment regarding materiality, which reflects on the quality of auditing (David & Abeysekera, 2021). Regarding the registration of auditors with the FRA as a moderating variable on the relationship between the professional assurance of auditors regarding the disclosure of greenhouse gas emissions and the auditor's professional judgment regarding materiality, the analysis of the requirements for the registration of auditors with the authority is of professional significance. These requirements necessitate that auditors seeking registration in the auditors' registry of the authority must

possess appropriate professional qualifications, experience, ability, and professional competence. This includes the availability of experienced work teams and the need to focus on their development and enhance their proficiency through specialized programs on greenhouse gas emissions. Additionally, the presence of quality control systems, their supervision, monitoring, inspection, and adherence to professional ethics and conduct rules are essential (Humphreys & Trotman, 2022).

For the registered auditor with the FRA to fulfill the requirements of professional solvency, there are three elements. As for the first element, which is the presence of a highly skilled and competent work team, numerous studies (e.g., Gul et al., 2013; Knechel et al., 2013; Jackson et al., 2017) have agreed that working as a group leads to accuracy and consensus among group members, which reflects on the quality of professional judgment, especially with an increased duration of association within the team. Work teams are also more capable of analysis, problem-solving, task performance, and managing brainstorming as a reservoir of experience and knowledge, which, in turn, reflects on the quality of professional judgments in general, the quality of the auditor's professional judgment regarding materiality in particular, and ultimately the quality of auditing as a whole.

The second element of professional solvency is the necessity of having an effective quality control system in all its aspects, starting with the responsibilities of leaders within the auditing firm, continuing with adherence to continuity policies or acceptance of the client, and commitment to ethical requirements, particularly independence, and ending with the process of documentation and consultation. Several studies (e.g., Bagley, 2010; Andiola, 2014; Andiola et al., 2019) have relied on identifying problems of professional judgment and how the process of periodic examination of working papers by supervisors can serve as a mechanism to ensure the exercise of due professional care and as one form of issuing the final professional judgment.

As for the third element of professional solvency, which is continuous professional development, Paisey & Paisey (2020) have clarified that continuous professional education and training methods

that simulate practical practices can enhance the proficiency of auditors, especially regarding the cognitive and perceptual aspects that enable them to issue high-quality professional judgments. Continuous professional education for auditors positively affects the quality of their judgments in general and their professional judgment on matters of relative importance in particular.

Regarding compliance with the code of professional conduct for registered auditors with the FRA, Rathnasamy & Mahabeer (2021) argue that it is important for auditors to adhere to the rules of ethics, morality, and professional behavior as they have a positive impact on the quality of decisions and professional judgments they issue, and consequently on the quality of auditing. An auditor with a high level of ethical development demonstrates greater sensitivity to information regarding the integrity of the client and is better able to identify improper behavior while being less susceptible to engaging in such behavior.

In Egypt, according to Decision No. 152 of the Board of Directors of the FRA in the year 2021 to amend the Authority's Board of Directors Decision No. (3) of 2021 regarding the reorganization of the registration controls and the continuation of registration and deletion in the auditors' register with the Authority, it is required for registration in the register the following: (1) be among those practicing the profession registered in the General Register of Accountants and Auditors at the Ministry of Finance, (2) no final criminal judgments have been issued against the auditor, (3) no disciplinary judgments have been issued against the auditor, and (4)) paying for the prescribed services, and (5) being a member of the Free Professional Accounting and Auditing Division of the Trade Union, and (6) the passage of at least five years as an auditor among those who have the right to audit and approve the financial statements of joint-stock firms in the General Register of Accountants and Auditors at the Ministry of Finance, and (7) conducting an audit of the accounts of joint stock firms during the five years preceding the application for registration, provided that he has audited the accounts of at least three joint stock firms each year in accordance with the Egyptian professional standards for auditing, and

(8) to be registered in the register prepared by the Central Auditing Organization for those who practice the profession from outside the governmental scope.

Finally, the auditor should satisfy at least one of the following (a) membership of the Egyptian Association of Accountants and Auditors or obtaining one of the foreign professional certificates equivalent thereto, or obtaining a doctorate in accounting from one of the recognized universities in Egypt, and (b) registration in the auditors of banks register at the Central Bank of Egypt, and (10) fulfilling the requirements of professional ability and solvency by submitting evidence of the existence of the following: (a) a work team includes at least three experienced persons in the field of accounting and auditing for joint stock firms for not less than five years, and (b) a summary of the system applied in the firm for quality control and verification of professional independence, and (c) the system applied for commitment to continuing professional education.

2.3.2 Development of H₃

The researchers believe that the auditor's registration with the FRA, with the conditions required by this restriction, will have an impact on his professional judgments, and thus influence the relationship between the auditor's professional assurance regarding the disclosure of greenhouse gas emissions and the auditor's professional judgment on the materiality. Accordingly, **the third hypothesis of the research (H₃) can be derived**, as follows:

H₃: The significant impact of auditors' professional assurance regarding the disclosure of GHGE on the quality of their professional judgment regarding materiality in Egypt varies according to whether they are registered with the FRA.

2. Research Methodology

The primary aim of this part is to focus on the **experimental study** of research. In order to achieve this objective, the researchers address the following aspects: data and sample, the research model,

measurement of variables, study tools and procedures, experimental design, treatments, and experimental comparisons.

3.1 Data and Sample

The study population for the purpose of basic analysis consists of certified accountants working in accounting and auditing firms authorized to audit joint-stock firms in the governorates of Cairo and Alexandria. A judgmental sample was selected from this population, consisting of 250 individuals. Several factors were considered in the selection process, including the number of individuals registered with the FRA, both registered and non-registered individuals, as well as large and small accounting and auditing firms, both registered and non-registered (Edgley et al., 2015; Jones et al., 2015; Jones et al., 2016; Moroney & Trotman, 2016; Canning et al., 2019).

For the purposes of sensitivity analysis, the study population consisted of academics, as it consisted of faculty members, the assistant staff of the Accounting Department, Faculty of Business, Alexandria University, and the Faculty of Commerce, Damanhour University. A judgmental sample was taken from them, which included 120 items. It was taken into consideration that the sample should include a group of master's and doctorate holders, especially in the field of auditing or financial accounting, and that they should be as homogeneous as possible in each category. Given the novelty and difficulty of the topic, the experiment is conducted on students to assess their awareness of the subject under study (Edgley et al., 2015; Canning et al., 2019; Appelbaum et al., 2023). **Table 1** states the distributed and received cases and the percentage of responses.

Table 1: Distributed and Received Experimental Cases

First: the experimental cases distributed and received under the basic analysis of the auditors		
Total cases distributed	Number of Cases Received	Response Rate
250	130	52%
Second: the experimental cases distributed and received under sensitivity analysis on academics		
Total cases distributed	Number of Cases Received	Response Rate
120	100	83%

Source: Prepared by researchers

3.2 Research Model

Figure (1) provides a summary of the research model under the basic analysis, which shows the effect of the auditor's professional assurance regarding the disclosure of GHGE on the quality of their professional judgment regarding the materiality, and the interactive effect of the auditor's professional experience and registration with the FRA on this relationship.

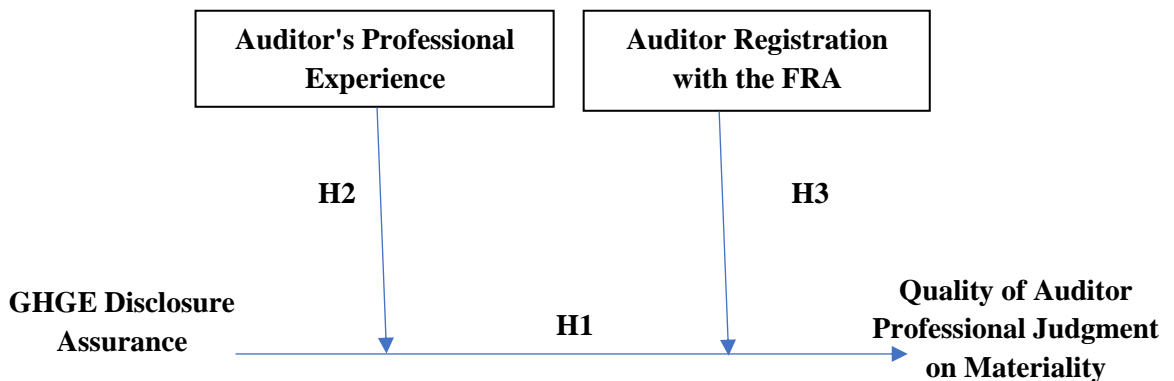


Figure (1): Research Model Under the Basic Analysis

Source: Prepared by researchers

3.3 Experimental Study Tools and Procedures

The experimental study was based on two hypothetical experimental cases.³ When distributing the two experimental cases, the researchers took into account making many field visits to the accounting and auditing firms, handing over and receiving the experimental cases by hand to the participants in the experiment, and providing an opportunity for the participants to discuss with the researchers and answer their inquiries and questions. Each time, some questions are asked to the individuals participating in the experiment, including that they estimate their judgment on the materiality of the attached statements by percentage. Thus, the tools of the experimental study can be limited to: the published financial statements in addition to the GHGE statement, personal interviews, the two experimental cases, and the answer to the attached question for the two experimental cases.

In terms of the study procedures, two experimental cases were designed, and the researchers asked the participants in the experimental cases to answer the following question: What is your estimated materiality at the level of the attached statements on 12/31/2022? Each participant in the two experimental cases was asked to answer this question by specifying a percentage of materiality for the attached statements. They were given varying percentages to answer this question, by using a Likert scale consisting of eleven degrees ranging from (0% to 100%), where 0% indicates a very low level of quality of the auditor's professional judgment on materiality for the attached statements, while 100% indicates a very high level of this materiality (Doxey & Sealy, 2022). **In Table 2**, a summary of the variable measurements utilized in this research is presented.

³ The first experimental case (a case that includes traditional financial statements only and greenhouse gases emissions statement is not added to it) in which the auditor was asked to estimate materiality for the attached statement, while in the second experimental case (a case that includes traditional financial statements in addition to a greenhouse gases emissions statement), which the auditor was asked to estimate materiality for the attached statements.

Table 2: Measurements of research variables

Variable	Type (Pred. Sign)	Measurement
Quality of Auditor Professional Judgment on Materiality	Dependent	It is measured by the degree of agreement of the participants in the experimental cases on the correct professional judgment to assess the materiality of the traditional financial statements in addition to the GHGE statement by choosing one of the levels of the Likert scale, which starts from very low to very high (Doxey & Sealy, 2022).
GHGE Disclosure Assurance	Independent (+)	It is measured by providing auditors with two experimental cases. The first experimental case includes traditional financial statements only and GHGE statement is not added to it, while the second experimental case includes traditional financial statements in addition to a GHGE statement (Doxey & Sealy, 2022).
Auditor's Professional Experience	Interactive (\pm)	A dummy variable takes the value (1) if the auditor is experienced, in the case of presenting the two experimental cases to audit partners and managers whose general experience exceeds 10 years, and the value (zero) otherwise (Martinov-Bennie & Pflugrath, 2009).
Auditor Registration with the FRA	Interactive (\pm)	A dummy variable takes the value (1) if the auditor is registered with the FRA and the value (zero) otherwise (Liu & Huang, 2020).

Source: Prepared by researchers

3.4 Experimental Design, Treatments, and Experimental Comparisons

The experimental design for testing the research hypotheses is shown in **Table 3**, where a $2 \times 2 \times 2$ experimental design was used resulting in 8 experimental treatments as follows:

- **Treatment (1):** Traditional financial statements are only audited by a highly experienced auditor, and participants are required to determine their judgment on the materiality of the attached statements.
- **Treatment (2):** Traditional financial statements in addition to a GHGE statement assured by a highly experienced auditor, and participants are required to determine their judgment on the materiality of the attached statements
- **Treatment (3):** Traditional financial statements are only audited by a low-experienced auditor, and participants are required to determine their judgment on the materiality of the attached statements.
- **Treatment (4):** Traditional financial statements in addition to a GHGE statement assured by a low-experienced auditor, and participants are required to determine their judgment on the materiality of the attached statements
- **Treatment (5):** Traditional financial statements are only audited by an auditor registered with the FRA, and participants are required to determine their judgment on the materiality of the attached statements.
- **Treatment (6):** Traditional financial statements in addition to a GHGE statement assured by an auditor registered with the FRA, and participants are required to determine their judgment on the materiality of the attached statements.
- **Treatment (7):** Traditional financial statements are only audited by an auditor not registered with the FRA, and participants are required to determine their judgment on the materiality of the attached statements.

- **Treatment (8):** Traditional financial statements in addition to a GHGE statement assured by an auditor not registered with the FRA, and participants are required to determine their judgment on the materiality of the attached statements.

Table 3: The experimental research design

Independent variables		Traditional Financial Statements Only	Traditional Financial Statements in Addition to a GHGE Statement
Moderated variables			
Auditor's Professional Experience	High	(1) The auditor's judgment on the materiality of the attached statements	(2)
	Low	(3) The auditor's judgment on the materiality of the attached statements	(4)
Auditor Registration with the FRA	Registered	(5) The auditor's judgment on the materiality of the attached statements	(6)
	Not registered	(7) The auditor's judgment on the materiality of the attached statements	(8)

Source: Prepared by researchers

In light of this design, to test the research hypotheses, the following comparisons are made:

- Comparison (1): [(1+3+5+7) * (2+4+6+8)] to test hypothesis H₁.
- Comparison (2): [(1) * (2)] * [(3) * (4)] to test hypothesis H₂.
- Comparison (3): [(5) * (6)] * [(7) * (8)] to test hypothesis H₃.

3. Research Hypotheses Testing Results

This part of the research aims to deal with determining the type of distribution of the study population (whether the study population follows a normal distribution or not), the result of the validity and reliability test, and the results of the research hypotheses test, as follows:

4.1 Determine the Type of Distribution of the Study Population and the Result of the Validity and Reliability Test

The Kolmogorov-Smirnov test was conducted to determine whether the distribution of the study population follows a normal distribution or not (Doxey & Sealy, 2022), to determine whether to use Parametric Tests or Non-Parametric Tests. The results of this test showed that the P-Value (0.000) is less than 0.05 for all the variables under study. This means rejecting the null hypothesis (which states that the population from which the study sample was drawn follows a normal distribution) and accepting the alternative hypothesis (which states that the population from which the study sample is drawn does not follow a normal distribution). Accordingly, non-parametric tests were relied upon to test the research hypotheses.

Cronbach's Alpha test was conducted to measure the validity and reliability, as this test measures the stability of the respondents' answers to the questions presented to them, testing the reliability of their responses, and the validity of the study data for statistical analysis to see the extent to which the results obtained from the sample can be generalized to a population the study. This coefficient takes values ranging from zero to the correct one (0-100%). If the data is stable, then this coefficient is equal to the correct one, and if this coefficient is equal to zero, this means that the data is not stable (Doxey & Sealy, 2022). Internal validity refers to the stability of the scale and its non-contradictoriness, that is, the scale gives the same results with a probability equal to the value of the coefficient if it is re-applied to the same sample, and the value of the coefficient is accepted if it exceeds 0.5, which is what was achieved in this research, as the results showed that the value of the Cronbach alpha coefficient (0.782) which represents a good level of validity and reliability.

4.2 The result of the first hypothesis test (H_1)

This hypothesis aimed to test, in Egypt, whether the auditor's professional assurance regarding the disclosure of GHGE significantly affects the quality of the auditor's professional judgment about materiality at the level of the attached financial statements. In this

regard, the researchers used the non-parametric Wilcoxon Signed-Rank test for two non-independent samples to conduct the two-way comparisons and to determine whether there was a difference between the medians of the two samples. To test this hypothesis statistically, it was reformulated as a null hypothesis as follows:

H_0 : The auditors' professional assurance regarding the disclosure of GHGE does not significantly affects the quality of their professional judgment regarding materiality in Egypt.

The hypothesis was formulated statistically as follows:

Null hypothesis⁴: $H_0: M_1=M_2$, that is, the median of the sample's responses to the second experimental case (a case that includes traditional financial statements in addition to a GHGE statement) is equal to the median of the sample's responses to the first experimental case (a case that includes traditional financial statements only and GHGE statement is not added to it).

Alternative hypothesis: $H_1: M_1 \neq M_2$, that is, the median of the sample's responses to the second experimental case (a case that includes traditional financial statements in addition to a GHGE statement) is not equal to the median of the sample's responses to the first experimental case (a case that includes traditional financial statements only and GHGE statement is not added to it). The results of the statistical test for the first hypothesis H_1 are shown in **Table 4**.

Table 4: The result of testing the first hypothesis H_1 under the basic analysis

<u>The name of the statistical test</u>	<u>P-Value</u>
Wilcoxon Signed-Rank Test (Z)	8.679
Asymp. Sig. (2-tailed)	0.000

Source: Prepared by researchers

⁴ M_1 refers to the median of the sample's responses to the first experimental case, M_2 refers to the median of the sample's responses to the second experimental case.

According to the Wilcoxon Signed-Rank Test (Z) if the P-Value is less than 0.05, the null hypothesis is rejected and the alternative hypothesis is accepted. If the P-Value is greater than 0.05, this means that the null hypothesis is accepted, and the alternative hypothesis is rejected. **Table 4** shows that the P-Value (0.000) according to the result of the Wilcoxon Signed-Rank Test (Z), is less than 0.05, and, therefore the null hypothesis is rejected and **the alternative hypothesis H₁ is accepted**. This finding is consistent with the findings of some studies (Doxey & Sealy, 2022; Thai et al., 2022; Appelbaum et al., 2023).

For further analysis, and in light of the existence of a positive and significant effect of the auditor's professional assurance regarding the disclosure of GHGE on the quality of his professional judgment in Egypt at the level of materiality for the attached statements, it was found that the auditor's identification of the level of materiality for the attached statements in the two experimental cases was greater in the case of the auditor's professional assurance regarding the disclosure of GHGE compared to non-disclosure of these emissions, Where the median of the sample responses in the case of the professional assurance of the auditor regarding the disclosure of greenhouse gas emissions was (86.7%) greater than the median of the sample responses in the case of non-disclosure of these emissions (13.3%).

The researchers believe that this result reflects the reality of professional practice and that the auditors determine a high level of materiality in the case of disclosure of GHGE compared to non-disclosure of these emissions.

4.3 The result of the second hypothesis test (H₂)

This hypothesis aimed to test whether the significant effect of the auditor's professional assurance regarding the disclosure of GHGE on the quality of his professional judgment in Egypt at the level of materiality for the attached statements differs according to his level of professional experience. In this regard, the researchers used the non-parametric Wilcoxon Signed-Rank Test for two non-independent samples to conduct the two-way comparisons and to determine whether there was a difference between the medians of the two samples

(Pallant, 2016). To test this hypothesis statistically, it was reformulated as a null hypothesis as follows:

H_0 : The significant impact of the auditor's professional assurance regarding the disclosure of greenhouse gas emissions on the quality of his professional judgment regarding materiality in Egypt does not vary according to their level of professional experience.

The hypothesis was formulated statistically as follows:

Null hypothesis: $H_0: M_1=M_2$, that is, the median of the sample's responses to the second experimental case is equal to the median of the sample's responses to the first experimental case.

Alternative hypothesis: $H_2: M_1 \neq M_2$, that is, the median of the sample's responses to the second experimental case is not equal to the median of the sample's responses to the first experimental case. The results of the statistical test for the second hypothesis H_2 are shown in **Table 5**.

Table 5: The result of testing the second hypothesis H_2 under the basic analysis

<u>Comparisons</u>	<u>P-Value</u>	<u>Wilcoxon Signed-Rank Test (Z)</u>
The impact of the professional experience of the auditor with high experience on H_1	0.000	8.160
The impact of the professional experience of the auditor with low experience on H_1	0.000	3.001

Source: Prepared by researchers

Table 5 shows that the P-Value (0.000 & 0.000) according to the result of the Wilcoxon Signed-Rank Test (Z) for the professional experience of the auditor (with high experience, with low experience), respectively, is less than 0.05. This means that the professional experience of the auditor has a significant impact on the relationship under study (H_1). To determine the extent of the impact of the

professional experience of the auditor on the relationship under study (H_1), the researchers made a comparison between the two previous cases (the professional experience of an auditor with high experience, with low experience) using the calculated (Z) value, as the higher the value of (Z) calculated, this indicates the strength of the influence of the professional experience of the auditor on the relationship under study. Referring to the results in **Table 5**, it is clear that the value of (Z) calculated in the case of the professional experience of the auditor with high experience (8.160) was greater than the value of (Z) calculated in the case of the professional experience of the auditor with low experience (3.001). This means that the professional experience of the auditor has a significant impact on the relationship between GHGE assurance and the quality of the auditor's professional judgment on materiality, and therefore the null hypothesis is rejected and **the alternative hypothesis H_2 is accepted**. This finding is consistent with the findings of several studies (e.g., DeZoort et al., 2019; Hegazy & Salama, 2022; DeZoort et al., 2023).

For further analysis, and in the presence of a positive and significant impact of the auditor's professional experience on the relationship under study (H_1). It turned out that the auditor's determination of the level of materiality was greater in the case of the auditor's professional assurance regarding the disclosure of GHGE compared to the non-disclosure of these emissions, where the median of the sample responses in the case of the professional assurance of the auditor regarding the disclosure of GHGE (88.2%) was greater than the median of the sample's responses in the case of non-disclosure of these emissions (11.8%), this appeared in the case of the professional experience of the highly experienced auditor.

The researchers believe that the impact of the professional experience of the auditor on the relationship under study is logical, because the greater the professional experience of the auditor, the better the quality of his professional judgments and the development of his procedures and methods to determine his judgment on the materiality.

4.3 The result of the third hypothesis test (H₃)

This hypothesis aimed to test whether the significant effect of the auditor's professional assurance regarding the disclosure of GHGE on the quality of his professional judgment in Egypt on the materiality of the attached statements differs according to whether or not he is registered with the FRA. In this regard, the researchers used the non-parametric Wilcoxon Signed-Rank Test for two non-independent samples to conduct the two-way comparisons and to determine whether there was a difference between the medians of the two samples. To test this hypothesis statistically, it was reformulated as a null hypothesis as follows:

H₀: The significant impact of the auditor's professional assurance regarding the disclosure of greenhouse gas emissions on the quality of his professional judgment regarding materiality in Egypt does not vary according to whether they are registered with the FRA or not.

The hypothesis was formulated statistically as follows:

Null hypothesis: H₀: M₁=M₂, that is, the median of the sample's responses to the second experimental case is equal to the median of the sample's responses to the first experimental case.

Alternative hypothesis: H₃: M₁≠M₂, that is, the median of the sample's responses to the second experimental case is not equal to the median of the sample's responses to the first experimental case. The results of the statistical test for the third hypothesis H₃ are shown in **Table 6**.

Table 6: The result of testing the third hypothesis H₃ under the basic analysis

<u>Comparisons</u>	<u>P-Value</u>	<u>Wilcoxon Signed-Rank Test (Z)</u>
The impact of the auditor's with the FRA on H ₁ registration	0.000	7.864
The impact of the auditor is not with the FRA on H ₁ registered	0.000	3.837

Source: Prepared by researchers

Table 6 shows that the P-Value (0.000 & 0.000) according to the result of the Wilcoxon Signed-Rank Test (Z) for the auditor's registration with the FRA (registered and not registered), respectively, is less than 0.05. This means that whether or not the auditor is registered with the FRA has a significant impact on the relationship in the field of the first hypothesis (H₁). In order to determine the extent of the impact of the auditor's registration with the FRA or not on the relationship under study (H1), the researchers made a comparison between the two previous cases (registration of the auditor, and not being registered with the FRA) using the value of (Z) calculated. As the higher the value of calculated (Z), the more this indicates the strength of the impact of the auditor's registration with the FRA on the relationship under study. Referring to the results in **Table 6**, it is clear that the value of (Z) calculated in the case of the auditor being registered with the FRA (7.864) was greater than the value of (Z) calculated in the case of the auditor not being registered with the FRA (3.837). This means that whether or not the auditor is registered with the FRA has a significant impact on the relationship between GHGE assurance and the quality of auditor professional judgment on materiality, and therefore the null hypothesis is rejected, and **the alternative hypothesis H₃ is accepted.**

For further analysis, and in light of the existence of a positive and significant effect of the auditor's registration with the FRA on the relationship under study (H1), It turned out that the auditor's determination of the level of materiality was greater in the case of the auditor's professional assurance regarding the disclosure of GHGE compared to non-disclosure of these emissions, where the median of the sample responses in the case of the professional assurance of the auditor regarding the disclosure of GHGE (89.4%) was greater than the median of the sample's responses in the case of non-disclosure of these emissions (10.6%), this appeared in the case of the auditor being registered with the FRA.

The researchers believe that the registration of the auditor with the FRA, and the conditions it requires such as the availability of appropriate professional qualification, experience, and professional

solvency, and includes of the availability of experienced work teams and continuing professional education, amended the relationship under study and helped the auditors in improving the quality of their professional judgments and their development for procedures and methods of determining their judgment on materiality.

4. Additional Analysis

It becomes clear to the researchers from the analysis of previous studies (e.g., Doxey & Sealy, 2022; Thai et al., 2022; Appelbaum et al., 2023) that the additional analysis can be considered as one of the methodologies used to give more understanding of the relationships under study with the basic analysis, by relying on variables whose impact has not been previously verified or changing the method of dealing with the impact of previously tested variables on the relationships under study.

By analyzing the most important previous relevant studies (e.g., DeZoort et al. 2019; Hegazy & Salama, 2022; DeZoort et al. 2023), a question can be raised about the extent to which it is preferable to follow either the control or the moderator approaches. To answer this question, the relationships under study of the second and third hypotheses (H_2 & H_3) are re-tested separately, after converting the two moderator variables (the professional experience of the auditor and his registration with the FRA) into two control variables. This is in order to make a comparison between the results of the additional and basic analyses and determine the extent of the difference between them, to provide more clarity on the main relationship under the basic analysis, and to verify the ability to influence the strength or direction of the relationship under study after the introduction of the control variables.

In the context of the influence relationship between the auditor's professional assurance regarding the disclosure of greenhouse gas emissions and the quality of his professional judgment on materiality. The first and second questions aimed at testing whether the professional experience of the auditor and his registration with the FRA in addition to the professional assurance of the auditor regarding the

disclosure of GHGE, affect the quality of his professional judgment on the materiality. To verify this effect, the impact of each of the control variables was tested.

5.1 The result of the impact of the auditor's professional experience on the quality of his professional judgment regarding materiality

The first question aimed to test whether the professional experience of the auditor affects the quality of his professional judgment on materiality in the Egyptian professional practice environment, regarding his professional assurance on the disclosure of greenhouse gases emissions, in the context of the influence relationship between the professional assurance of the auditor regarding the disclosure of emissions Greenhouse gases and the quality of his professional judgment regarding materiality.

The untabulated results indicated that the P-Value (0.000) for the control variable, the professional experience of the auditor, is less than the significance level of 0.05, and then the first question (Q1) was answered “yes”.

The researchers believe that the result of the statistical analysis in the case of considering the auditor's professional experience as a moderating or controlling variable did not differ, which supports the importance of this variable in affecting the relationship under study, on the one hand, and the quality of his professional judgment on materiality on the other hand.

5.2 The result of the impact of the auditor's registration with the FRA on the quality of his professional judgment regarding materiality

The second question aimed at examining whether the auditor's registration with the FRA affects the quality of his professional judgment regarding materiality in the Egyptian professional practice environment, regarding his professional assurance on the disclosure of greenhouse gases emissions, in the context of the influencing relationship between the auditor's professional assurance regarding the

disclosure of GHGE and the quality of his professional judgment regarding materiality.

The untabulated results indicated that the P-Value (0.016) for the control variable, a registered auditor with the FRA, is less than the significance level of 0.05, and then the second question (Q2) was answered “yes”.

The researchers believe that the result of the statistical analysis in the case of considering the registration of the auditor with the FRA as a moderator or control variable did not differ, and this confirms the importance of this registration and the conditions it requires, especially the professional solvency in affecting the relationship under study, on the one hand, and the quality of his professional judgment regarding materiality on the other hand.

Table 7 shows a comparison between the results of testing the second and third hypotheses (H₂ & H₃) in the basic analysis and the results of answering questions about the control variables corresponding to these two hypotheses under the additional analysis.

Table 7: Comparison between the results of the basic and additional analyses

Hypotheses in light of adopting the moderator variables approach	Results	Questions under the adoption of the control variables approach	Ans.
H ₂ : The significant impact of auditors' professional assurance regarding the disclosure of GHGE on the quality of their professional judgment regarding materiality in Egypt varies based on their level of professional experience.	Accepted	Q1: Does the auditor's professional experience affect the quality of his professional judgment on materiality in the Egyptian professional practice environment, regarding his professional assurance on the disclosure of GHGE, in the context of the influence relationship between the GHGE auditor's assurance and the quality of his professional judgment regarding materiality?	Yes
H ₃ : The significant impact of auditors' professional assurance regarding the disclosure of GHGE on the quality of their professional judgment regarding materiality in Egypt varies based on whether they are registered with the FRA or not.	Accepted	Q2: Does the auditor's registration with the FRA affect the quality of his professional judgment on materiality in the Egyptian professional practice environment, regarding his professional assurance on the disclosure of greenhouse gases emissions, in the context of the influence relationship between the GHGE auditor's assurance and the quality of his professional judgment regarding materiality?	Yes

Source: Prepared by researchers

It is clear from tracking the answers to the questions under the control variables approach and comparing them with the results of hypothesis testing under the moderator variables approach, the results of both approaches agree that there is an impact on each of the auditor's professional experience and his registration with the FRA on the relationship between the auditor's professional assurance regarding the disclosure of GHGE and the quality of his professional judgment on materiality.

5. Sensitivity Analysis

One method used to confirm the reliability of the conclusions drawn from the basic analysis of the research hypotheses is sensitivity analysis. Testing research hypotheses over time can be used for sensitivity analysis (e.g., Doxey & Sealy, 2022; Thai et al., 2022; Appelbaum et al., 2023), or utilising proxies for the studied independent or dependent variables, or both (e.g., DeZoort et al., 2019; Hegazy & Salama, 2022), or adapting the research assumptions to a new population and sample to retest them (DeZoort et al., 2023).

Accordingly, the researchers extend the study questions to a new population and sample to retest the hypotheses, represented by academics, faculty members, assistant lecturers, and demonstrators in the Accounting Departments at the Faculty of Business, Alexandria University and the Faculty of Commerce, University of Damanhur.

Through sensitivity analysis, the researchers want to provide an answer to the following: When testing research hypotheses, do the findings change from the primary analysis when the study population and sample are different? To answer this question, the researchers distributed the two experimental cases to faculty members, assistant lecturers, and demonstrators.

The researchers took into account the delivery and receipt of the experimental cases by hand to the participants in the experiment, and to provide the participants with the opportunity to discuss the researchers and answer their inquiries and questions, and every time some questions are asked to the individuals participating in the

experiment, including that they estimate his judgment on materiality by a percentage. **Table 8** shows the sensitivity of the hypothesis test results according to the change in study population and sample and compared with basic analysis.

Table 8: Comparison between the results of the basic analysis and the sensitivity analysis

Hypotheses in their alternative form	Results of hypothesis testing under basic analysis (auditors)	Results of hypothesis testing under sensitivity analysis (academics)
H1: The auditors' professional assurance regarding the disclosure of GHGE significantly affects the quality of their professional judgment regarding materiality in Egypt.	Accepted	Accepted
H2: The significant impact of auditors' professional assurance regarding the disclosure of GHGE on the quality of their professional judgment regarding materiality in Egypt varies according to their level of professional experience.	Accepted	Accepted
H3: The significant impact of auditors' professional assurance regarding the disclosure of GHGE on the quality of their professional judgment regarding materiality in Egypt varies according to whether they are registered with the FRA or not.	Accepted	Accepted

Source: Prepared by researchers

By analyzing the results shown in the previous table, it is clear that the results of the sensitivity analysis fully support the results of the main analysis.

6. Research Findings, Recommendations, and Suggested Future Research

This study reached a set of important results, which can be summarized as follows: This study concluded that the auditor's

professional assurance regarding the disclosure of GHGE has a positive and significant effect on the quality of his professional judgment regarding materiality, and this positive and significant effect differs according to each of the auditor's professional experience and his registration with the FRA.

In addition, the **results indicated**, in light of the additional analysis, that each of the professional experience of the auditor and his registration with the FRA has a positive and significant effect on the quality of his judgment regarding materiality in the context of the main relationship under study when they are treated as control variables. In light of the sensitivity analysis, this paper concluded that the results of the hypothesis test under the sensitivity analysis agreed with the results of the hypothesis test under the basic analysis.

In light of the research limitations, and its results, and in light of the research problem and its objective, the researchers **recommend** the following:

- The necessity of establishing an independent national professional organization to grant the necessary license to engage in the practice of professional assurance service regarding the disclosure of greenhouse gases emissions, with the membership of specialized experts representing the following concerned authorities; The Egyptian Association of Accountants and Auditors, the Ministry of State for Environmental Affairs, the FRA, and a number of professors from the faculties of engineering, science, accounting, and auditing, provided that this organization obtains the necessary accreditation from the concerned international authorities, to deal with it as an organization entrusted with granting licenses to the providers of this service.
- The proposed independent national professional organization should undertake some related tasks, especially those related to approving professional measurement and performance standards, issuing an Egyptian accounting measurement standard, and developing the Egyptian Assurance Standard No.

3000 to keep pace with the amendments of its international counterpart. In addition to issuing Egyptian guidelines specifically related to the assurance service for disclosing GHGE and adding them to a set of standards and guidelines for Egyptian assurance services.

- The Ministry of State for Environmental Affairs must take all necessary measures to activate the environmental legislative system, activate the sustainable development policy, encourage efforts to raise energy efficiency and reduce emissions, and use its efforts in preparing disclosure reports on greenhouse gases emissions, in identifying and publishing detailed data on these emissions.
- The FRA must oblige firms listed on the stock exchange that exceed the permissible emissions limits during a certain period to disclose information about emissions accompanied by a report for independent assurance, and work to increase the awareness of speculators in the stock exchange, investors, firms' management and other stakeholders regarding the importance of the product of this service through providing credibility to the emissions disclosure content.
- The mandatory continuous professional development system must be activated for auditors registered with the FRA, in order to improve their professional competence in performing assurance services in general, and the assurance service in disclosing GHGE in particular, provided that these programs are carried out under the supervision of the national professional organization previously proposed standalone.
- Accounting departments in Egyptian universities should adopt the preparation and implementation of a professional master's program in accounting, including among its courses two courses in accounting for emissions, aimed at developing and qualifying accounting human resources capable of supporting the technical capabilities of accounting and auditing facilities to perform this service in Egypt and compete with foreign service providers.

Professors from the faculties of engineering and science, as well as professors of accounting and auditing, as well as pioneers of professional practice in Egypt, especially partners with international accounting and auditing firms, should be among those teaching in this program.

- Accounting departments in Egyptian universities should be keen to develop accounting and auditing courses at the bachelor's level, as well as at the master's and doctoral levels, by including a tangible focus on accounting and auditing issues related to the environment and sustainability in general, and the accounting and professional dimensions of climate change in particular.

In light of the aim of the research, its plan, the problem it addressed, and the results of the study, some suggested **future research** points can be presented. The researchers see the importance of the direction of accounting research in Egypt in the future towards the following areas: determinants of quality assurance on disclosure of emissions reduction projects by listed firms in the Egyptian Stock Exchange; the impact of the auditor's fulfillment of the assurance requirements on the disclosure of firms listed in the Egyptian Stock Exchange about emissions reduction projects on stakeholders' perception of the credibility of the content of this disclosure; the impact of the complexity of methodologies for calculating and measuring emissions on activating the concept of a multidisciplinary team; the impact of the complexity of methodologies for calculating and measuring emissions on the planning of assurance on firms' disclosure of emissions; studying and testing the relationship between the qualitative characteristics of accounting and auditing firms in Egypt and the provision of emissions assurance services; and finally, studying and testing the impact of the auditor's professional assurance regarding the disclosure of GHGE on firm value of commercial banks, telecommunication firms, and financial technology firms.

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