DOI: 10.1478/AAPP.104S1A12

AAPP | Atti della Accademia Peloritana dei Pericolanti
Classe di Scienze Fisiche, Matematiche e Naturali
ISSN 1825-1242

Vol. 104, No. S1, A12 (2026)

MANAGING TAX RISKS UNDER ITALY'S TAX CONTROL FRAMEWORK: CHALLENGES AND OPPORTUNITIES

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ABSTRACT. The Italian fiscal landscape has seen a major evolution in 2025 with the introduction of official guidelines for the development of tax risk management systems. These guidelines were issued in accordance with Article 4, paragraph 1-quater, of Legislative Decree 128/2015. Because the current system is strongly influenced by subjective assessments from those measuring tax risk, this study aims to develop a more objective analytical model. The proposed approach combines AHP and DEMATEL within a specially structured FMEA to measure tax risk more consistently. This model provides company management with a practical tool to measure tax risk. It can be used both to plan mitigation actions and as a quantitative methodology to support potential disputes with the Financial Administration

1. Introduction

In recent years, tax risk management has become a key component of corporate governance for companies seeking to ensure compliance and transparency. In Italy, the Tax Control Framework (TCF), introduced by the Italian Revenue Agency (Provision of 14 April 2016), offers a structured approach to detect, measure, manage, and control tax risk. It is aimed at companies that adopt the Collaborative Compliance Regime under Legislative Decree 128/2015. Under this framework, companies must compile a risk and control map. This involves identifying their main business processes, assessing the Inherent Risk (i.e., the risk associated with each process regardless of controls), and determining the Residual Risk, which reflects the remaining exposure after applying preventive or mitigating measures (Kusumabangsa 2025). The assessment is typically based on the combination of impact and probability parameters, leading to a qualitative classification of risk levels (High, Medium, Low) (Notbohm et al. 2025; Sadjiarto et al. 2020; Schneider et al. 2023). Figure 1 illustrates the methodological scheme provided by the Revenue Agency for risk mapping, highlighting the main steps required for identifying, assessing, and documenting tax risks within the TCF (Adeusi et al. 2018; Hopkin 2018).

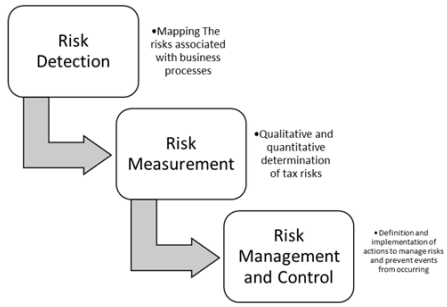


FIGURE 1. Tax Risk Mapping Process: Methodological scheme

Although this approach offers a systematic procedure, it remains fundamentally qualitative and thus heavily dependent on subjective judgments. This subjectivity limits reproducibility and may hinder the ability to demonstrate the validity of risk assessments during interactions with the Tax Administration (Miethe 2024; Saw 2025). In other words, current methodologies under the TCF lack an objective and quantitative basis for measuring and prioritizing tax risk, which creates difficulties in both internal decision-making and external verification. To overcome these limitations, this paper proposes a quantitative and replicable model for tax risk assessment that integrates multiple decision-making techniques. The model first applies DEMATEL (Decision-Making Trial and Evaluation Laboratory) to identify cause–effect relationships among risk factors (Si et al. 2018), then uses AHP (Analytic Hierarchy Process) to determine their relative importance (Saaty 2003 and 2008). These results are incorporated into an FMEA-based approach (Sharma & Srivastava 2018) to compute a Tax Risk Index (TRI), which quantifies both inherent and residual risk. The proposed framework transforms subjective evaluations into data-driven risk scores, enabling companies to prioritize mitigation actions, enhance transparency, and strengthen the defensibility of their tax control systems within a collaborative compliance environment.

2. Literature Review

The implementation of a tax index rate within the tax control framework emerged as a fundamental consideration for companies that strive to mitigate tax risks. As organizations operate in an increasingly complex regulatory environment, a solid tax strategy becomes fundamental to ensure compliance by optimizing financial services. The concept of a rate of the tax index can be connected to the largest framework of Enterprise Risk Management (ERM), a strategic approach that incorporates the management of tax risk as a fundamental domain (Nocco and Stulz 2022). A significant advantage of the integration of a taxation rate is its potential to improve transparency within the tax conformity process. By establishing a standardized measure of tax obligations, companies can improve the accuracy of their reporting and reduce the ambiguity relating to tax liabilities, thus minimizing the probability of tax sanctions (Chooi 2020). In addition, the alignment of tax strategies with the corporate government mechanisms can favor a culture of responsibility, since companies are better positioned to evaluate the implications of their tax planning decisions (Choi and Park 2022). This alignment can serve to improve the trust of the interested parties, thus leading to a

better corporate reputation and performance (Mao 2019). In addition, a rate of the tax index can effectively facilitate the identification and management of tax risks through a systematic assessment of the tax profile of a company. The integration of risk management principles in tax strategy is underlined by the adoption of framework that give priority to tax liability (Rossing, 2013). By proactively monitoring tax positions, companies can identify potential risk exposures, which align with the results in literature which highlight the positive correlation between risk management practices and financial services (Adeuso et al. 2014). In addition, using a rate of the tax index, organizations can engage more effectively in planning the scenario and stress, allowing them to prepare for potential tax shocks (Shad et al. 2019; Hull 2012). Despite these potential advantages, the implementation of a rate of the tax index is fraught with challenges. A key barrier to effective distribution concerns the complexity of tax regulations and the dynamic nature of tax laws through different jurisdictions (Donohoe 2015). The variability of tax rates and compliance requirements can complicate the establishment of a standardized tax index rate, with consequent challenges associated with personalization and applicability to various organizational structures (Eckles et al. 2014). Companies can find demanding navigation in the compromises between tax risk management and operational flexibility, since excessively rigorous tax controls could suffocate innovative commercial practices (McShane, Nair and Rustamekov 2011). Another critical challenge concerns monitoring and adaptation to change in tax legislation. Organizations must remain agile and sensitive to evolving tax policies that may have significant implications for their financial strategies (Sweeting 2017). The non -adequate failure to adapt the rate of the alignment fiscal index with these variations can involve ineffective results of risk management. In addition, the degree in which companies can exploit a rate of the tax index can be influenced by organizational culture and by the measure to which risk management is incorporated into their operational processes (Horcher 2011). As noted by Abdullah et al. (2017), a strong culture of corporate risk management can lead to better results for businesses, but requires a commitment to all levels of the organization. In addition, the interaction between tax avoidance and tax risk must be carefully considered. Research suggests a nuanced relationship between corporate government and tax aggression, highlighting the need for companies to find a balance between legal tax optimization strategies and reputation considerations (Richardson, Taylor and Lanis 2013). The complexity of this balance underlines the challenge in the implementation of a tax index rate which effectively integrates tax conformity with wider risk management strategies. In conclusion, while the integration of a rate of the tax index within the tax control framework has various potential benefits, such as greater compliance, better risk management and better financial performance - also places significant challenges that must be addressed. The dynamic nature of the tax legislation, the complexities of multi-legion compliance and the relationship between governance and tax avoidance indicate that companies must adopt an informed and agile approach to navigation of tax risks. Research continues in this sector will be essential for the development of effective strategies that exploit a rate of the tax index to cultivate a sustainable tax framework.

3. Materials and Methods

The Tax Risk Index is an index that can be proposed as a Tax Compliance KPI for those organizations that intend to prevent potential tax risks through a qualitative/quantitative assessment of certain parameters such as the tax complexity associated with a given organization and its resilience to the regulatory changes that occur annually in the tax landscape. In general, the Tax Risk Index (hereinafter TRI) is expressed in the following report (Eq.1)

$$TRI = \sum_{i=1}^{n} W_i R_i \tag{1}$$

Where it expresses the score assigned to the i-th risk and the weight assigned to each risk. In determining TRI, it is necessary to ignore the fact that each organization must provide a certain value ε which expresses the tolerance value within which is in any case considered acceptable with respect to what is calculated in Eq.1. The need to express this tolerance derives from the fact that the determination of this index is affected by latent variables inside and outside the organization itself for which it is not economically/technically possible to predict the real trend. Therefore, the real value of must fall within a closed interval expressed according to the following notation (Eq.2)

$$TRI_{\text{Real}} = [TRI - \varepsilon,\ TRI + \varepsilon] \tag{2}$$

ε, in mathematical notation, will be expressed through the following expression (Eq.3) which expresses a confidence interval linked to a Standard Normal Random Variable for risk scores.

$$\varepsilon = TRI \pm Z_\alpha \frac{\delta_{TRI}}{\sqrt{N}} \tag{3}$$

Where it expresses the confidence value, the standard deviation calculated for the risk scores, and the number of factors evaluated for the calculation of TRI. With regard to what is expressed in Eq.1, the first element to clarify is that it represents the weight assigned to each assessed risk. These values are framed within the risk determination framework defined by the Tax Administration: in particular, they represent the Intrinsic Risk associated with a given transaction, while the residual risk is understood as the maximum limit of Risk Appetite accepted by the company. To strengthen the objectivity and replicability of the model, the criteria used to identify and classify tax risks were selected based on their regulatory relevance (Article 4, Legislative Decree 128/2015) and their ability to be measured through standardized scales, such as economic impact, probability of occurrence, and detection capability. The integration of these criteria into the model is achieved by assigning weights obtained from the DEMATEL/AHP analysis and scores determined through the FMEA methodology, thus transforming qualitative assessments into numerical indices that are comparable and reproducible across different organizational contexts. To better express this approach, a multi-criteria decision analysis model was adopted, combining the Analytic Hierarchy Process (AHP) with the Decision-Making Trial and Evaluation Laboratory (DEMATEL) method. The aim is to exploit the advantages offered by both techniques: AHP decomposes complex problems into a hierarchy of criteria and alternatives, allowing weights to be determined through pairwise comparisons that reflect the importance of each factor in the final decision. These weights are then refined using DEMATEL, which makes it possible to understand the causal relationships among

the factors and highlight which are the most influential or dependent. The mathematical formulation of these procedures is described in the following subsections.

3.1. Decision-Making Trial and Evaluation Laboratory.

In DEMATEL (Si et al., 2018) a matrix $D = [d_{ij}]_{n\times n}$ with expression of the direct influence of the factor with respect to the factor is considered. This value is determined according to a scale of values from 0 to 4 which expresses, with 0 "No influence between factors" and with 4 "A very high influence": Given therefore factors, the matrix of direct relationship of the values obtained through the following formulation (Eq.4) will then be calculated

$$S = [d_{ij}]_{n\times n} = \left[\frac{x_{ij}}{\max\left(\sum_{j=1}^{n} x_{ij},\, \sum_{i=1}^{n} x_{ij}\right)}\right]$$

Then we proceed to the construction of the total relation matrix T, obtained using the following notation (Eq.5)

$$T = S \cdot (I - S)^{-1} \tag{4}$$

Where is the dimension identity matrix and is the total relation matrix, where each element of the aforementioned matrix shows the degree of influence of the generic factor on the factor. Once the matrix is obtained, we proceed to calculate the row and column vectors expressed, respectively, by the Eq. 6 and 7.

$$D_i = \sum_{j=1}^{n} t_{ij} \tag{5}$$

$$R_i = \sum_{j=1}^{n} t_{ij} \tag{6}$$

The sum of the rows (Eq.6) represents the degree of influence of each factor on the others, while the sum of the columns (Eq.7) represents the degree of dependence. Obtained D_i and proceed to calculate and, it represents the prominence or importance of the i-th factor within the system while indicating the role that the i-th factor has with respect to the system itself. A value greater than zero indicates that the factor is primarily cause, while a value less than zero indicates that the factor evaluated is primarily influenced by the others. From the value, we then calculate the DEMATEL weight determined for the factor according to the following notation (Eq.8)

$$W_i^{DE} = \frac{D_i + R_i}{\sum_{k=1}^{n}(D_k + R_k)}. \tag{7}$$

3.2. Analytic Hierarchy Process.

The Analytic Hierarchy Process (AHP) is a decision support model developed by Saaty (2003,2008) in the 1970s. This method is widely used, in academia and industry, to solve complex decision-making problems, through their decomposition into objectives, criteria, and sub-criteria through an evaluation process based on pairwise comparisons. From the pairwise comparison, we arrive at the construction of a square matrix, called a pairwise comparison matrix, where each element represents the relative importance of the generic criterion with respect to another criterion $a_{ij}\, C_i\, C_j$. The values of are chosen from a Saaty scale (2003,2008), ranging from 1 (equal importance) to 9 (absolute importance of one

criterion over another). In general, the pairwise comparison matrix is expressed according to the following notation:a_{ij}

$$A = \begin{pmatrix} 1 & a_{12} & a_{13} \\ \frac{1}{a_{12}} & 1 & a_{23} \\ \frac{1}{a_{13}} & \frac{1}{a_{23}} & 1 \end{pmatrix} \tag{8}$$

The second step involves determining the weight of the individual criteria. The weight is determined through the construction of a normalized matrix that is constructed using the following notation:

$$\sum_{i=1}^{n} v_i(A_j) = 1, \qquad j = 1, \ldots, n \tag{9}$$

$$v_j(A_j) = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}, \qquad j = 1, \ldots, n \tag{10}$$

The priority vector, which represents the relative weight of each element, is represented by the following relation:

$$v_k(A_i) = \frac{1}{n} \sum_{j=1}^{n} v_j(A_i), \qquad i = 1, \ldots, n \tag{11}$$

The validity of the calculations and evaluations obtained through the AHP methodology is guaranteed through a consistency analysis of the processed data, whose mathematical notation is:

$$a_{ij} a_{jk} = a_{ik}, \qquad \forall i, j, k \tag{12}$$

Thanks to this method, considering the number of elements, the maximum eigenvalue of the reciprocal matrix "M", and "" vector of priorities is defined. Optimal coherence will be obtained when the following relations satisfy it:$n\lambda_{\max}$,$w_{\lambda_{\max}}$ and a_{ij}

$$\lambda_{\max} = n \tag{13}$$

$$a_{ij} = \frac{w_i}{w_j} \tag{14}$$

However, taking into account that optimal consistency does not exist in real contexts, we will take into account what Saaty (2008) elaborates, according to which data consistency is considered admissible the closer the value of is to the value n. Saaty (2008) has also shown that, given a square matrix "A", it is possible to identify a vector w such that the eigenvector connected to it is given by the following notation:

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(A\mathbf{w})_i}{w_i} \tag{15}$$

The vector W_i^{AHP} is then normalized (Eq.17)

$$W_i^{\mathrm{AHP}} = \frac{w_i}{\sum_{k=1}^{n} w_k} \tag{16}$$

3.3. DEMATEL/AHP integration.

In order to proceed with the determination of W_i it was decided to combine the values and using the geometric mean as a calculation approach (Eq.18)

$$W_i = \frac{W_i^{DE} W_i^{\text{AHP}}}{\sum_{k=1}^{n} \left(W_k^{DE} W_k^{\text{AHP}} \right)} \tag{17}$$

The motivation underlying the use of the geometric mean instead of other integration methodologies (e.g. Arithmetic Mean), is linked to the intention to obtain a more balanced integration of the two methods, also capable of attenuating the influence of any outlliers.

3.4. Determination of the risk parameter R_i.

Returning to what is provided for in Eq.1, we proceed to determine R_i following, as a methodological approach, that envisaged for FMEA, an acronym for analysis of the effects and modes of failure, (Sharma et al., 2018). We decided to chose the FMEA approach thanks to its capacity to turn qualitative tax risk assessments into a structured, quantitative process based on three key parameters: Severity, Occurence and Detection. Through the application of FMEA, it will be possible to determine R_i which product of three elements: the impact of the failure mode, its probability of occurrence and the ability of the system to be able to identify the failure through the systems present at the time of verification (Chang et al, 2010) all normalized so as to ensure the reliability of the calculation. (Eq.19)

$$R_i = \frac{S_i O_i D_i}{1000} \times 10 \tag{18}$$

As for the "Occurrence" parameter, this will be determined through the use of the Weibull Random Variable, a statistical distribution widely used to model the time until a fiscal failure occurs. Following the statistical notation received in the literature, the Weibull cumulative distribution function (Eq.20)

$$F(t) = 1 - e^{-\left(\frac{t}{\lambda}\right)^{\beta}} \tag{19}$$

With λ a scale parameter that determines the ability of the event to occur in the short term and a shape parameter of the distribution that describes the trend of the risk over time. Depending on whether it is greater, less than or equal to 1, we will have a risk trend that is increasing, decreasing, or constant over time. The value will be obtained through the complement to , called "Survival Function" (Eq.21) from which we can obtain the probability that the event will occur in a given time horizon according to the notation below (Eq.22)

$$S(t) = e^{-\left(\frac{t}{\lambda}\right)^{\beta}} \tag{20}$$

$$P(O_i) = 1 - e^{-\left(\frac{t}{\lambda}\right)^{\beta}} \tag{21}$$

As for the severity of the impact of the tax risk (S_i), it will be determined according to the standard methods provided for the FMEA, i.e. through a scale of values between 1 and 10 which represents the economic and reputational impact that derives from a given tax failure. The proposed scale is described in the following table (Table 1)

TABLE 1. Scale for the determination of S_i

Effect	**Criteria: Severity of effect**	**Rank**
Dangerous	Massive fine or tax assessment leading to company closure or serious legal issues. Potentially devastating impact on the image, which compromises existence itself.	10
Serious	Important tax litigation that involves serious economic damage and enormous reputational damage that could compromise the continuation of business activities.	9
Extreme	Heavy penalties or serious tax errors, with serious reputational damage, such as the loss of customers or contracts with public entities.	8
High	Significant amounts due to tax errors or litigation, with limited reputational damage that could be reflected in lower credibility with institutions and the public.	7
Moderately high	The tax penalties are considerable, with a slight loss of reputation that can affect the trust of customers and suppliers.	6
Moderate	The assessment has temporary effects on the company's operations, such as a suspension or payment of moderate sums.	5
Relatively low	A small error of interpretation that causes a tax audit, but the company continues to operate without major difficulties.	4
Low	Modest additional penalties or taxes that do not affect the company's operations but require correction.	3
Very low	Small penalties, minor errors with implications that can be easily corrected without damage to the image.	2
No effect	No tax audits or a small amount that does not affect the profitability of the company.	1

Going into the merits of the assessment of the economic and reputational impact, it should be noted that in the model described, "economic impact" means the "Economic Value", possibly quantifiable, inherent to the activity to which the tax risk refers. This criterion, which can be deduced from the documents of the Tax Administration, must refer to accounting data referred to in the last available financial statements or other documentation that can be reconciled with such financial statements. The economic value must be associated with the "reputational" parameter to be used as an additional criterion where it is not possible to deduce a certain datum of the former. Reputational impact means the impact that a given tax failure will have on corporate reputation (i.e. perception of customers, investors, and stakeholders. The last element to be determined is the Detection capability D_i. In this case, the determination of the ability to determine a possible failure could be associated with the ability of the company system to carry out correct tax compliance during the tax year in question. At this point, let both the ratio between the number of correct tax obligations and the total number of obligations carried out during the year. Taking into account that tax legislation provides for the possibility of undergoing automated checks that formally verify the correctness of the obligations, the parameter must be calculated taking into account this variable as well. Therefore, if it is a function that expresses the ability to reduce the possibility of having fulfilled an incorrect tax compliance over time, the probability of

Detection can be expressed by the following expression.

$$P(D_i) = 1 - \left(\frac{\lambda \, f(T_c)}{1+\lambda} \right) \tag{22}$$

By λ which describes the ratio between correct tax obligations and the total obligations achieved in a given year, it represents the function that defines the time required by current legislation to carry out an automated control and is a parameter that normalizes the effect of to prevent the Detection score from increasing in a disproportional way with respect to the number of correct obligations. The Detection parameter normalized according to a scale from 1 to 10 is summarized in the following scale (Tab.2)

TABLE 2. Scale for the determination of D_i

Effect	**Criteria: Probability of detection by design control**	**Rank**
Absolute Uncertainty	The check does not detect a potential cause of failure or a consequent failure mode, or there is no project control.	10
Very remote	Very remote possibility that the control will detect a potential cause of failure or a subsequent failure mode.	9
Remote	Remote possibility that the control detects a potential cause of failure or a subsequent failure mode.	8
Very low chance	Very low chance that the design check will detect a potential cause of failure or a subsequent failure mode.	7
Low chance	Low probability that the control will detect a potential cause of failure or a subsequent failure mode.	6
Moderate chance	Moderate chance that the control will detect a potential cause of failure or a subsequent failure mode.	5
Moderately high chance	Moderately high probability that the control will detect a potential cause of failure or a subsequent failure mode.	4
High chance	High probability that the control will detect a potential cause of failure or a subsequent failure mode.	3
Very high possibility	Very high chance that the control will detect a potential cause of failure or a subsequent failure mode.	2
Absolute certainty	The check will almost certainly detect a potential cause of failure or a subsequent failure mode.	1

4. Example

The case study presented here involves applying the TRI determination model within a hypothetical organization that has decided to implement the TCF in accordance with the provisions issued by the Italian Tax Administration. The example is purely illustrative and aims to verify the validity of the calculation methodology presented. For the simulation, we considered a hypothetical working group made up of the heads of Accounting, Internal Auditing, and Tax Planning, supported by the Audit department. These functions reflect the typical team involved in preparing the financial statements as well as determining and formalizing the main tax aspects for an SME.

4.1. DEMATHEL/AHP Application.

The first activity to which the members of the Working Group are subjected is the determination of the weight associated with the four main variables that affect the determination of the IRR, i.e. "Volatility of tax legislation" (T1), the "ability and experience of the staff dedicated to the administrative management of the entity" (T2), the "technical and organizational quality of the accounting system implemented" (T3) and finally "the corporate structure of the organization" (T4). The initial phase applied the DEMATEL approach to determine the weight of each variable. As shown in Table 3, volatility and staff capacity have a strong influence compared to the other elements analyzed. The variable T3 ("technical and organizational quality of the accounting system") is considered an "effect" by DEMATEL, but its very low value (close to zero) is still regarded as decisive when calculating the overall weight using AHP

TABLE 3. Importance, influence direction, and direct influence weight for criterion *c*

c	T1	T2	T3	T4
Importance	2,566064982	3,122021661	3,296750903	2,807220217
Influence direction	0,508303249	0,278700361	-0,072202166	-0,714801444
Direct influence weight	0,217609601	0,264756307	0,279573843	0,23806025

Once the DEMATEL analysis was completed, the next step was to build the priority matrix and evaluate variables T1–T4 against the five functions defined in the TCF: "Active Cycle", "Passive Cycle", "Fixed Asset and Warehouse Management", Financial Management", "Personnel Management," and "Tax Compliance". Applying the AHP method, updated with the DEMATEL results, produced the weight of each function used to calculate the TRI (Fig. 2)

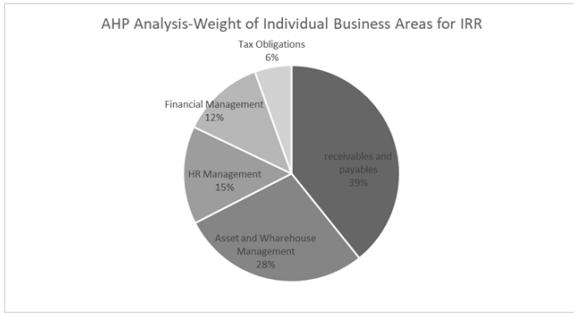


FIGURE 2. AHP Analysis – Weight of Individual Business Areas for IRR

The chart shows the relative weight of different business areas in determining tax risk (TRI). The areas with the greatest impact are the Active and Passive Cycle, followed by Fixed Asset Management and Inventory. In particular, the area of the Active and Passive Cycle contributes to 39% of the risk, while the Fixed Assets and Inventory Management accounts

for 28%. These business areas, such as invoicing, purchasing, and wealth management, are particularly sensitive to tax risk, especially when internal control is limited. In contrast, activities related to tax compliance have a relatively limited impact (6%). This highlights how tax risk is primarily connected to operational processes and suggests that companies need to focus on these areas to implement effective preventive measures. Particular attention should be paid to the monitoring and proper management of activities involving business transactions and company assets, so as to ensure tax compliance and reduce the risk of errors or omissions.

4.2. Application of FMEA.

After completing the first phase of analysis, the second step of the model involved constructing the FMEA. In this phase, the working group assigned each risk identified within the TCF a score from 1 to 10 for the parameters Severity (S), Occurrence (O), and Detection (D). These scores were then used to calculate the Risk Priority Number (RPN). This value, coordinated with the weight of the individual business areas obtained in the previous phase, will lead to the determination of the TRI value. In addition, the TRI is determined together with the epsilon (ε) value, which considers several parameters, including: "Average assessment time", "Risk of being subject to a tax assessment", "Probability of assessment in the next year", "Number of correct obligations", Number of total obligations", "Average time associated with an automated control by the tax administration on the obligations made" and "Probability of detection of a possible failure by the company control". This combination allows the TRI to reflect not only the inherent and residual risk of each process but also the organization's actual ability to prevent, detect, and respond to tax anomalies.

4.3. Design Of Experiment on the variables impacting on TRI and ε.

As mentioned, earlier, it is possible to determine a value of TRI and ε which are a function of the parameters mentioned above, i.e. "Average assessment time", "Risk of undergoing a tax assessment", "Probability of assessment in the next year", "Number of correct obligations", Number of total obligations", "Average time related to an automated control by the tax administration on the obligations made" and "Probability of detection of a possible failure by the corporate control function". At this stage it is interesting to understand what happens to the values of TRI and ε by varying certain parameters. The focus will be on Average assessment time", "Risk of undergoing a tax assessment" and "probability of detection of a possible failure by the company control function". The choice of these criteria over the others derives from the fact that the latter can be easily acquired from reliable and verifiable sources such as the Tax Administration or the annual reports of the Ministry of Economy and Finance. Other parameters — such as the number of corrected obligations, total obligations, and the probability of assessment in the next year — are tied to the size and nature of the organization or are explicitly defined by tax legislation (e.g., Articles 36-bis and 36-ter of Presidential Decree 600/73). Based on these considerations, the following scenarios were selected (Tab. 4):

TABLE 4. Experimental scenarios and associated risk parameters

Experiment	Scenario	Average time to assessment	Risk of being subject to an assessment	Probability of detection as a function of control
1	High evasion sector, weak internal controls	5	0,6	0,3
2	Sector with moderate evasion, sufficient internal controls	5	0,4	0,5
3	Sector with low evasion, effective internal controls	3	0,2	0,7
4	Sector with moderate evasion, excellent internal controls	5	0,5	0,9
5	Sector with low evasion, excellent internal controls	5	0,3	0,8
6	Very high risk sector, no internal controls	5	0,7	0,2

The scenarios were designed to reflect the main variables that influence tax risk and to cover a broad range of realistic business situations. First, the average assessment time was set by considering the legal framework in Italy. Normally, the Revenue Agency has five years to perform tax assessments, which can be extended to seven years if the taxpayer fails to file a return. However, companies that adopt specific traceability and transparency measures may benefit from a reduced assessment period of three years. This makes the assessment time an important driver of risk exposure, as shorter assessment windows can lower the overall level of fiscal uncertainty. The risk of being subject to a tax assessment is another crucial factor and varies significantly by industry. For instance, the propensity to evade IRPEF for self-employed and business income is approximately 63.9%, while for IRAP it drops to about 20.2%. To account for these differences, we selected risk values ranging from 0.2 to 0.6, covering sectors with low, medium, and high exposure to tax audits. Finally, the detection capability of internal controls reflects the maturity of the organization's compliance systems. This parameter depends on the presence of internal audit functions, compliance monitoring processes, and adherence to organizational models compliant with Legislative Decree 231/01. In this analysis, a value of 0.2 represents companies with no formal internal controls, while a value of 0.9 represents companies with well-developed, structured compliance systems. By combining these three parameters, the selected scenarios make it possible to simulate situations ranging from high-risk, poorly controlled environments to low-risk, well-governed organizations, allowing a comprehensive evaluation of how TRI and ε respond to different risk profiles.

4.4. Results. The analysis of the data reveals several important trends in how the overall Intrinsic Risk Rate (IRR) behaves under different scenarios (Fig. 3).

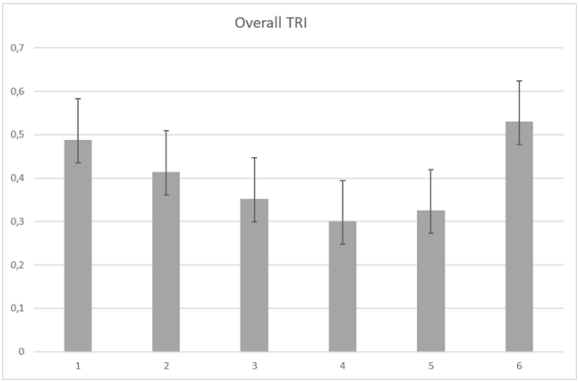


FIGURE 3. Overall TRI

The most evident finding is that the introduction of more efficient internal controls significantly reduces tax risk and improves the overall efficiency of business processes. However, the relationship between controls and risk reduction is not strictly linear. In particular, scenarios 3, 4, and 5 show that even advanced control systems do not always yield a proportional decrease in IRR. In some cases — such as in scenario 5 — there can even be a slight worsening of performance.This phenomenon can be explained by the fact that the implementation of high-performance detection systems can have negative side effects, such as excessive segmentation of operational functions, which can lead to the loss of crucial information in the management flow and, consequently, to an increased risk of tax penalties. The graph relating to the overall IRR shows how the error bands become narrower and narrower as the level of control increases and the reduction of tax evasion, highlighting that the overall tax risk depends not only on the sector in which the company operates but, above all, on the maturity of internal controls. The wide bands of error in the first scenarios indicate great uncertainty and low reliability in the estimation of tax risk, increasing the probability of misalignments with the expectations of the Tax Administration. In the first scenarios, those with a low level of supervision and high tax evasion, the error bands are very wide, indicating a high variability of risk. In these cases, the overall IRR is extremely sensitive to errors, omissions, or fraud that could occur in different areas of the business, such as in the active cycle, liabilities, fixed assets, and so on. The lack of an integrated oversight exposes the company not only to specific risks but, to systemic risks that could compromise the entire tax system. In the case of scenario 3, it is observed that the error bands narrow considerably while remaining visible. This reflects the effectiveness of more coordinated and structured control, which helps to stabilise the IRR, reducing uncertainty and improving fiscal risk forecasting. In scenarios 4 and 5, on the other hand, the error bands become thinner and more compact, signalling that the company has implemented a solid and well-distributed tax risk management system among the different business areas. In these situations, risk is reduced and measurement becomes more precise, leading to more reliable tax management. Finally, in scenario 6, where there is a lack of adequate control and tax risks are very high, the error bands reopen considerably, indicating that, even in sectors with a high tax focus, the lack of adequate governance can generate unpredictable

problems that are incompatible with the standards required by tax law. To improve the overall IRR, it is crucial to strengthen the integration between the different business areas. Tax risk decreases when all business functions, such as finance, administration, personnel, purchasing and sales, adopt consistent and coordinated safeguards. The introduction of a Tax Control Framework, as required by the Revenue Agency Provision of 10 January 2025, allows the company to demonstrate proactive tax risk management, thus obtaining advantages in terms of collaborative compliance. In addition, periodically monitoring IRT through dynamic indicators and an early warning system helps prevent risk build-up and intervene promptly. The error bands in the overall IRR should not be seen as mere statistical margins but as direct indicators of the maturity of the fiscal risk management system. When controls are absent or fragmented, uncertainty increases dramatically. On the contrary, when controls are solid and well-structured, the risk is reduced and its measurement becomes more reliable, a fundamental aspect for effective dialogue with the Revenue Agency. Going into the specifics of the individual functions analyzed in the TCF, the results obtained will be commented on in the following paragraphs.

4.5. Receivables and payables (Active and Passive Cycle).

In the context of the Active Cycle, the IRR (Tax Risk Rate) is analyzed in relation to typical management activities, such as the issuance of invoices and credit notes to customers, whether domestic or foreign. The main problems that may arise concern the lack of or late active invoicing, as well as errors in VAT management, in particular with regard to foreign invoices. Another relevant aspect is the lack of adequate documentation that can prove the actual implementation of the transactions, creating the risk that, in the event of a tax audit, it may be thought that the transactions are non-existent and aimed at evading income tax or VAT. The introduction of control systems in the active cycle contributes to reducing the IRR, but the complexity and delicacy of transactions, especially those with foreign countries, still require a certain "flexibility" in the assessment of the risk associated with transactions. In fact, excessive supervision is not recommended, as it could have counterproductive effects in the determination of the effective IRR

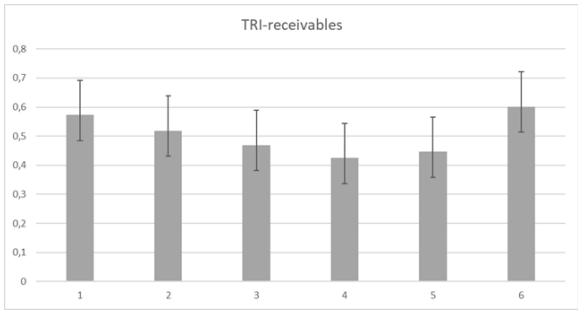


FIGURE 4. TRI- receivables

In the graph of the IRR relating to the Active Cycle (Fig.4), the error bands are wide and unstable in the early stages, highlighting a high level of uncertainty in fiscal risk when internal controls are insufficient, as in scenarios 1 and 2, and the sector is at high or moderate

evasion. This is consistent with the nature of the Active Cycle: errors or irregularities can lead to omissions, false invoicing, incorrect VAT determinations or undeclared revenues, all situations with high tax and criminal risk. In these scenarios, the broad bands reflect the high variability of tax behavior, which depends on the ability, or inability, of the company to properly track and document active transactions. When controls are effective and the sector is characterized by low evasion (as in scenario 3), the error band narrows but does not disappear completely, indicating that tax risk can never be eliminated completely, even in virtuous contexts. In scenarios 4 and 5, with excellent or excellent internal controls, the variability of sales-related fiscal risk decreases significantly due to the adoption of rigorous processes, such as prior checks on invoicing, price validation and verification of the correspondence between orders and deliveries. On the contrary, in scenario 6, in which the sector is at very high risk and controls are absent, the error band reopens drastically, indicating maximum instability and high fiscal danger. This scenario is typical in which VAT fraud and false or omitted invoices occur and where the Revenue Agency historically focuses controls. To limit tax risk, some operational ideas are suggested: check in advance the consistency between deliveries, invoices and collections to avoid undeclared revenues or duplication; implement automatic monitoring systems for electronic invoicing, integrating them with the management system and logistics flows; and carry out regular audits on credit notes, discounts and returns, areas that are often used to manipulate the tax result. Considering the Provision of the Revenue Agency of 10 January 2025, which highlights the importance of monitoring active flows within the new synthetic reliability indices (evolved ISAs), the Active Cycle must be treated as an absolute priority in the Tax Control Framework. The analysis of the accounting passive cycle focuses on the management of documents received from suppliers, an aspect closely linked to the correct recording of transactions. As with the active cycle, the main focus is on the possibility of errors, such as transactions not being recorded or being recorded incorrectly. A particular risk is related to Value Added Tax (VAT), where operations that require greater attention, such as the Reverse Charge are involved. In this context, one of the most critical aspects is the possibility of carrying out non-existent transactions, with the risk of illegitimately reducing the tax paid.

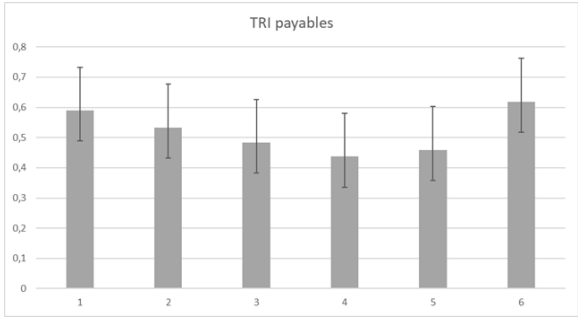


FIGURE 5. TRI payables

The analysis conducted on the passive cycle (Fig.5) shows a decrease in TRIs (fiscal risk indicators) depending on the degree of risk associated with the transaction and the

organization's ability to detect. However, unlike the active cycle, in this case an increase in both the minimum and maximum value of epsilon is observed, due to the presence of operations that require special attention and a high level of expertise on the part of operators. An example of these operations includes not only the Reverse Charge, but also the incorrect exposure in accounting of transactions for which the right to deduct VAT is limited or even excluded, or the failure to manage the terms necessary to take advantage of the deduction on purchases. The graph for IRR in the passive cycle shows particularly wide and variable error bands, which underlines the fiscal uncertainty that characterizes this business area, especially in the absence of strict control. In scenarios with high or moderate evasion and weak internal controls, the risk estimation has a high tolerance, as errors in purchase registrations, invoice management and VAT deduction are the main sources of tax risk. In the scenario where fulfillment is low and, controls are effective, the bands narrow, indicating that active monitoring of approval and registration procedures significantly reduces uncertainty. In scenarios with excellent controls, error bands are further narrowed, demonstrating how tax uncertainty can be minimized thanks to structured processes that include supplier validation, monitoring of contract conditions and cross-checking between orders, delivery notes and invoices. Finally, in very high-risk scenarios with no controls, the error band expands considerably, highlighting the maximum fragility in the management of the passive cycle. In such contexts, the risk of fraud, duplicate registrations or non-existent invoices is very high, which makes the IRR, highly unstable. To improve risk management, it is suggested to formalize a supplier validation process, with checks on VAT numbers, chamber of commerce registrations and data adequacy. It is also important to implement automatic reconciliation systems between purchase orders, packing slips, and invoices to ensure consistency between documents. In addition, it is essential to monitor the deductible VAT, carefully verifying both objective and subjective requirements to reduce the risk of disputes. In light of the Revenue Agency's Provision of 10 January 2025, which underlines the importance of consistency between document and tax flows, it is advisable to include the passive cycle in the Tax Control Framework, with recurring internal audits and digital traceability to minimize tax risk.

4.6. Assets and Warehouse Cycle.

The management of IRR for fixed assets has effects on two main aspects: the management of depreciation of assets with repeated fertility and transactions relating to real estate in general. In this context, the main errors that can occur concern the incorrect determination of the differences between statutory and tax depreciation, as well as the incorrect classification of company assets, which then leads to incorrect management of the depreciation rules for each asset. In particular, with regard to property management, it is essential to correctly calculate the mortgage and cadastral taxes related to the purchase or sale of real estate, as well as to determine any capital gains or losses deriving from transactions. When calculating the IRR, it is observed that the introduction of an increasingly efficient alert system makes it possible to significantly reduce the IRR, which does not happen in the management of active and passive cycles (Fig.6). This improvement is justified by better management, thanks also to the use of ERP systems, which allows greater automation in the treatment of fixed assets. In other words, through an adequate classification of the asset, it is possible to correctly manage the associated tax obligations, taking advantage of the automatic functions of the

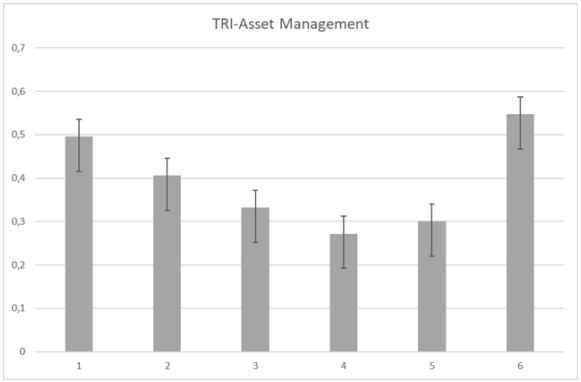


FIGURE 6. TRI-Asset management

ERP systems in use. However, the adoption of these technologies implies a certain reluctance on the part of the organization to accept a particularly high epsilon value, especially with regard to the maximum value. In the graph relating to IRR – Fixed Asset Management, the error bands are wide in the first scenarios (especially in scenarios 1 and 2), indicating significant uncertainty in the detection, management and control of tax risk in contexts where evasion is high or moderate and internal controls are weak or barely sufficient. This uncertainty can derive from recurring problems, such as the incorrect classification of fixed assets (for example, capitalized expenses vs. operating expenses), errors in the determination of depreciation rates, omissions in the processes of disposal or sale of assets, and the lack of physical traceability of the asset with respect to the accounting records. In intermediate scenarios (3, 4 and 5), where internal controls improve significantly, error bands visibly narrow, indicating greater reliability in the fiscal management of fixed assets. This suggests that the effectiveness of internal control has a direct impact on the company's ability to deal with fixed assets correctly, even in complex contexts. Scenario 6, characterized by a very high risk sector and a total absence of internal controls, again presents a very wide error band, indicating high uncertainty and high fiscal risk. This is typical of a context where asset processes are poorly monitored, especially in companies with fragile or informal governance, where the risk of irregularities is real. To improve the management of fixed assets, it would be useful to implement a system of physical and accounting traceability, with periodic updates of the asset registers. In addition, it would be important to formalize capitalization policies, establishing clear criteria on when an expense should be capitalized and how it should be amortized. It is also advisable to integrate periodic audits, both physical and documentary, especially in sectors with high capital intensity or in the case of frequent acquisitions or divestments. Finally, the management of fixed assets should be aligned with the regulations established by the Revenue Agency Provision of 10 January 2025, which requires greater consistency between accounting, tax and physical data for capital goods relevant for tax control purposes. Warehouse management refers to the set of risks associated with the management of the movement of tangible and intangible assets within the company. In addition to the alignment between physical values and accounting data in the ERP, the risks associated with an incorrect determination of value added tax in customs



FIGURE 7. TRI- Warehouse Management

transactions are also determined in this context. Examining the graph relating to the IRR for Warehouse Management, it shows how the tax risk associated with this area is strongly influenced by the effectiveness of internal controls and the nature of the sector in which the company operates (Fig.7). In the first scenarios, characterized by sectors with high or moderate evasion and weak or sufficient internal controls, the IRR is high and accompanied by very wide error bands. This signals a significant instability in the estimation of tax risk, which can derive from unstructured inventory management, approximate valuations or poor traceability of movements. These conditions can easily generate discrepancies between accounting and physical inventories, errors in the valuation of stocks, or anomalies in inventory adjustments, with significant tax repercussions on IRES, IRAP and VAT. As we move on to the central scenarios, the IRR shows progressive containment, and the error bands are noticeably narrowing. In contexts with low evasion and effective controls, the perception and measurability of tax risk improve significantly. Warehouse management appears more stable and reliable, thanks to the adoption of integrated management systems, the regular execution of physical inventories and consistent policies for the valuation of inventories. In the most virtuous contexts, those with excellent or excellent internal controls, the level of tax risk remains low and the error bands are very narrow, a sign that the company not only correctly oversees this function but is also able to accurately assess the tax impact of its operational choices. However, in the extreme scenario – the one with very high risk and no controls – the graph shows a sharp deterioration. The IRR rises again, and the error band expands, bringing the situation back to levels of strong unpredictability. In these cases, the warehouse can become a critical point, potentially used to alter the economic-fiscal results through, for example, the overestimation of stocks or the simulation of movements. In summary, the graph shows how Warehouse Management represents a fiscally sensitive area, whose reliability depends directly on the quality of internal controls. The progressive reduction of risk and its variability in different scenarios is a clear invitation to strengthen operational oversight of this function, enhancing the integration between accounting and logistics. Furthermore, in light of the Provision of the Revenue Agency of 10 January 2025, which underlines the need for transversal control of business processes, the importance of including warehouse management within the perimeter of the Tax Control Framework

emerges strongly so that tax risk is reduced in a systematic, measurable and sustainable way over time.

4.7. Financial management.

Financial management includes all operations related to business financing, which can be both internal and obtained from third parties. These operations are particularly delicate from a management point of view, since incorrect management can lead to evasive phenomena with serious consequences for the company, as in the case of cash pooling. The graph we are analyzing shows a rather regular trend, although less pronounced than others (Fig. 8).

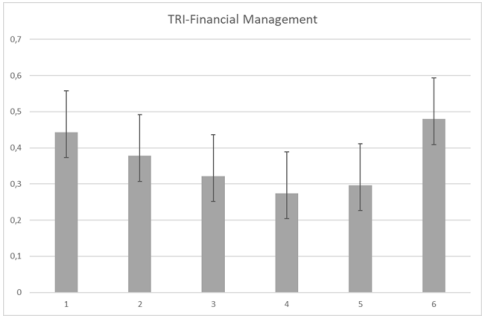


FIGURE 8. TRI-Financial Management

In the graph, it can be seen that the IRR tends to decrease progressively from scenario 1 to scenario 5, which demonstrates the importance of introducing solutions to mitigate risk, which are becoming more and more effective. However, changes in the IRR are relatively smaller than in other areas of management examined, suggesting that while financial management is important, it has a less direct impact on tax risk than other areas of operation. In the graph relating to IRT – Financial Management, the error bands remain quite narrow and stable in the first five scenarios, indicating that the fiscal risk in this area is well predictable and controlled, especially when sufficient or high-quality internal controls are in place. This suggests that processes related to financial management, such as bank transactions, consistency between financial and accounting flows, and the management of relations with banking institutions, are generally well structured and less subject to significant deviations. However, in scenario 6, characterized by high tax evasion and the absence of internal controls, a marked widening of the error band is observed, indicating considerable uncertainty in the organization's ability to properly manage tax risk in the financial context. This deterioration is probably due to the lack of precise reconciliations, the poor traceability of financial flows and the absence of formalized control procedures. In operational terms, it is important to standardize financial reconciliation processes, integrating monitoring software that connects accounting data with bank movements. In addition, it is essential to formalize periodic checks on cash flows, loans and intercompany movements, as well as to integrate financial management into the Tax Control Framework, so that any tax anomalies related to the financial component can be detected at an early stage.

4.8. HR Management.

HR management mainly concerns the risks associated with the processing, settlement and accounting of taxes and contributions relating to employees and self-employed personnel working in the company. The risks at this stage focus mainly on calculation errors in determining the withholdings to be applied to recipients and on the tax management of expenses that are reimbursed to employees and self-employed workers for activities such as, for example, food and lodging expenses during business trips. Since these risks involve different operational areas, it is natural that the IRR associated with this management is of great relevance in the business economy. Consequently, it is necessary to modulate the IRR considering that it is very complex to define mitigating actions that cover only management risks. In the graph relating to TRI – Personnel Management (Fig.9), the error bands show a significant trend, highlighting a variability of risk depending on the scenario.

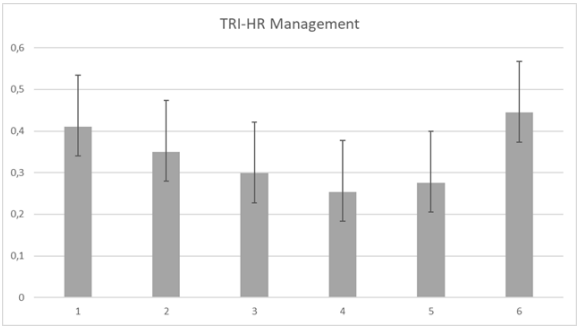


FIGURE 9. TRI-HR Management

In the first three conditions (from scenario 1 to scenario 3), ranging from sectors with high evasion to those with low evasion but with weak to effective internal controls, the error bands are moderately wide. This indicates that personnel management is a sensitive area and potentially exposed to uncertainty in the absence of robust control structures. Causes of this uncertainty can include contractual misclassification, incorrect management of benefits from a tax point of view, and inconsistencies between labor costs and tax and contribution returns. In the next two scenarios (4 and 5), where internal controls are excellent and the risk of evasion is low or moderate, the error bands are significantly narrowed. This indicates that a well-structured personnel management system, supported by company policies and digital tools, significantly reduces tax uncertainty. However, in scenario 6, characterized by a very high-risk sector and a total absence of controls, the error band widens drastically. This signals a strong instability and unpredictability of tax risk in this area, reflecting untracked personnel management, with possible exposures related to irregular work, undeclared compensation or benefits not accounted for correctly. In operational terms, it would be useful to accurately map the tax risks related to labor costs and also to verify their consistency with financial flows and accounting records. In addition, automated checks on benefits, fringe benefits, stock options and expense reimbursements should be introduced to ensure their correct tax relevance. Finally, it is essential to formalize internal policies in

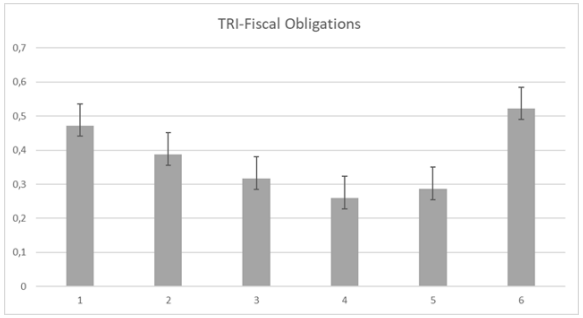


FIGURE 10. TRI-Fiscal Obligations

line with tax and social security legislation, monitoring in particular any facilitated treatment and non-standard subjects, such as consultants and collaborators.

4.9. Management of "Tax Obligations".
The "Tax Compliance" section includes all those so-called residual activities ranging from the determination of the taxable base and the related tax to the purely documentary and declaratory management. It is therefore a very important section of the TCF that requires particular attention from the individual area managers. Going into the merits of the graph, it shows an overall stable and low-risk situation along almost all the scenarios analyzed. Unlike what happens for the operational areas, the level of the Tax Risk Indicator in this case is on average low, and this reflects the more procedural and less discretionary nature of this function (Fig.10). Activities related to tax compliance – such as the preparation of returns, the settlement of VAT or the transmission of forms – are in fact regulated in a timely manner, with well-defined deadlines and traceability, and often supported by standardized management tools. This relative "tranquility" is visible from the first scenario, in which the IRR, despite a context of high evasion and weak internal controls, does not assume high values and has moderate error bands. Even in the following scenarios, the trend remains constant: fiscal risk does not increase significantly, and the variability associated with risk – expressed by the error bands – tends to narrow progressively, but without significant jumps. This suggests that, even in the most fragile contexts, tax compliance is still overseen with a minimum level of structure, perhaps thanks to the intervention of external consultants or automated software. The interesting fact, however, emerges in the most virtuous scenarios, where internal controls are excellent or excellent: in these cases, the IRR drops further to levels close to zero, and the error bands are drastically reduced. This testifies that, in the presence of advanced tax governance, this function becomes completely reliable and transparent, almost "automated" in terms of risk. This approach fully responds to the principles of the Provision of the Revenue Agency of 10 January 2025, which invites companies to integrate compliance systems with structured monitoring indicators, even in apparently "routine" areas. In summary, the graph confirms that tax compliance, although fundamental for formal compliance, does not represent the main source of tax risk within the company. Their impact on IRR is small and relatively stable, with limited margins of error. However, this should not lead to underestimating its importance, since material

errors in this area – although rare – can still generate direct findings by the Administration. The added value in terms of risk management is therefore obtained not only with the daily monitoring of deadlines but also with an integration between this function and the flows from the operational areas so that the information transmitted to the Treasury is always correct, consistent and timely.

5. Conclusions

The increasing complexity of tax legislation and the pressure exerted by tax authorities make it essential for companies today to adopt structured tools for tax risk management. In this context, the Tax Control Framework (TCF), promoted by the Revenue Agency with the Provision of 14 April 2016, represents the methodological reference for companies that adhere to the Collaborative Compliance Regime introduced by Legislative Decree 128/2015. The TCF provides an integrated approach to the detection, measurement, management and control of tax risk through the mapping of business processes and the qualitative assessment of the related risks, taking into account impact and probability. However, the traditional approach, based on a qualitative classification of risk (high, medium, low), shows limits in terms of objectivity and defensibility in the context of cross-examination with the Tax Authorities. To overcome these critical issues, the present work proposes a quantitative model for tax risk assessment, based on a Tax Risk Index (TRI) calculated through multi-criteria techniques (DEMATEL and AHP) integrated with FMEA analysis and probability distributions. This index makes it possible to estimate both the intrinsic and residual risk, offering a more robust and replicable measure of the company's tax position. The goal is to provide an operational tool that supports companies in the design of an effective and transparent tax control system, consistent with regulatory expectations and capable of strengthening the relationship of trust with the Administration. The model, validated through a simulated case study, demonstrated that the adoption of effective internal controls significantly reduces uncertainty and exposure to tax risk. The scenarios analysed show that the operational areas with the greatest impact on tax risk are the active and passive cycles, and the management of fixed assets and inventory, while tax compliance, which is more proceduralized, has a lower impact. However, the introduction of very sophisticated controls, if not properly balanced, can lead to a worsening of IRR due to operational fragmentation and loss of management coordination. In particular, the results show that the reduction of tax risk is not always proportional to the increase in safeguards: the added value of controls decreases beyond a certain threshold, with potential distorting effects. It is therefore essential to implement a balanced Tax Control Framework integrated into business processes, capable of guaranteeing transparency but also efficiency. The IRT proves to be a useful tool for objectively and dynamically measuring tax risk, facilitating dialogue with the Tax Administration and supporting companies in a path of proactive compliance management. The TRI model, as structured, can pave the way for future research developments oriented, for example, to the calibration of the IRR on a sectoral basis, to the integration with ESG indicators, or to the use of machine learning techniques for the prediction of fiscal risk based on historical and accounting data.

6. AI Disclosure

The author(s) used OpenAI's ChatGPT 5 to improve the clarity and grammar of the article. All content was reviewed and verified by the authors

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Paper contributed to the#ApplMath2025 International Workshop
held in Messina, Italy (9-11 June 2025) under the patronage of the *Accademia Peloritana dei Pericolanti.*

Manuscript received 26 June 2025; published online 18 November 2026



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