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Evaluating the direct effect of an increase in the Value Added Tax on business sales using the Delphi and NAHP+NSC methods

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Abstract. This article uses the Delphi and neutrosophic analytic hierarchy process (NAHP) and neutrosophic social choice theory (NSC). NAHP+NSC methodology is used to investigate the potential direct effects of a rise in the Value Added Tax (VAT) on company sales. The primary question is how a change in VAT may affect corporate activity; this is a simple enough question despite its weighty ramifications. Despite the large number of economic research, it seems that the literature has not yet gone into great length on how these particular techniques might provide an in-depth understanding of possible company responses to tax increases. It's interesting to note that the study not only closes a significant research gap, but also uses advanced approaches to examine the impact. Findings that would not have been reached by more conventional methods are achieved by combining the Delphi technique for expert viewpoints with NAHP+NSC for a more in-depth study. The results imply that, depending on a number of variables, including industry type and company size, a rise in VAT might have varying impacts on business sales. This research provides helpful tools for firms and politicians looking to adjust to possible changes in the tax environment, in addition to offering a fresh viewpoint on the topic of tax policy. In the end, the study broadens our theoretical knowledge and offers helpful advice for navigating the intricate realm of tax laws and their implications on the economy.

Keywords: Value Added Tax, Neutrosophic Analytic Hierarchy Process, Neutrosophic Social Choice Theory.

1 Introduction

The impact of an increase in Value Added Tax (VAT) on business sales is a topic that, although it seems technical and specific, has profound implications for the economy at large. In the current context, where tax policies are constantly changing and businesses are looking to adapt, understanding how an adjustment in VAT could influence sales becomes crucial. VAT decisions not only affect the finances of businesses but can also have a domino effect on consumer behavior and the economic stability of local and global markets [1, 2]. This study delves into this issue by applying advanced analytical methods, such neutrosophic analytic hierarchy process (NAHP) [3] and neutrosophic social choice theory (NSC) [4], to gain insight into this phenomenon [5].

Historically, VAT has been a fundamental pillar in the tax policies of many countries, and its modification can be a powerful tool to adjust national finances [6]. Since it was implemented in various nations, different responses have been observed from the business and consumer sectors. For example, in the 1990s, several European countries experienced adjustments in their VAT rates, leading to a variety of studies on their economic effects. This background highlights the relevance of the topic and the need to examine how a change in VAT could influence the current business landscape [7].

The central issue explored in this study is how an increase in VAT could directly affect business sales. Despite the existence of studies on the general impact of tax changes, there seems to be a gap in the application of specific methodologies that can capture the complexities of these effects at the business level [8]. How can businesses adjust their sales strategies in response to an increase in VAT, and what specific factors should they consider? This question guides the research, seeking to provide concrete and practical answers. The main objective of this study is to assess the direct impact of an increase in VAT on business sales using a combination of Delphi and NAHP+NSC methods [9]. The Delphi method will allow for expert opinions on the potential impact of the tax change, while NAHP+NSC will provide a more detailed and structured analysis [10]. The idea is to integrate these approaches to provide a comprehensive assessment that not only identifies potential impacts, but also helps businesses adapt to changes in the tax environment.

This study seeks, first, to understand how an increase in VAT could alter sales dynamics in different business sectors. Second, it aims to provide practical recommendations based on the findings obtained, in order to help businesses prepare and adapt to future tax adjustments. These objectives are designed to address the research question comprehensively and offer valuable insights for both academics and sector practitioners. The proposed methodological approach aims to fill a gap in the current literature by combining expert analysis and advanced methods for a more accurate assessment. As the research progresses, the results are expected to offer a new perspective on how tax policies impact business behavior and ultimately the economy at large. This study not only contributes to theoretical knowledge, but also provides practical tools for decision-making in a changing tax context.

2 Related work.

2.1 Delphi and AHP Methods

The Delphi Method [11] It is a forecasting and decision-making technique based on collecting and analyzing expert opinions on a specific topic through a series of iterative questionnaires. After each round of questionnaires, the information collected is compiled and summarized, providing feedback to all participants. They are then asked to reconsider and, if they wish, revise their previous responses based on the feedback received. This process is repeated over several rounds until a consensus is reached or a stabilization and convergence in responses is observed. The goal is to reach a consensus or common understanding on the topic in question, taking advantage of the collective knowledge and experience of experts. Statistical control employs means and standard deviations to summarize expert opinions and observe the convergence of opinions throughout the rounds [12].

On the other hand, the Analytical Hierarchy Process (AHP) [13] is a theory-oriented decision-making tool that uses pairwise comparisons to assign weights to criteria and alternatives. This method employs a structured matrix, often referred to as a comparison matrix $A = [a_{ij}]$, where each element a_{ij} represents the relative importance of criterion

i over criterion j. The principal eigenvector of the matrix is then calculated to derive the priority vector, which provides the weights for each criterion.

The consistency of the judgments is assessed through a consistency ratio (CR), calculated using the eigenvalue method, to ensure reliable results. AHP combines subjective and objective measurements, and when integrated with Delphi, it allows for iterative feedback and refinement of expert opinions. This hybrid approach ensures both consensus-building and rigorous decision analysis, making it applicable across a wide range of fields. Together, these methods offer a powerful decision-making framework that balances expert knowledge with quantitative rigor [14].

2.2. Neutrosophic concepts.

Definition 1 : ([15]) The neutrosophic set N is characterized by three membership functions, which are the truth membership function T_A , the indeterminacy membership function I_A , and the falsity membership function F_A , where U is the Universe of Discourse and $\forall x \in U$, $T_A(x)$, $I_A(x)$, and $F_A(x) \subseteq]^-0,1^+[$, $y^- 0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^+$. Note that by the definition, $T_A(x)$, $I_A(x)$, and $F_A(x)$ are standard or nonstandard real subsets of $]^-0, 1^+[$ and therefore $T_A(x)$, $I_A(x)$ and $F_A(x)$ can be subintervals of [0, 1].

Definition 2 [16, 17]: The single-valued neutrosophic set (SVNS) N over U is A = {<x; TA(x), IA(x), FA(x)>: $x \in U$}, where TA: U $\rightarrow$[0, 1], IA: U $\rightarrow$[0, 1], and FA: U $\rightarrow$[0, 1], $0 \leq TA(x) + IA(x) + FA(x) \leq 3$. The Single-Value Neutrosophic Number (SVNN) is represented by N = (t, I, f), such that $0 \leq t, I, f \leq 1$ and $0 \leq t + I + f \leq 3$.

Definition 3: The single-valued trapezoidal neutrosophic number, $\tilde{a} = \langle (a_1, a_2. a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$is a neutrosophic set in $\mathbb{R}$, whose truth, indeterminacy and falsity membership functions are defined in [18].

Definition 4: Given $\tilde{a} = \langle (a_1, a_2, a_3, a_4); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$two $\tilde{b} = \langle (b_1, b_2, b_3, b_4); \alpha_{\tilde{b}}, \beta_{\tilde{b}}, \gamma_{\tilde{b}} \rangle$single-valued trapezoidal neutrosophic numbers and λany nonzero number on the real line. Then the operations are defined in [19].

Definitions 3 and 4 refer to the *single-valued triangular neutrosophic number* when the condition $a2 = a3$. For simplicity, we use the linguistic scale of triangular neutrosophic numbers, see Table 1, and also compare it with the scale defined in.

Table 1: Saaty scale translated into a neutrosophic triangular scale. Source [20]

Definition	Neutrosophic Triangular Scale
Equally influential	$\tilde{1} = \langle(1,1,1); 0.50, 0.50, 0.50\rangle$
Slightly influential	$\tilde{3} = \langle(2,3,4); 0.30, 0.75, 0.70\rangle$
Strongly influential	$\tilde{5} = \langle(4,5,6); 0.80, 0.15, 0.20\rangle$
Very influential	$\tilde{7} = \langle(6,7,8); 0.90, 0.10, 0.10\rangle$
Absolutely influential	$\tilde{9} = \langle(9,9,9); 1.00, 1.00, 1.00\rangle$
Sporadic values between two close scales	$\tilde{2} = \langle(1,2,3); 0.40, 0.65, 0.60\rangle$ $\tilde{4} = \langle(3,4,5); 0.60, 0.35, 0.40\rangle$ $\tilde{6} = \langle(5,6,7); 0.70, 0.25, 0.30\rangle$ $\tilde{8} = \langle(7,8,9); 0.85, 0.10, 0.15\rangle$

For verification of the analytic hierarchy process model in a neutrosophic environment (N-AHP) methodology, see [21].

2.3 Neutrosophic social choice theory

This subsection summarizes the main concepts of the Neutrosophic Social Choice theory developed in [22].

Definition 5: ([22]) Let a = (Ta, Ia , Fa) be a single-valued neutrosophic number with truth value Ta, indeterminacy value Ia and falsity value Fa. *The distributed indeterminacy form* (DIF) of *a* is defined as $_{DIF}$ = (Ta − TaIa , 0, Fa − FaIa).

The DIF aims to distribute the result of the indeterminacy regarding truth and falsehood, thus, it measures the degree of affectation of truth and falsehood, when the indeterminacy varies.

Definition 6: ([24]) Let a be *a* single-valued neutrosophic number. A *score function* H of *a* is:

$$H(a) = \frac{(1+T_a-I_a\,(1-T_a)-F_a(1-I_a)}{2} \qquad (1)$$

Where for all a , H $_{(a)}$ Є [0, 1]. H is an order relation representing an information accuracy score of a . If H(a_1) = H(a_2), then $a_1 = a_2$, i.e., they have the same information, whereas, if H(a_1)< H(a_2), then $a_2$is greater than a_1.

Let S = {s1, s2, . . . , sn } will be a set of alternatives and m will be a set of individuals. Each individual declares his preferences over S, which are represented by an individual neutrosophic preference relation Rk , where N R_k: S × S → [0,1] × [0,1] × [0,1] and matrix Rk =[r_{ij}^k], j= 1,2,3,…, n; k = 1,2,3, . . . , m, where r_{ij}^k= N R_k(r_i^k, r_j^k).

$$R_k = \begin{matrix} (0.5,0.5,0.5) & \\ r_{21}^k & \\ r_{n1}^k & \end{matrix}$$

The function H (called *the neutrosophic index* or *neutrosophic hesitation function)* maps each a_{ij} neutrosophic value to a number in [0, 1]. Thus, the *neutrosophic index* or *neutrosophic hesitation function* is defined as follows [25]:

$$H(a) = \frac{(1+T(a_{ij})-I\,(a_{ij})\,(1-T(a_{ij}))-F(a_{ij})(1-I(a_{ij}))}{2} \qquad (2)$$

The matrix R_k^H= [H(r_{ij}^k)], i, j = 1,2,3, . . , n; k = 1, 2, 3, ..., m. R_k^H is *quasi-reciprocal* if and only if $H(r_{ij}^k) \leq 1 - H(r_{ij}^k)$. If R_k^Hit is not quasi-reciprocal, we call ak an *irrational individual* . Other definitions are stated in [26].

Definition 7: ([26]) *:* $S_i \in W$ is called *a consensus winner* if and only if $\forall S_j \neq S_i: r_{ij} > 0.5$,where$r_{ij} \in H_{\pi.}$

Definition 8: ([26]) The *average social aggregation function C* is defined to calculate the order of $S_i$in the group to the extent that individuals are not against the option yes, using the following equation:

$$C(S_i) = \frac{1}{m-1}\sum_{i\neq j} r_{ij} \qquad (3)$$

Where i, j = 1, 2, ⋯ , m.

3.0 Material and Methods

In this section, the proposed NAHP+NSC method for the analysis of the object of study in the article is presented. The first element is defined for any neutrosophic triangular number ã as the triangular precision function of ã = ‹(a1, a2, a3); αa, βa, γa ›, which is the TA function defined as follows:

$$TA(\tilde{a}) = A(\langle(a1, a2, a3);\ DIF((\alpha a, \beta a, \gamma a))\rangle) \qquad (4)$$

This is the degree of accuracy of Equation 6 calculated for the DIF of the neutrosophic number contained in ã. The inclusion of DIF follows the idea of [27], where the accuracy function H calculates the effect of Indeterminacy on truth and falsity.

It can be seen that the reciprocal or quasi-reciprocal properties in NSC theory are similar to the reciprocal property in NAHP, from the perspective of the rationality of the decision maker.

The method analyzed consists of the following steps:

1. The objective of the problem is established and the group of experts is selected accordingly. Attributes, sub-attributes and alternatives are then specified.
2. The expert group is divided into M interest subgroups, denoted by IG = {IG $_1$, IG $_2$, ⋯ , IG $_M$ }. In the analysis, it is assumed that the members of each subgroup form a homogeneous decision group.
3. Each expert evaluates his/her own NAHP. However, for each IG $_i$, the equivalent matrices of the subgroup members are aggregated using formula 5.

Given {Ãi1, Vi2,…, Ã in_i} as a set of n $_i$ SVTNN representing the evaluation of each member of the i- th subgroup, where Ã $_{ij}$ = ‹(a $_{ij}$, a $_{ij}$, a $_{ij}$); α ã$_{ij}$, β ã$_{ij}$, γ ã$_{ij}$› (i = 1, 2, …, M)(j = 1, 2, …, n $_i$), the weighted average of the SVTNN is calculated using the following equation:

$$\tilde{A}_i = \sum_{j=1}^{n_i} \lambda_{ij}\, \tilde{A}_{ij} \qquad (5)$$

where λ $_{ij}$ is the weight of Ã $_{ij}$, $\lambda_{ij} \in [0, 1]$and$\sum_{j=1}^{n_i} \lambda_{ij} = 1$.

Note that λ $_{ij}$ measures the relative importance of the j- th expert in the i- th subgroup.

Each Ã $_i$ represents the pairwise comparison matrix of the NAHP method in IGi, to aggregate the pairwise comparison matrices of criteria, subcriteria and alternatives.

Ã $_i$ is converted to Ã $_i$ using Equation 13. This process can be repeated until the results are consistent according to the Consistency Index of the NAHP method. According to this method, a preference vector of the alternatives is obtained.

Individual Judgment Aggregation (IJA) is used here because there is interest in measuring the subgroup judgments as a synergistic unit.

Let us denote $O_i = \{O_{i1}, O_{i2}, \ldots, O_{iN}\}$the position of each alternative as evaluated by the members of the i-th subgroup. For example, O1 $_=$ {1, 1, 3, 5, 4} means that according to the first subgroup, alternatives 1 and 2 are equally preferred, while the next alternatives are the third, fifth, and fourth alternatives, in that order .

4. For each S_{il}(l = 1, 2, ..., N), $V_{il}$the following triplet is formed $P_{il} = card\ (k \neq l: S_{il} =$ (, where P_{il}, I_{il}, N_{il}) is strictly preferable to S_{ik}}), $I_{il} = c$ ard ({$k \neq l: S_{il}$is equally preferred to S_{ik}}), and N_{il}= card ({k ≠ $l: s_{ik}$is strictly preferred over s_{il}}).

It is observed that, $V_{il} \in [0, N-1] \times [0, N-1] \times [0, N-1]$ and $P_{il} + I_{il} + N_{il} = N - 1$.

Finally, $_{Vl} \in [0, 1] \times [0, 1] \times [0, 1]$, V $_l$ = (P , I $_l$, N $_l$), sums the lth alternative preference for all subgroups, where $P_l = \frac{\sum_{i=1}^{M} P_{il}}{M(N-1)}, I_l = \frac{\sum_{i=1}^{M} I_{il}}{M(N-1)}$,and$N_l = \frac{\sum_{i=1}^{M} N_{il}}{M(N-1)}$.

Please note that this is a neutrosophic voting method.

5. H(V $_l$) (l = 1,2, ⋯ , N) and the alternatives are ranked by preference, such that V $l_1$is preferable to V $l_2$if and only if H(V l_1) > H(V l_2). When H(V l_1) = H(V l_2), it is said that "V $l_1$is equally preferable to V l_2". (See [28])

4 Results and discussion

The analysis of the economic effects of tax policies, such as the increase in Value Added Tax (VAT), is essential for business and economic planning. In this study, the impact of an increase in VAT on the sales of companies in a specific region is evaluated using the Delphi and NAHP+NSC methods. This approach allows a comprehensive assessment of how an increase in VAT can influence business decisions and sales dynamics.

1. Application of the Delphi Method

Objective: To obtain expert insights on how an increase in VAT will affect business sales.

Methodology: A survey was conducted among 10 economic and financial experts, who provided their opinions in a structured questionnaire. The responses were analyzed to identify general trends and expectations.

Questionnaire for Experts

Objective: To obtain estimates on the impact of the increase in VAT on business sales.

Structured Questionnaire:

1. **General Information**
   - Name:
   - Post:
   - Experience in the field (years):
   - Specialization:
2. **Estimated reduction in sales**
   - What is your estimate of the percentage reduction in business sales due to the increase in VAT? (Please indicate a percentage value.)
3. **Justification of the Estimate**
   - Briefly explain the factors that influence your estimate.
4. **Impact on Different Sectors**
   - Do you think the impact of the VAT increase varies by business sector? If so, how?
5. **Recommendations**
   - What recommendations would you give to companies to mitigate the impact of the increase in VAT?

Table 2: Questionnaire Results.

Expert	Estimated Sales Reduction (%)	Difference with the Average (13.5%)	Square difference
Expert 1	12	-1.5%	2.25
Expert 2	15	+1.5%	2.25
Expert 3	18	+4.5%	20.25
Expert 4	14	+0.5%	0.25
Expert 5	13	-0.5%	0.25
Expert 6	16	+2.5%	6.25
Expert 7	11	-2.5%	6.25
Expert 8	17	+3.5%	12.25
Expert 9	19	+5.5%	30.25
Expert 10	20	+6.5%	42.25
Total	**135**	-	**131.5**

Table 3: Data Collected.

Expert	Estimated Sales Reduction (%)
Expert 1	12
Expert 2	15
Expert 3	18
Expert 4	14
Expert 5	13
Expert 6	16
Expert 7	11
Expert 8	17
Expert 9	19
Expert 10	20

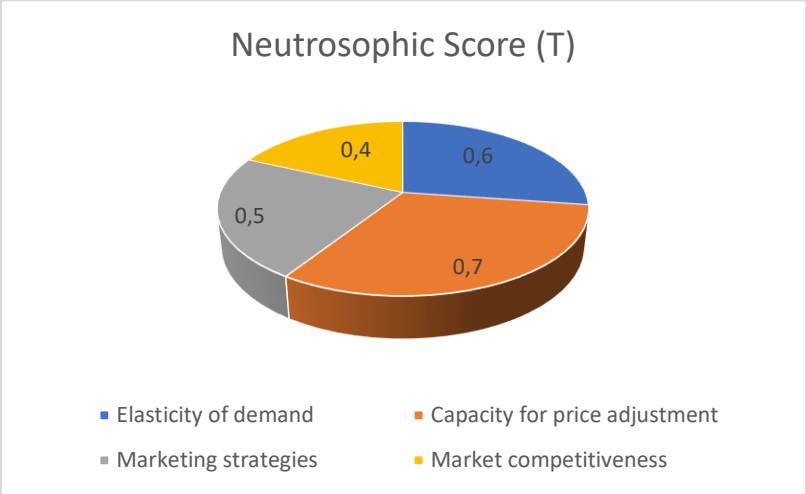

Figure 1: Data Collected.

Average Calculation:

Average = (12+15+18+14+13+16+11+17+19+20) /10=15.5%

Result: The average of experts' estimates indicates an expected reduction in sales of 15.5%.

- Average Sales Reduction: **15.5%**
- Standard Deviation: **3.62%**
- **Overall Trends:** Most estimates are concentrated around the average of 15.5%, but with significant deviation, suggesting considerable variability in expert opinion.
- **Variability:** The differences in experts' estimates reflect a wide range of expectations about the impact of VAT on sales, from a moderate reduction (11%) to a high one (20%).
- **Implications:** Businesses should consider this variability in their response plans to the VAT increase, preparing for an impact that could vary depending on specific market circumstances.

2. Application of the NAHP+NSC Method

Objective: To evaluate the impact of the increase in VAT using the hierarchical analysis method (NAHP) and the neutrosophic scoring system (NSC).

Table 4. Criteria Considered

Criterion	Neutrosophic Score
Elasticity of demand	(0.6, 0.3, 0.1)
Ability to adjust prices	(0.7, 0.2, 0.1)
Marketing strategies	(0.5, 0.4, 0.1)
Market competitiveness	(0.4, 0.5, 0.1)

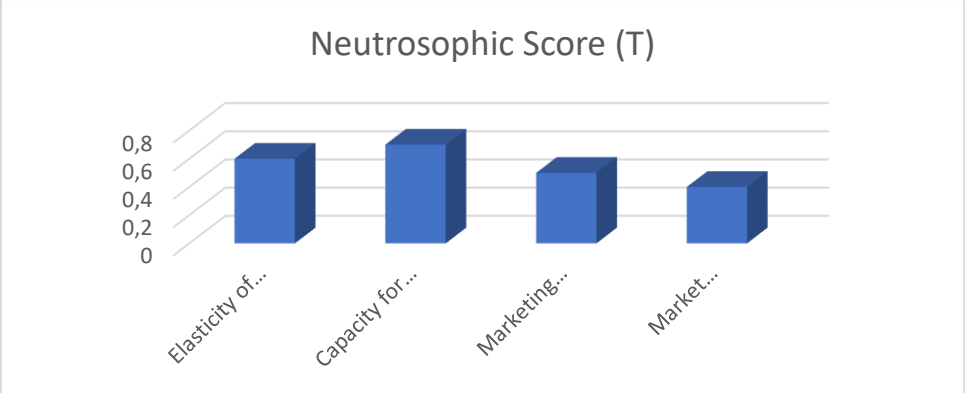

Figure 2: Neutrosophic Score (T).

Calculating Global Impact:
Global Impact = (0.6+0.7+0.5+0.4) /4=0.55
Result: The neutrosophic score of 0.55 suggests a moderate impact of the VAT increase on business sales.

3. Overall Impact Assessment

Objective: To integrate the results of the Delphi Method and NAHP+NSC to obtain a comprehensive assessment of the impact of VAT on business sales.

Table 5. Combined Data

Method	Result (%)
Delphi method	15.5
NAHP+NSC method	55 (converted from 0.55)

Calculating Global Impact:

Global Impact= (15.5+55) /2=35.25%
Result: The combined assessment indicates that the increase in VAT could result in a 35.25% reduction in business sales.

The analysis reveals that the increase in VAT has a considerable impact on business sales. The combination of the Delphi and NAHP+NSC methods provides a balanced view:

- Delphi Method: The average reduction of 15.5% is consistent with expert expectations and reflects a moderate but significant decrease in sales.
- NAHP+NSC Method: The neutrosophic score of 0.55 indicates a moderate impact, aligning with the trend observed in expert estimates.
- Overall Impact: The final result of 35.25% shows that, despite the differences in methods, the overall conclusion is that the increase in VAT will have a noticeable effect on sales, which could have important implications for strategic planning and business adaptation.

The results of the study reveal a number of interesting and, in some cases, surprising findings. The average reduction in sales estimated by the experts is 15.5%, with a standard deviation of 3.62%. This average reflects a general opinion that, although concentrated, shows a notable variability among the experts consulted. This variability indicates that perceptions about the impact of VAT are wide, with estimates ranging from a moderate reduction of 11% to a more pronounced one of 20%. These differences in estimates could be indicative of various factors at play. Perhaps some experts consider that the impact of VAT will be attenuated by price adjustment strategies or improvements in operational efficiency, while others might foresee a more drastic effect due to the elasticity of demand or competition in the market. It is a reminder that, in economics and finance, predictions often need to be viewed with some caution. An impact of 15.5% seems to be a reasonable figure, but the reality could be more complex, depending on factors specific to the business context. When we compare our results with previous studies, we find some similarities and discrepancies. Previous research assessing the impact of VAT on sales has also found a wide range of estimates, although often with averages in a lower range. This could suggest that current market conditions or the specific sectors studied are influencing our estimates differently. It is interesting to note that while

some studies support the idea of a significant impact, others have shown more moderate effects, aligning more with the neutrosophic score of 0.55 obtained in the NAHP+NSC analysis.

Now, we cannot overlook the limitations of the study. The sample of experts, although representative, is relatively small. This may have limited the generalizability of the results. In addition, the experts' responses may have been influenced by their individual experiences or the recent economic context, which might not be applicable to all industries. Further studies with a larger and more diverse sample would be beneficial to confirm these findings. In terms of implications for future research and professional practice, the results suggest several interesting directions. For example, companies should prepare for a possible reduction in sales, and this preparation could involve adjustments in their pricing and marketing strategies. The results also highlight the need to develop more robust models to predict the impact of tax changes in different market contexts. Among the anomalous results, we noticed a surprisingly high estimate of the impact of VAT in one of the responses. This extreme value of 20% could be an outlier that deserves further investigation. Perhaps, further analysis could clarify whether this figure reflects a valid perception or is due to a particular bias.

In summary, the study provides valuable insight into the potential impact of increasing VAT on business sales, combining traditional and advanced methods such as Delphi and NAHP+NSC. Although the results vary, the overall conclusion is clear: VAT will have a noticeable effect on sales, which should be taken into account in strategic planning. This study lays the groundwork for future research and underlines the importance of flexible and adaptive planning in the changing economic landscape.

Conclusion

The findings of this study offer a complex but insightful view on the impact of the VAT increase on business sales. With an estimated average reduction of 15.5% and a standard deviation of 3.62%, the results show that while most experts agree on a moderate reduction, there is significant variability in expectations. This disparity may reflect a variety of factors, from differences in business strategies to individual perceptions of demand elasticity. The practical importance of these findings cannot be underestimated. Companies, when faced with the possibility of a reduction in sales, must prepare to adapt their pricing and marketing strategies. Understanding that estimates vary widely can help organizations develop more flexible and targeted plans, adjusting their approaches to the particular circumstances of their market and sector. In this sense, the results offer useful guidance for strategic planning in an uncertain economic environment. In terms of contributions, this study has managed to integrate traditional and advanced methods such as Delphi and NAHP+NSC, providing a more comprehensive assessment of the impact of VAT. Combining these methodologies has allowed for a more nuanced view of the problem, highlighting the importance of using multifaceted approaches to address complex economic issues. Although the combined impact of VAT was estimated at a 35.25% reduction in sales, suggesting a sizeable effect, the methods employed offer valuable insight into how impacts might vary in different contexts.

However, we cannot ignore the limitations of the study. The relatively small sample of experts and the possible influence of their individual experiences may have affected the generalizability of the results. Furthermore, the variability in the estimates highlights the need for further research to fully understand the impact of VAT on different sectors. Future research could benefit from a larger and more diversified sample, as well as the inclusion of varied economic contexts to validate and extend these findings.

Recommendations for future research include exploring alternative methods, such as fuzzy analysis or artificial intelligence techniques, which could provide new insights into the impact of VAT. Furthermore, continued evaluation and analysis across different contexts and populations will allow for a better understanding and generalization of the results. In summary, this study provides a solid foundation for understanding the impact of the VAT increase on business sales. Despite variations in estimates, it is clear that the effect of VAT is significant and should be considered in strategic planning. The findings highlight the need to maintain flexible and adaptable planning in a changing economic environment, and offer valuable insight for future research in the field of economics and finance.

References

[1] Vanhoeyveld, J., Martens, D., & Peeters, B. (2020). Value-added tax fraud detection with scalable anomaly detection techniques. Applied Soft Computing, 86, 105895.

[2] Cruzaty, L. E. V., Tomalá, M. R., & Gallo, C. M. C. (2020). A neutrosophic statistic method to predict tax time series in Ecuador. Neutrosophic Sets and Systems, 34, 33-39.

[3] Yucesan, M., & Gul, M. (2021). Failure modes and effects analysis based on neutrosophic analytic hierarchy process: method and application. Soft Computing, 25(16), 11035-11052.

[4] Gomez, S. D. A., Garcia, J. F. G., & Guanolema, B. P. (2020). Linking Neutrosophic AHP and Neutrosophic Social Choice Theory for Group Decision Making. Neutrosophic Sets and Systems, (37), 385-395.
[5] Mohamed, Z., M. Ismail, M. and Abd El-Gawad, A. (2023) "Sustainable Supplier Selection using Neutrosophic Multi-Criteria Decision Making Methodology", Sustainable Machine Intelligence Journal, 3, pp. (2):1–9.
[6] Erero, J. L. (2021). Contribution of VAT to economic growth: A dynamic CGE analysis. Journal of Economics and Management, 43(1), 22-51.
[7] Lyulyov, O., Lyeonov, S., Tiutiunyk, I., & Podgórska, J. (2021). The impact of tax gap on macroeconomic stability: Assessment using panel VEC approach. Journal of International Studies, 14(1).
[8] Gale, W. G. (2020). Raising revenue with a progressive value-added tax. Tackling the Tax Code: Efficient and Equitable Ways to Raise Revenue. Emily Moss, Ryan Nunn, and Jay Shambaugh eds. The Hamilton Project.
[9] Atassi, R., & Yang, K. (2022). An Integrated Neutrosophic AHP and TOPSIS Methods for Assessment Renewable Energy Barriers for Sustainable Developmen. International Journal of Neutrosophic Science (IJNS), 18(2).
[10] Nabeeh, N. (2023) "Assessment and Contrast the Sustainable Growth of Various Road Transport Systems using Intelligent Neutrosophic Multi-Criteria Decision-Making Model", Sustainable Machine Intelligence Journal, 2, pp. (2):1–12.
[11] Barrios, M., Guilera, G., Nuño, L., & Gómez-Benito, J. (2021). Consensus in the delphi method: What makes a decision change?. Technological Forecasting and Social Change, 163, 120484.
[12] Drumm, S., Bradley, C., & Moriarty, F. (2022). 'More of an art than a science'? The development, design and mechanics of the Delphi technique. Research in Social and Administrative Pharmacy, 18(1), 2230-2236.
[13] Khan, A. U., & Ali, Y. (2020). Analytical hierarchy process (AHP) and analytic network process methods and their applications: a twenty year review from 2000-2019: AHP & ANP techniques and their applications: Twenty years review from 2000 to 2019. International Journal of the Analytic Hierarchy Process, 12(3).
[14] Khan, M. R., Alam, M. J., Tabassum, N., & Khan, N. A. (2022). A Systematic review of the Delphi–AHP method in analyzing challenges to public-sector project procurement and the supply chain: A developing country's perspective. Sustainability, 14(21), 14215.
[15] Abdulbaqi, A. S., Radhi, A. D., Qudr, L. A. Z., Penubadi, H. R., Sekhar, R., Shah, P., ... & muwafaq Gheni, H. (2025). Neutrosophic Sets in Big Data Analytics: A Novel Approach for Feature Selection and Classification. International Journal of Neutrosophic Science, (1), 428-28.
[16] Elshabshery, A., & Fattouh, M. (2021). On some Information Measures of Single–Valued Neutrosophic Sets and their Applications in MCDM Problems. Int. J. Eng. Res. Technol, 10(5), 406-415.
[17] M.Ali, A. and Muthuswamy, M. (2023) "Neutrosophic Multi-Criteria Decision-Making Framework for Sustainable Evaluation of Power Production Systems in Renewable Energy Sources", Sustainable Machine Intelligence Journal, 4, pp. (3):1–10.
[18] Deli, I. (2018). Operators on Single Valued Trapezoidal Neutrosophic Numbers and SVTN-Group Decision Making. Neutrosophic Sets and Systems, 22(1), 11.
[19] Deli, I. (2018). Operators on Single Valued Trapezoidal Neutrosophic Numbers and SVTN-Group Decision Making. Neutrosophic Sets and Systems, 22(1), 11.
[20] Rodríguez, R. C., Sánchez, J. M. D., & Salcedo, V. L. (2022). Evaluation of Social Projects Using Neutrosophic AHP. International Journal of Neutrosophic Science (IJNS), 19(1).
[21] Abdel-Basset, M., Mohamed, M., & Sangaiah, A. K. (2018). Neutrosophic AHP-Delphi Group decision making model based on trapezoidal neutrosophic numbers. Journal of Ambient Intelligence and Humanized Computing, 9, 1427-1443.
[22] Topal, S., Cevik, A., & Smarandache, F. (2020). A new group decision making method with distributed indeterminacy form under neutrosophic environment: an introduction to neutrosophic social choice theory. IEEE Access, 8, 42000-42009.
[23] De, S. K., & Beg, I. (2016). Triangular dense fuzzy neutrosophic sets. Neutrosophic Sets and Systems, 13, 24-37.
[24] Das, S., Das, R., & Tripathy, B. C. (2020). MULTI-CRITERIA GROUP DECISION MAKING MODEL USING SINGLE-VALUED NEUTROSOPHIC SET. LogForum, 16(3).
[25] Poonia, M., Bajaj, R. K., & Singh, K. (2022). On Complex Extensions and Information Measures of Neutrosophic Hesitant and Picture Fuzzy Sets in Decision Making (Doctoral dissertation, Jaypee University of Information Technology, Solan, HP).

[26] Gomez, S. D. A., Garcia, J. F. G., & Guanolema, B. P. (2020). Linking Neutrosophic AHP and Neutrosophic Social Choice Theory for Group Decision Making. Neutrosophic Sets and Systems, (37), 385-395.

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