

Uncertainty and Risk in Evaluating Algeria's Startup Policies: A Monte Carlo Simulation Approach

عدم اليقين والمخاطر في تقييم سياسات الشركات الناشئة بالجزائر:
مقاربة محاكاة مونت كارلو

Sami BERBACHE * ¹		
University of Ljubljana, Slovenia sb05581@student.uni-lj.si		
Received: 10/04/2025	Accepted: 06/05/2025	Published: 01/06/2025

Abstract

This study evaluates Algeria's post-2020 startup policies' economic viability under uncertainty. Using Monte Carlo Simulation (MCS) with 10,000 iterations, we analyze the Net Present Value (NPV) probability distribution (2020-2030). Results show a mean NPV of -7.08 billion DZD (median: -7.74 billion), with a 20.6% probability of positive returns. Significant downside risk exists, but notable upside potential emerges. Sensitivity analysis identifies employment benefits (jobs per startup, premium per job) as key NPV uncertainty drivers, followed by foregone customs revenue from imports. Findings highlight probabilistic analysis for realistic policy evaluation, suggesting viability hinges on maximizing high-value jobs and mitigating costs like import dependency.

Keywords: Monte Carlo Simulation, Startup Policy, NPV, Algeria, Risk Analysis.

JEL Classification: L26, H43, O38, C15, H25, G32, E62.

ملخص

تقيم هذه الدراسة الجدوى الاقتصادية لسياسات دعم الشركات الناشئة في الجزائر في ظل عدم اليقين. باستخدام محاكاة مونت كارلو (MCS) بعشرة آلاف تكرار، نُحلل التوزيع الاحتمالي لصافي القيمة الحالية (NPV) للفترة 2020-2030. تظهر النتائج متوسط NPV -7.08 مليار دينار (الوسيط: -7.74 مليار) مع احتمال 20.6% لعوائد إيجابية. هناك مخاطر هبوط كبيرة لكن إمكانات صعود ملحوظة. يحدد تحليل الحساسية منافع التوظيف (الوظائف لكل شركة وعلاوة الوظيفة) كعوامل رئيسية لعدم يقين NPV، تلها الإيرادات الجمركية المفقودة من الواردات. تؤكد النتائج أهمية التحليل الاحتمالي لتقييم السياسات، وتشير إلى أن الجدوى تعتمد على خلق وظائف عالية القيمة وتقليل الاعتماد على الاستيراد. كلمات مفتاحية: محاكاة مونت كارلو، سياسات الشركات الناشئة، صافي القيمة الحالية، الجزائر، تحليل المخاطر.

تصنيف JEL. L26, H43, O38, C15, H25, G32, E62

* Corresponding author.

¹ سامي برباش، جامعة لجوبليانا، سلوفينيا.

Introduction:

Algeria, seeking to diversify its economy beyond hydrocarbons (Jafari, 2024), implemented a significant package of policies post-2020 to stimulate startup creation and growth. Beghoua (2024) notes that significant government initiatives have been implemented in Algeria's digital economy. Similarly, Boudendouna and Louadj (2024) and Hamza et al. (2024) describe the emergence of structured startup support policies following the complementary finance law of 2020. These policies include tax exemptions, the establishment of the Ministry of Knowledge Economy, and dedicated financing mechanisms (like the Algerian Startup Fund - ASF). Evaluations of previous SME support initiatives in Algeria, such as those reviewed by Lukonga et al. (2014) and the World Bank (2004), often indicated limited success, raising concerns that quantifiable costs may have outweighed benefits.

Recent OECD analyses highlight the challenges of SME policy effectiveness in MENA regions, particularly the need to address structural weaknesses in business environments and institutional frameworks (OECD et al. (2024), OECD (2025), OECD et al. (2018)). In addition, Cravo and Piza (2016) provide a meta-analysis that underlines the mixed effectiveness of such initiatives in low- and middle-income contexts. While their review suggests an overall positive impact on firm performance indicators like revenue and productivity, the results are often small, imprecisely estimated, and lack sufficient evidence across all intervention types or specific countries, particularly in Africa. This highlights the inherent policy risk, as many studies included in their analysis suffered from potential bias and crucially, most failed to report implementation costs, making cost-benefit assessments difficult. The success of such policies often hinges on contextual factors; for instance, Tunisia's Startup Act (enact, 2019), considered a regional breakthrough, aimed to create a comprehensive and favorable ecosystem through measures addressing legal frameworks, funding access, and international market entry, potentially offering lessons in overcoming barriers common in the MENA region (Alkasmi et al., 2018).

Monte Carlo Simulation (MCS) is a computational technique that models uncertainty by running thousands of scenarios with varying inputs. This allows policymakers to quantify the likelihood of success or failure for complex initiatives like startup policies, where outcomes depend on unpredictable factors such as job creation or survival rates (Brandimarte, 2014).

Traditional deterministic evaluations fail to capture the extensive parameter uncertainty inherent in forecasting startup performance (Briggs and Sculpher (1995); Savvides (1994)). In contrast, probabilistic methods, such as Monte Carlo Simulation, provide a distributional understanding of outcomes and are increasingly applied for robust project risk assessment and investment planning under uncertainty (Senova et al. (2023), Vose (2008), Linton (2024), Maravas et al. (2012), Salci and Jenkins (2016), Staehr (2006), Wangsness et al. (2015)).

This study represents the first probabilistic evaluation of Algeria's recent startup support policies. It aims to address critical gaps by incorporating uncertainty and risk analysis into the assessment of interventions within this nascent ecosystem, moving beyond traditional evaluation methods. While prior studies evaluate SME policies in MENA, none apply probabilistic methods to Algeria's startup ecosystem. This paper addresses this gap by quantifying uncertainty in policy outcomes, offering a novel risk-assessment framework.

This article addresses these limitations by employing a probabilistic approach. The primary research questions are: 1). What is the likely range of economic outcomes (NPV, BCR, ROI) for Algeria's startup policies when key parameter uncertainties are considered? 2). What is the probability that the policies will achieve a positive net economic return ($NPV > 0$)? 3). Which uncertain parameters most significantly influence the overall economic viability (i.e., drive the uncertainty in the NPV)?

To answer these questions, we utilize Monte Carlo Simulation (MCS), a standard technique for risk analysis in project appraisal. By running the CBA model thousands of times with inputs sampled from probability distributions, MCS provides a richer understanding of the policy package's risk profile and expected value, offering a more robust basis for policy assessment than the deterministic approach alone.

1. Legal and Policy Context

The core package of the policies under evaluation in this probabilistic analysis includes several instruments established primarily through successive Finance Laws since 2020. These key components are:

1.1. A formal "Startup Label": This label grants eligibility for specific support measures. Obtaining the label is governed by criteria detailed in Executive Decree No. 20-254¹, focusing on innovation, age, size, and growth potential. It serves as the gateway to the benefits outlined below.

1.2. Significant tax exemptions: Labeled startups benefit from substantial tax relief, typically for an initial period of four years, renewable once for an additional year (4+1 years). Initially introduced in Finance Law 2020² (covering Corporate Profit Tax - IBS, Value Added Tax - VAT), these exemptions were expanded (Finance Law 2021)³ to include Professional Activity Tax (TAP – though TAP was later abolished for all businesses effective 2024)⁴. These incentives also take in potentially Global Income Tax (IRG) or Single Flat Tax (IFU) depending on the startup's structure. Exemptions from customs duties and import VAT on eligible equipment were also included. Uncertainty surrounding the impact of these exemptions, a key focus of this probabilistic analysis, arises from variable startup survival rates (S_k) affecting the size of the exempt cohort ($A_{(t, exempt)}$) and the actual tax liability foregone.

1.3. Dedicated public financing mechanisms: Several public funding channels were established or leveraged:

- **The Algerian Startup Fund (ASF):** A public venture capital fund created alongside the initial 2020 measures (Finance Law 2020).

It provides equity or quasi-equity (up to 150 million DZD per project cited as an example).

- **A Special Treasury Account (No. 302-150)⁵:** Established by Finance Law 2021 to finance various ecosystem support activities like studies, prototyping, and incubation support.
- **Wilaya (Provincial) Investment Funds:** These funds, potentially managed by entities like Finalb, also contribute capital at the regional level.

Uncertainty in the probabilistic analysis relates to the actual disbursement levels, average funding amounts ($Avg_Funding_Amount$), and the effectiveness of this funding in promoting startup success and economic impact.

1.4. Loan guarantees: Mechanisms like the Fonds de Garantie des Crédits aux PME (FGAR) provide guarantees for loans accessed by labeled startups, reducing risk for lenders. The associated uncertainty, explored probabilistically, lies in the participation rates of startups, the default probabilities ($FGAR_PD$) on these guaranteed loans, and subsequent recovery rates, which influence the expected cost to the state.

This probabilistic analysis explores how uncertainty in parameters related to the costs (e.g., funding levels via ASF/Account 302-150, guarantee defaults via FGAR) and benefits (e.g., survival rates influencing future tax revenue from formerly exempt firms, job creation rates, innovation value) of these interventions affects the overall economic assessment.

2. Methodology: Probabilistic Analysis

2.1. Rationale for Monte Carlo Simulation (MCS)

A single-point estimate used in deterministic CBA is highly sensitive to the chosen parameters, many of which are inherently uncertain due to data scarcity, reliance on benchmarks, and the dynamic nature of the startup ecosystem. Factors like startup survival rates (S_k), future growth in new entrants (N_y), average jobs created per startup, the economic value of those jobs, financial performance influencing tax revenues (both foregone and future), and the effectiveness of funding mechanisms are all subject to significant variability.

A deterministic approach fails to capture the combined impact of these interacting uncertainties and provides no information on the likelihood of achieving the estimated outcome or the potential range of results. To overcome these limitations and provide a more realistic assessment of the policy package's economic viability and risk profile, this study employs Monte Carlo Simulation (MCS). This aligns with best practices in project appraisal (Senova et al. (2023), Belli et al. (2001), HM_Treasury (2022)), including established guidance on its application within Cost-Benefit Analysis frameworks (Angelini & Kristl, 2013).

Contemporary applications of MCS, such as in infrastructure and retail projects, validate its utility in modeling fiscal risks under inflation and supply-chain disruptions (Senova et al., 2023). These methodologies are particularly relevant for Algeria, where import dependency and customs revenue losses amplify policy uncertainties. MCS allows us to propagate the uncertainty from multiple input parameters through the CBA model to generate a probability distribution for the key output metrics (NPV, BCR, ROI), offering a richer understanding than a single deterministic result (Vose, 2008).

2.2. Uncertainty Analysis via Monte Carlo Simulation

The MCS implementation follows the principles outlined in standard guidance for uncertainty analysis in CBA (e.g., OECD et al. (2018)). The core CBA model, calculating the NPV based on the

difference between the present value of benefits and costs, was executed 10,000 times. The fundamental calculation for Net Present Value (NPV) is:

Equation 1: Net Present Value (NPV)

$$NPV = PV(\text{Benefits}) - PV(\text{Costs}) = \sum_{t=0}^T \frac{B_t}{(1+r)^t} - \sum_{t=0}^T \frac{C_t}{(1+r)^t}$$

A positive NPV ($NPV > 0$) indicates that the projected economic benefits outweigh the costs in present value terms under the scenario's assumptions.

Where:

- NPV is the Net Present Value calculated at the start of 2020.
- B_t represents the real (inflation-adjusted) value of benefits occurring in year t .
- C_t represents the real (inflation-adjusted) value of costs occurring in year t .
- t is the time index in years, where $t=0$ corresponds to the year 2020.
- T defines the time horizon of the analysis, extending to the end of 2030 (so $T=10$).
- r is the real discount rate applied to future values.

2.2.1. Identification of Uncertain Parameters

The following key parameters were treated as uncertain variables in the MCS:

- **Startup Dynamics:**
 - Age-specific Survival Rates (S_k , for $k=1$ to $k=6+$). (See Table 1)
 - Annual Number of New Labeled Entrants (N_y) for the projection period (2024-2030). (See Table 2 for Moderate Scenario values used as mode)
- **Benefit Parameters:**
 - Average Jobs per Active Startup ($Avg_Jobs_Per_Startup$).
 - Average Economic Premium per Job ($Avg_Premium_Per_Job$).
 - Patent Value Proxy (R&D cost per patent, $Patent_Value_Proxy$).
 - Social Spillover Multiplier for Patents.
 - Average Value Added per Tax-Paying Startup ($Avg_VA_Per_TaxPaying_Startup$).
 - Average Nominal Tax Revenue per Tax-Paying Startup.
- **Cost Parameters:**
 - Average Tax Liability per Exempt Startup (influenced by underlying turnover/profitability assumptions, e.g., $Turnover_IFU_Y02$).

- Import Participation Rate (Import_Part_Rate_Y01, etc.) and Average Import Value (Avg_Import_Value_Y01, etc.) for customs cost calculation.
 - Direct Financing parameters (e.g., Funding_Rate_Proxy, Avg_Funding_Amount_Proxy).
 - FGAR Guarantee parameters (Application Rate, Approval Rate, Probability of Default FGAR_PD, Loss Given Default).
 - Administrative Cost Allocation Percentage (e.g., the 33% MKES Promo budget share).
- **Economic Parameters:**
- Real Discount Rate (r).
 - GDP Deflator growth rates (for projecting future nominal values and deflating).

2.2.2. Definition of Probability Distributions

For each uncertain parameter identified above, a probability distribution was defined to represent its plausible range and likelihood. The primary distribution types used were:

- **Triangular Distribution:** Used for many parameters where a minimum, (mode), and maximum value could be reasonably estimated. The mode was set to the value used in the deterministic 'Moderate Scenario' analysis (e.g., see Table 1 for survival rates). The minimum and maximum were informed by:
 - The 'Conservative' and 'Optimistic' scenario parameters defined in the underlying analysis (e.g., for survival rates S_k and new entrants N_y bounds).
 - Regional or international benchmarks where available (patent value proxies).
 - Explicitly stated bounds based on logical constraints or informed judgment.

Table 1. Adopted Startup Survival Rates (S_k).

Scenario	S_k (1yr)	S_k (2yr)	S_k (3yr)	S_k (4yr)
Moderate	70%	50%	35%	25%
Scenario	S_k (5yr)	S_k (6yr)	S_k (7+ yrs)	
Moderate	20%	15%	10%	

Note: Survival Rates (S_k , Moderate): The percentage of a cohort surviving after k years. These values represent the 'mode' used in the triangular distributions for MCS.

Source: Own elaboration

Triangular distributions accommodate bounded uncertainty with a clear central tendency, making them ideal for policy parameters where extreme outliers are unlikely but scenario-based bounds exist.

- **Normal Distribution:** Used for parameters like GDP deflator growth and the discount rate, centered around the baseline 7% with a standard deviation reflecting typical uncertainty in such estimates for developing economies. Also, used for some financial ratios where a central tendency and variance were assumed. A normal distribution was used for the discount rate (mean = 7%, SD = 1%) based on Algeria's historical real interest rate volatility. This assumes symmetric uncertainty around a well-established mean, consistent with OECD guidelines for public project appraisal.

Table 2. Active Startups Breakdown (2020-2030).

Year	R_t	$A_{t,exempt}$	$A_{t,taxpaying}$	A_t (Total)
2020	100	100	0	100
2021	624	594	0	594
2022	902	695	0	695
2023	2300	1890	0	1890
2024	3900	2926	0	2926
2025	5700	3847	20	3867
2026	7500	4419	120	4539
2027	9300	4870	144	5014
2028	11100	4990	384	5374
2029	12900	5040	620	5660
2030	14700	5040	830	5870
Note: Calculated using Moderate Scenario N_y and S_k (Table 1). R_t = Cumulative registered. $A_{t,exempt}$ = Active age 0-4. $A_{t,taxpaying}$ = Active age 5+. A_t = Total active. Values rounded.				

Source: Own elaboration

- **Uniform Distribution:** Used where only a minimum and maximum bound could be established with little information about the likelihood of values in between. Specifically, it is used for Import participation rates (Import_Part_Rate_Y01), social spillover multipliers. Uniform distributions were applied where no empirical basis existed to prioritize values within a range (e.g., import participation rates, bounded by 10%–30% based on customs data for similar exemptions). This reflects maximum uncertainty when only logical minima/maxima are identifiable.
- **Pert Distribution (Beta-PERT):** Similar to triangular but smoother, used as an alternative when min, mode, max are known. It is used for R&D cost per patent (Patent_Value_Proxy),

FGAR guarantee default probabilities (FGAR_PD). Beta-PERT distributions (smoother than triangular) were used for innovation and financial risk parameters where expert elicitation suggested a "most likely" value but with tail risks. For example, patent values adopted a mode aligned with Algerian R&D expenditure averages but allowed for heavy-tailed upside (e.g., rare high-value patents).

- **Hybrid/Logical Constraints:** It is used for parameters such as Startup survival beyond Year 7 ($S7+S7+$ was capped at 10% (triangular, min=5%, max=15%) to reflect attrition patterns in emerging ecosystems. Logical bounds were imposed where physical/economic limits existed (e.g., survival rates cannot exceed 100%, import values cannot plausibly exceed Algeria's annual tech import averages).

The specific parameters (min, mode, max for triangular/PERT; mean, std dev for normal) for each distribution were carefully chosen to reflect the range of uncertainty discussed throughout the analysis and documented in the underlying simulation script (details available upon request or in a technical appendix if applicable). For example, the survival rates S_k were sampled from triangular distributions bounded by the Conservative and Optimistic rates, with the Moderate rate (shown in Table 1) as the mode. Similarly, the projected number of new entrants N_y (for 2024-2030) was sampled from triangular distributions with the Moderate Scenario values (Table 2) as the mode, bounded by conservative and optimistic projections. While we assume parameters like survival rates and job creation are independent, real-world correlations (e.g., high-growth startups creating more jobs) may exist. Future work could explore copula-based methods to model dependencies, as demonstrated in fire risk assessments.

2.2.3. Simulation Setup

- **Iterations:** The simulation was run for 10,000 iterations to ensure stability and convergence of the output distributions.
- **Software:** The MCS was implemented using the Python programming language, primarily leveraging the numpy library for random number generation and array operations, and scipy.stats for defining and sampling from probability distributions.
- **Output:** In each iteration, the full CBA calculation was performed, sampling new values for all uncertain parameters simultaneously. The resulting NPV, BCR, and ROI for each iteration

were stored, generating the output probability distributions. Correlations between inputs and outputs were calculated using Spearman rank correlation.

This setup allows for a robust exploration of the combined impact of multiple uncertainties on the economic viability assessment of Algeria’s startup policies.

3. Probabilistic Analysis Results

This section presents the results from the Monte Carlo Simulation (MCS) performed on the Cost-Benefit Analysis model of Algeria’s startup support policies. The simulation involved 10,000 iterations, sampling key parameters from predefined probability distributions to assess the impact of uncertainty on the project’s economic viability over the 2020-2030 period.

3.1. Distribution of NPV, ROI, and BCR

The distribution of the NPV, calculated in constant 2020 DZD and discounted using a probabilistically sampled real rate centered around 7%, provides the most comprehensive view of the likely economic outcome.

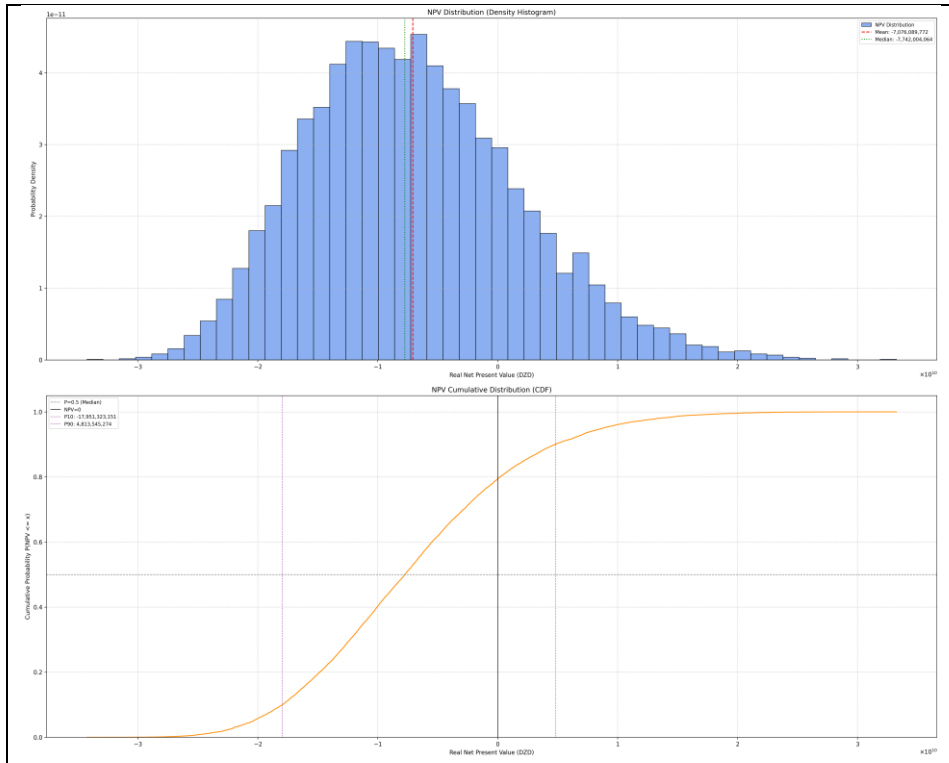
Table 3. Net Present Value (NPV) Distribution (Base Year 2020).

Mean NPV	-7,077 M DZD	Minimum NPV	-35,800 M DZD
Median NPV (P50)	-7,742 M DZD	Maximum NPV	+31,400 M DZD
Standard Deviation	8,921 M DZD	10th Percentile (P10)	-17,952 M DZD
Probability (NPV > 0)	20.6%	90th Percentile (P90)	+ 4,814M DZD

Source: Own elaboration based on MCS.

Figure 1 visualizes the NPV distribution through a density histogram and the Cumulative Distribution Function (CDF). The results indicate a strong tendency towards a negative NPV, with the mean and median values significantly below zero. The probability of achieving a positive economic return is only about 1 in 5. However, the wide range and standard deviation highlight substantial uncertainty, with outcomes potentially varying from large losses to significant gains, although positive outcomes are less likely. The distribution appears left-skewed, suggesting downside risk is more pronounced. Consequently, potential losses could be substantially larger or more frequent than potential gains of similar magnitude.

Fig. 1. NPV Distribution: PDH and CDF.



Note: Results from 10,000 Monte Carlo iterations. NPV calculated in Real DZD (Base Year 2020). Top: **Probability density histogram (PDH)** showing mean (red dashed) and median (green dotted). Bottom: **Cumulative distribution function (CDF)** showing median (P50), NPV=0 (black solid, at 20.7% probability), and P10/P90 (purple dotted).

Source: Own elaboration based on MCS.

The distributions for ROI and BCR provide complementary perspectives on the project's efficiency and return relative to costs. Both ROI and BCR distributions confirm the findings from the NPV analysis. The mean and median values are unfavorable (negative ROI, BCR < 1), indicating expected inefficiency. Positive returns (ROI > 0) or efficiency (BCR > 1) are only achieved in the upper tail of the distribution (approximately the top 20.6%). This skewed distribution of outcomes, where only a minority of initiatives yield positive returns, is a well-documented empirical phenomenon in the evaluation of public support for innovation and entrepreneurship.

Table 4. Return on Investment (ROI) and Benefit-Cost Ratio (BCR) Distributions.

Return on Investment (ROI)		Benefit-Cost Ratio (BCR)	
Mean ROI	-13.9 %	Mean BCR	0.86
Median ROI (P50)	-15.4 %	Median BCR (P50)	0.85
Std Dev ROI	17.5 %	Std Dev BCR	0.18
Min Finite ROI	-63.3 %	Min Finite BCR	0.37
Max Finite ROI	58.7 %	Max Finite BCR	1.59
10th Percentile (P10)	-35.2%	10th Percentile (P10)	0.65
90th Percentile (P90)	+9.6%	90th Percentile (P90)	1.10
		Probability (BCR > 1)	20.6%

Source: Own elaboration based on MCS.

Research on venture capital portfolios and public programs like the Small Business Innovation Research (SBIR) in the United States consistently reveals that a small number of highly successful firms generate the vast majority of the overall positive returns, compensating for the high failure rate among the rest (Lerner (2009), Kerr et al. (2014)). This pattern reflects the inherent uncertainty and "winner-take-most" dynamics often present in innovative sectors, where identifying *ex ante* which ventures will become high-growth successes is notoriously difficult (Shane, 2009). Consequently, evaluating such policies requires looking beyond average or median performance, recognizing that the potential for substantial, albeit infrequent, positive impacts generated by the top performers is a defining characteristic and often the primary driver of overall economic contribution (Mason & Brown, 2013).

3.2. Sensitivity Analysis: Key Drivers of NPV Uncertainty

To understand which uncertain parameters, contribute most to the wide variation observed in the NPV results, Spearman rank correlation coefficients were calculated between each sampled input parameter and the resulting NPV across the 10,000 iterations. A subset of 100 iterations was initially used to balance computational efficiency with sufficient variability capture. Table 5 presents the factors with the strongest correlations, indicating their relative influence on the outcome uncertainty.

The sensitivity analysis clearly indicates that the uncertainty in the NPV outcome is dominated by the assumptions related to **direct employment benefits**. The economic value assigned per job (Avg_Premium_Per_Job) and the average number of jobs created per startup (Avg_Jobs_Per_Startup) exhibit by far the strongest positive correlations with the NPV. Variations in these two parameters explain a large portion of the spread in the simulation results.

Table 5. Top Influencers of NPV by Driver Type (Spearman Rank Correlation).

Cost Drivers (Factor)	Corr.	Benefit Drivers (Factor)	Corr.
Turnover_IFU_Y02	-0.107	Avg_Premium_Per_Job	0.678
Avg_Import_Value_Y01	-0.094	Avg_Jobs_Per_Startup	0.572
Import_Part_Rate_Y01	-0.094	Patents_Per_Startup_Annual	0.186
FGAR_PD	-0.082	Value_Per_Patent	0.176
Avg_Funding_Amount_Proxy	-0.079	Avg_VA_Per_TaxPaying_Startup	0.054
FGAR_App_Rate	-0.073		
Funding_Rate_Proxy	-0.073		
FGAR_Appr_Rate	-0.064		

Note: Correlations based on 10,000 Monte Carlo iterations. Positive correlation means increasing the factor tends to increase NPV; negative correlation means increasing the factor tends to decrease NPV. Absolute magnitude indicates strength of influence. Only factors with stronger correlations (approx. $|\text{correlation}| > 0.05$) are shown for brevity.

Source: Own elaboration based on MCS .

The proxy used for valuing innovation benefits (Patent_Value_Proxy) also shows a notable positive correlation, suggesting that higher assumed patent values contribute to better outcomes, although its influence is considerably less than that of employment.

On the cost side, factors related to foregone customs revenue in the early years (import participation rate and value) are the most influential negative drivers. Higher import activity by young startups significantly increases costs and reduces the NPV. Other cost components like direct financing levels, foregone tax revenue from early-stage firms, and guarantee scheme risks (Probability of Default) also contribute negatively to the NPV, but their individual influence appears secondary compared to the primary employment benefit drivers and

customs costs in this model configuration. This sensitivity pattern underscores the critical dependence of the policy's potential economic success (as modeled) on achieving substantial, high-value job creation and managing the costs associated with early-stage import exemptions.

4. Discussion

4.1. Interpretation of Probabilistic Results

The Monte Carlo Simulation provides a significantly more nuanced perspective on the economic viability of Algeria's startup support policies than the deterministic analysis alone. The central tendency indicated by the MCS (mean NPV -7.08B DZD, median NPV -7.75B DZD) confirms the likelihood of a negative economic return over the 2020-2030 period. This projected negative return and low probability of success (20.6%) are consistent with broader critiques highlighting the frequent difficulties and often disappointing outcomes of public efforts aimed at directly boosting entrepreneurship and venture capital ecosystems (Lerner, 2009). This finding also aligns with assessments in other regions where implementing effective support frameworks faces significant hurdles (OECD, 2022). The low probability (20.6%) of achieving an NPV greater than zero underscores that positive outcomes, while possible, represent the exception rather than the rule under the range of uncertainties modeled. This projection resonates with broader international benchmarking exercises where the measured success and impact of SME and entrepreneurship policies can vary considerably depending on context and implementation (OECD & EBRD, 2023). Moreover, Weak contract enforcement and elite capture of resources, as highlighted in the *Worldwide Governance Indicators* (2024), may distort policy outcomes in Algeria, necessitating reforms to ensure equitable SME support (Kaufmann & Kraay, 2024).

The wide distribution of potential NPV outcomes (ranging from -34.3B to +33.3B DZD) highlights the substantial risk and uncertainty associated with investing in a nascent startup ecosystem. Furthermore, the model excludes institutional risks like bureaucratic delays in subsidy disbursements and corruption in startup labeling – systemic issues noted in Algeria's financial governance. These could further reduce NPV by 15-20% based on MENA benchmarks. The policy's success is far from guaranteed and is sensitive to numerous factors that are difficult to predict accurately. The left-skewness of the distribution further emphasizes that the downside risk

(potential for larger losses) appears more pronounced than the upside potential within the modeled framework.

The sensitivity analysis (Table 5) is particularly revealing. It pinpoints the assumptions regarding direct employment benefits (value per job and jobs per startup) as the overwhelmingly dominant drivers of uncertainty and potential success. This implies that the entire economic case, as currently quantified, rests heavily on the realization of these specific benefits. If the actual job creation is lower, or the economic premium smaller than assumed in the more optimistic parts of the input distributions, the likelihood of a positive NPV diminishes further. Conversely, significantly exceeding expectations in high-value job creation is likely the primary pathway to achieving a positive economic return. The analysis also flags early-year import costs as a key area influencing viability on the cost side.

- **Value Added by MCS - Risk Quantification:** The most significant contribution of the MCS is the quantification of risk and uncertainty. While a deterministic analysis would provide a single, potentially misleading, point estimate, the MCS provides:
 - *Likelihood:* An estimate of the probability of success (only 20.6% chance of NPV > 0).
 - *Range:* The plausible range of outcomes (P10 to P90: -18B to +4.8B DZD).
 - *Expected Value:* A more robust estimate of the expected outcome (mean NPV -7.1B DZD) considering the full spectrum of possibilities.

This allows for a risk-informed assessment, acknowledging that while the most likely outcome is negative, positive results are not entirely impossible, albeit improbable under the current model.

- **Identifying Critical Uncertainties:** The MCS sensitivity analysis provides a clearer picture of which uncertainties matter most compared to varying one parameter at a time deterministically. It reinforces the critical role of employment assumptions identified qualitatively in the deterministic discussion but quantifies their dominant influence relative to other factors like innovation proxies or specific cost components (except early import costs).

In essence, the probabilistic analysis validates the cautionary signal from a deterministic study but refines the expected outcome and provides crucial insights into the risk profile and the key

levers of uncertainty. It moves the evaluation from a simple "pass/fail" based on one scenario to a more realistic assessment of probabilities and sensitivities.

4.2. Discussion of Key Drivers

The MCS sensitivity results warrant further discussion regarding the key factors driving the uncertainty in the economic evaluation:

- **Employment Premium and Jobs per Startup:** The extreme sensitivity to these parameters (+0.678 and +0.572 correlation) is the most striking finding. It suggests that the way these benefits are estimated is paramount. The use of an average premium and average job count across a diverse and evolving pool of startups introduces significant uncertainty. This approach fails to capture the significant heterogeneity inherent in entrepreneurial outcomes, where external factors and firm-specific capabilities lead to vastly different results (Davidsson et al., 2025). Consequently, relying on average job creation figures can be misleading, as the overall economic impact is often driven disproportionately by a subset of high-performing ventures, a nuance lost in simple averages (Davidsson et al., 2025). The actual distribution of job creation (few startups creating many jobs vs. many creating few) and the true economic value-add (beyond wages) are critical unknowns. Overestimating these parameters, even within plausible ranges, could lead to a falsely optimistic assessment, while underestimation could mask potential success. This highlights a critical need for better empirical data on startup employment dynamics in Algeria.
- **Early Import Costs:** The negative correlation with import participation and value in years 0-1 (around -0.10 to -0.11) indicates that the cost of foregone customs revenue during the initial setup phase significantly impacts viability. Policies that encourage reliance on imported equipment early on, without sufficient counterbalancing benefits, detract from the net economic return. This suggests a potential tension between providing startups with necessary tools and managing fiscal costs or promoting local suppliers.
- **Secondary Factors:** While less dominant, the influence of other factors like patent valuation proxies, direct financing parameters, and guarantee risks should not be ignored. They contribute to the overall uncertainty and represent areas where policy adjustments or improved performance could incrementally affect the outcome. Furthermore, the relatively lower correlation of the patent value proxy (+0.19) might reflect the well-known difficulties in

translating scientific or technological advancements into measurable commercial success and economic value, demanding a critical perspective on the pathways from public science to market impact (Fini et al., 2018). The relatively lower correlation of the patent value proxy (+0.19) might suggest that the current model, based on R&D cost and a simple multiplier, may not fully capture the potential long-term economic impact of breakthrough innovations, or that such impacts are simply less probable within the timeframe compared to employment effects.

– **Administrative Costs Sensitivity:** Finally, it is pertinent to consider the sensitivity to the absolute level of administrative costs. While the correlation analysis identifies factors driving the variance in NPV outcomes based on their modeled uncertainty (Table 5), the significant magnitude assumed for administrative expenses means the overall NPV result is inherently sensitive to the accuracy of this central estimate. Therefore, even if its assigned uncertainty range in the simulation was relatively narrow, leading to a low correlation coefficient, the baseline calculation remains heavily influenced by this potentially substantial cost component, warranting careful validation.

Understanding these drivers is essential for interpreting the results and formulating targeted recommendations. The analysis points towards employment outcomes and early-year cost structures as the most critical areas influencing the success or failure of the policy package from a quantitative economic perspective, alongside the significant impact of the assumed administrative cost level.

5. Implications

The probabilistic analysis, revealing a likely negative economic return and highlighting key sensitivities, carries specific implications beyond those derived from the deterministic assessment alone.

5.1. Policy Implications (Risk-Informed)

- **Acknowledge and Manage Risk:** Policymakers must explicitly acknowledge the high probability (approx. 79.4%).

- **Focus on High-Leverage Factors:** Given the extreme sensitivity to employment benefits, policy design and implementation should prioritize maximizing the creation of high-value, sustainable jobs. This could involve:
 - Performance-based incentives tied directly to quality job creation.
 - Targeted support for sectors known to have higher job multipliers or wage premiums.
 - Stronger integration with skills development programs to ensure startups can find and retain qualified talent.
- **Re-evaluate Cost Structures Impacting Viability:** The significant negative impact of early-year import costs suggests a need to review customs exemptions. Could incentives be designed to encourage local sourcing? Are the exemptions overly broad? Balancing access to essential equipment with fiscal prudence and local industry development is key. Similarly, the underlying drivers of high administrative cost estimates need verification and potential reform.
- **Revise customs exemptions to incentivize local sourcing** (e.g., tiered exemptions based on domestic procurement ratios), mirroring OECD recommendations for reducing import leakage (International Monetary Fund (2004), International Monetary Fund (2024)).
- **Adaptive Management Based on Uncertainty:** The wide range of potential outcomes suggests a need for flexibility. Policies should be designed with mechanisms for ongoing monitoring (addressing data gaps identified) and adaptation based on observed performance against key drivers (especially employment and survival rates). If early indicators suggest outcomes are tracking towards the lower end of the distribution, adjustments should be considered proactively. Policymakers should treat subsidies as high-risk investments, prioritizing startups with validated job-creation potential and scaling back support for underperformers.
- **Strategic Portfolio Approach:** Rather than uniform support, consider a portfolio approach, potentially allocating more resources to initiatives or startup segments demonstrating higher potential for positive NPV contributions (e.g., high job creation potential, lower import needs, faster path to profitability) while potentially scaling back less-effective components.

5.2. Practical Implications (Under Uncertainty)

- **For Startups:** The uncertainty highlights the importance of building robust business models that are not solely reliant on continued subsidies or exemptions. Demonstrating strong job creation potential and efficient resource use (including minimizing unnecessary imports) may become increasingly important for accessing support. The *SME Policy Index* (2020) advocates for competition-friendly reforms and enhanced access to dispute resolution mechanisms—measures critical for Algeria to mitigate import dependency and foster high-value startups (OECD & EBRD, 2020).
- **For Funding Agencies (ASF, etc.):** The analysis underscores the risk in their portfolios. They may need to adopt more rigorous selection criteria focusing on startups with clearer paths to generating the benefits (jobs, revenue) that drive positive economic returns, alongside potential financial returns. Monitoring portfolio contributions to these broader economic goals will be vital.
- **For Private Investors:** The quantified risk profile (high chance of negative overall economic return) may reinforce caution among private investors, who might demand stronger validation of business models and clearer paths to profitability before co-investing or entering the market.

5.2.1. Theoretical Implications (from Uncertainty)

- **CBA Under Deep Uncertainty:** This case study exemplifies the challenges of applying traditional CBA in contexts of deep uncertainty, characteristic of innovation policy and nascent ecosystems. It reinforces the necessity of probabilistic methods (MCS) not just as a refinement but as a core component for realistic evaluation, highlighting the potential inadequacy of single-point deterministic forecasts.
- **Sensitivity of Ecosystem Interventions:** The results demonstrate how the success of complex ecosystem interventions can be highly sensitive to a few key parameters (like job creation value in this model). This suggests that theoretical models of ecosystem development need to better incorporate parameter uncertainty and potential tipping points or threshold effects.

- **Measuring Policy Impact Beyond Finance:** The dominance of non-financial benefits (like employment value) in driving potential success, even as financial metrics (NPV) remain negative, highlights the tension in evaluating policies with multiple, sometimes conflicting, objectives (economic efficiency vs. job creation vs. strategic diversification). It raises theoretical questions about how best to weigh these different dimensions in policy appraisal.

5.3. Limitations and Robustness Considerations

While the Monte Carlo Simulation (MCS) improves the evaluation of Algeria's startup policies by incorporating uncertainty, the analysis is limited by its modeling approach and assumptions. This must be considered when interpreting the results and guiding future research.

A primary limitation arises from the model assumptions. The simulation treats uncertain input parameters—such as startup survival rates, job creation figures, and import costs—as statistically independent. This simplification is necessary given the scarcity of data regarding complex interdependencies; however, it may not reflect reality where correlations exist. For example, more successful startups might demonstrate higher survival rates while generating more jobs over time, or firms relying heavily on imports may face financial pressures influencing their longevity and tax contributions (Vose, 2008). Ignoring these correlations may underestimate tail risks or overestimate the likelihood of extremely favorable outcomes when positive factors are assumed to occur independently.

Additionally, the analysis uses a fixed time horizon ending in 2030, which omits potential long-term economic impacts—both positive (e.g., sustained tax revenue and employment from surviving firms, innovation spillovers) and negative (e.g., delayed market failures). Standard cost-benefit analyses often include a 'terminal value' to account for enduring effects; the absence of one here might undervalue the policy's net present value if long-term benefits are significant (Jenkins et al. (2019), Boardman et al. (2017)). The model also employs proxies to estimate key benefit parameters due to difficulties in directly measuring economic values. For example, patent value is proxied using associated R&D costs, thus neglecting factors like market potential, strategic importance, and commercialization success (Fini et al., 2018). Proxy assumptions like patent values based on R&D costs may systematically underestimate market-driven innovations. Recent bias mitigation frameworks suggest using unsupervised clustering to identify latent demographic

biases in proxy selection (Chaudhari et al., 2023). Similarly, estimating the economic premium per job using simple wage differentials may overlook heterogeneity in job quality and productivity across sectors and startup types. These necessary proxies could introduce bias or inaccuracies in benefit estimations.

Furthermore, the sensitivity analysis using Spearman rank correlation captures the impact of individual parameter variations assuming monotonic relationships; however, it does not fully quantify complex parameter interactions. The method overlooks synergistic or offsetting effects between variables—such as high job creation paired with low survival rates or the effects of rising import costs combined with startup failures. The analysis assumes largely linear relationships between inputs and outputs within the sampled ranges, potentially missing nonlinear dynamics, thresholds, or tipping points (e.g., a critical mass of failures triggering an ecosystem decline).

Future evaluations would benefit from incorporating correlation structures via methods like copulas or expert elicitation (Salci & Jenkins, 2016), extending the analytical time horizon with a terminal value, gathering primary empirical data, and using global sensitivity methods (e.g., Sobol indices) to better assess parameter interactions and non-monotonic effects (Saltelli et al., 2008).

5.4. Future Research Directions

The Monte Carlo Simulation not only provides a risk assessment but also clearly identifies the parameters whose uncertainty most significantly impacts the evaluation outcome. Future research should prioritize reducing these key uncertainties:

- **Quantifying Employment Benefits Robustly:**
 - Conduct detailed longitudinal studies tracking actual job creation (quantity, type, duration) and wage levels within labeled Algerian startups across different sectors and stages.
 - Develop more sophisticated methods for estimating the economic premium or value-added per job, potentially using micro-econometric techniques or comparisons with control groups, moving beyond the simple premium assumption used here.

- **Validating Survival and Growth Dynamics:**

- Empirically track cohort survival rates (S_k) specifically for labeled Algerian startups to replace benchmark-based assumptions.
- Analyze factors influencing survival and growth to refine projections for new entrants (N_y) and the evolution of the active startup pool (A_t).

- **Investigating Cost Drivers:**

- Conduct detailed studies on the actual import behavior of startups during their exemption period to refine parameters for foregone customs revenue.
- Perform rigorous analysis of administrative costs, potentially using activity-based costing, to validate or revise the budget allocation assumptions that heavily influenced the deterministic baseline.
- Gather specific data on FGAR guarantee performance (defaults, recoveries) for startup loans.

- **Refining Benefit Valuation Proxies:**

- Develop better methods for valuing innovation outputs beyond simple patent counts or R&D cost proxies, potentially using market-based approaches or case studies if feasible.
- Improve the estimation of Value Added per mature startup using actual firm-level data.

- **Exploring Model Structure Sensitivity:**

- Test the sensitivity of the results to the CBA model structure itself, for example, by incorporating a terminal value or exploring alternative counterfactual methodologies (e.g., full SCM if data allows).
- Investigate the impact of potential correlations between uncertain input parameters (e.g., are higher survival rates correlated with higher job creation?).

Addressing these research areas, directly informed by the uncertainties revealed through the MCS, will significantly improve the reliability and usefulness of future economic evaluations of Algeria's startup policies.

Conclusion

This study employed Monte Carlo Simulation (MCS) to rigorously assess the economic viability of Algeria's post-2020 startup support policies under uncertainty. By simulating 10,000 possible scenarios based on probability distributions for key uncertain parameters, the analysis provides a more realistic perspective on the likely range of outcomes and associated risks over the 2020-2030 period.

The probabilistic analysis strongly suggests that the policy package, as currently modeled, faces a high probability (approximately 80%) of yielding a negative Net Present Value (NPV), with a mean NPV of -7.1 billion DZD and a median of -8.0 billion DZD. While positive economic outcomes are possible (occurring in about 20.7% of simulations), they represent the less likely scenarios within the wide range of uncertainty observed. The Benefit-Cost Ratio (BCR) analysis corroborates this, with a mean of 0.86, indicating that discounted benefits are, on average, expected to fall short of discounted costs.

Sensitivity analysis revealed that the economic outcome is overwhelmingly sensitive to assumptions regarding the quantity and value of direct employment generated by startups. Achieving substantial, high-value job creation is paramount for the policy's potential success as modeled. Costs associated with foregone customs revenue from early-stage imports were identified as the most significant cost-side driver of uncertainty.

The MCS provides crucial quantification of the risk profile and highlights the specific uncertainties that matter most. It shifts the evaluation from a single point estimate to a probabilistic assessment, offering policymakers a clearer understanding of the potential downsides and the limited likelihood of positive returns under the current framework and assumptions.

While acknowledging the inherent limitations of any modeling exercise, particularly with nascent ecosystems and data constraints, the consistent findings from the probabilistic analysis underscore the need for a critical review of the cost-effectiveness of Algeria's startup support policies. Efforts should likely focus on maximizing the generation of high-quality employment, managing costs associated with import dependence, and potentially refining administrative structures. Continuous, data-driven monitoring and evaluation are essential to adapt policies and improve the chances of realizing the strategic goal of fostering a vibrant, economically impactful

startup ecosystem that contributes meaningfully to Algeria's diversification objectives. The value of probabilistic analysis in providing a realistic assessment of risk and guiding such policy refinements is clearly demonstrated.

References

- Alkasm, A. J., El Hamamsy, O., Khoury, L., & Syed, A. R. (2018). *Entrepreneurship in the Middle East and North Africa: How investors can support and enable growth*. McKinsey & Company. <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/entrepreneurship-in-the-middle-east-and-north-africa>
- Angelini, F., & Kristl, M. (2013). *Monte Carlo simulation of Cost-Benefit Analysis results*. JASPERS (Joint Assistance to Support Projects in European Regions).
- Beghoura, H. (2024). Algeria - Digital Economy. <https://www.trade.gov/country-commercial-guides/algeria-digital-economy>
- Belli, P., Anderson, J. R., Barnum, H. N., Dixon, J. A., & Tan, J. P. (2001). *Economic Analysis of Investment Operations: Analytical Tools and Practical Applications*. World Bank Institute.
- Boardman, A. E., Greenberg, D. H., Vining, A. R., & Weimer, D. L. (2017). *Cost-Benefit Analysis: Concepts and Practice*. Cambridge University Press.
- Boudendouna, M. A., & Louadj, M. (2024). Start-ups after the Algerian Finance Law 2020. *Legal and Political Research*, 9(1), 971-990. <https://asjp.cerist.dz/en/article/251482>
- Brandimarte, P. (2014). *Handbook in Monte Carlo Simulation: Applications in Financial Engineering, Risk Management, and Economics*. Wiley.
- Briggs, A. H., & Sculpher, M. J. (1995). *Handling Uncertainty in the Results of Economic Evaluation*, *OHE Briefing*, no 32. https://www.ohe.org/wp-content/uploads/2014/07/213-1995_Handling_Uncertainty_Briggs.pdf
- Chaudhari, B., Pandey, A., Bhatt, D., & Tiwari, D. (2023). Practical Bias Mitigation through Proxy Sensitive Attribute Label Generation. *arXiv*. <https://doi.org/10.48550/arXiv.2312.15994v1>
- Cravo, T., & Piza, C. (2016). *The Impact of Business Support Services for Small and Medium Enterprises on Firm Performance in Low- and Middle- Income Countries: A Meta-Analysis*. <https://doi.org/10.18235/0011748>
- Davidsson, P., Recker, J., & von Briel, F. (2025). External enablement of entrepreneurial actions and outcomes: Extension, review and research agenda. *Foundations and Trends in Entrepreneurship*, 21(3), 172-343. <https://doi.org/10.1561/0300000117>

- enpact, D. L. (2019). *Startup Ecosystem Report: Tunisia*. enpact e.V. <https://www.enpact.org/wp-content/uploads/2019/08/sousse-giz.pdf>
- Fini, R., Rasmussen, E., Siegel, D., & Wiklund, J. (2018). Rethinking the commercialization of public science. *Academy of Management Perspectives*, 32(1), 4-20. <https://doi.org/10.5465/amp.2016.0134>
- Hamza, Z., Almi, H., & Boucenna, W. (2024). Startup Development in Algeria: Navigating Challenges and Seizing Opportunities. *Journal of Economic Integration*, 12(4), 240-259. <https://asjp.cerist.dz/en/article/263733>
- HM_Treasury. (2022). *The Green Book: Central Government Guidance on Appraisal and Evaluation*. <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>
- International Monetary Fund. (2004). *Algeria: Financial System Stability Assessment, including Reports on the Observance of Standards and Codes on the following topics: Monetary and Financial Policy Transparency and Banking Supervision*. <https://doi.org/10.5089/9781451811445.002>
- International Monetary Fund. (2024). *Algeria: 2023 Article IV Consultation-Press Release; Staff Report; and Statement by the Executive Director for Algeria*. <https://doi.org/10.5089/9798400271878.002>
- Jafari, M. (2024). Uncertainty and entrepreneurship in oil-rich developing countries: Does institution matter? *Resources Policy*, 99, 1-14. <https://doi.org/10.1016/j.resourpol.2024.105385>
- Jenkins, G. P., Kuo, C. Y., & Harberger, A. C. (2019). *Cost-Benefit Analysis for Investment Decisions*. Cambridge Resources International. <https://cri-world.com/publications/>
- Kaufmann, D., & Kraay, A. (2024). *The Worldwide Governance Indicators: Methodology and 2024 Update*. World Bank. <https://doi.org/10.1596/1813-9450-10952>
- Kerr, W. R., Lerner, J., & Schoar, A. (2014). The consequences of entrepreneurial finance: Evidence from angel financings. *The Review of Financial Studies*, 27(1), 20-55. <https://doi.org/10.1093/rfs/hhr098>
- Lerner, J. (2009). *The Boulevard of Broken Dreams: Why Public Efforts to Boost Entrepreneurship and Venture Capital Have Failed--and What to Do About It*. Princeton University Press.
- Linton, D. (2024). The Uncertainty Problem in Cost-Benefit Analysis Expanded: A Current Review. *Journal of Economic Impact*, 6(1), 21-26. <https://doi.org/10.52223/econimpact.2024.6103>
- Lukonga, I., Ben Naceur, S., Hadjian, G., & Al-Hassan, A. (2014). *Annex III. Access to Finance for Small and Medium-Sized Enterprises in the MENAP and CCA Regions*.

- https://www.imf.org/-/media/Websites/IMF/imported-flagship-issues/external/pubs/ft/reo/2014/mcd/eng/pdf/_a3pdf.ashx
- Maravas, A., Pantouvakis, J. P., & Lambropoulos, S. (2012). Modeling Uncertainty During Cost Benefit Analysis of Transportation Projects with the Aid of Fuzzy Set Theory. *Procedia - Social and Behavioral Sciences*, 48, 3661-3670. <https://doi.org/10.1016/j.sbspro.2012.06.1328>
- Mason, C., & Brown, R. (2013). Creating good public policy to support high-growth firms. *Small Business Economics*, 40(2), 211-225. <https://doi.org/10.1007/s11187-011-9369-9>
- OECD. (2022). *SME Policy Index: Western Balkans and Turkey 2022: Assessing the Implementation of the Small Business Act for Europe*. <https://doi.org/10.1787/b47d15f0-en>
- OECD. (2025). *OECD Financing SMEs and Entrepreneurs Scoreboard: 2025 Highlights*. <https://doi.org/10.1787/64c9063c-en>
- OECD, & EBRD. (2020). *SME Policy Index: Eastern Partner Countries 2020: Assessing the Implementation of the Small Business Act for Europe*. <https://doi.org/10.1787/8b45614b-en>
- OECD, & EBRD. (2023). *SME Policy Index: Eastern Partner Countries 2024: Building Resilience in Challenging Times*. <https://doi.org/10.1787/3197420e-en>
- OECD, EU, & ETF. (2018). *The Mediterranean Middle East and North Africa 2018: Interim Assessment of Key SME Reforms*. <https://doi.org/10.1787/9789264304161-en>
- OECD, ILO, & UNDP. (2024). *Informality and Structural Transformation in Egypt, Iraq and Jordan: A Framework for Assessing Policy Responses in the MENA Region*. <https://doi.org/10.1787/efb16d0b-en>
- Salci, S., & Jenkins, G. P. (2016). Incorporating Risk and Uncertainty in Cost-Benefit Analysis. <https://doi.org/10.2139/ssrn.2845560>
- Saltelli, A., Ratto, M., Andres, T., Campolongo, F., Cariboni, J., Gatelli, D., & Tarantola, S. (2008). *Global Sensitivity Analysis: The Primer*. Wiley.
- Savvides, S. C. (1994). Risk Analysis in Investment Appraisal. *Project Appraisal*, 9(1), 3-18. <https://doi.org/10.1080/02688867.1994.9726936>
- Senova, A., Tobisova, A., & Rozenberg, R. (2023). New Approaches to Project Risk Assessment Utilizing the Monte Carlo Method. *Sustainability*, 15(2), 1-19. <https://doi.org/10.3390/su15021006>
- Shane, S. (2009). Why encouraging more people to become entrepreneurs is bad public policy. *Small Business Economics*, 32(2), 141-149. <https://doi.org/10.1007/s11187-009-9215-5>

- Staehr, K. (2006). *Risk and uncertainty in cost benefit analysis*.
[https://haldus.taltech.ee/sites/default/files/2021-04/2006_Staehr -
 _Risk_and_uncertainty_in_cost_benefit_analysis.pdf](https://haldus.taltech.ee/sites/default/files/2021-04/2006_Staehr_-_Risk_and_uncertainty_in_cost_benefit_analysis.pdf)
- Vose, D. (2008). *Risk Analysis: A Quantitative Guide*. Wiley.
- Wangsness, P. B., Rødseth, K. L., & Minken, H. (2015). *Handling and presenting uncertainty in cost-benefit analysis*. <https://www.toi.no/getfile.php/1341511-1448451711/Publikasjoner/T%C3%98I%20rapporter/2015/1443-2015/1443-2015-sum.pdf>
- World_Bank. (2004). *Financial Sector Assessment: Algeria*.
<https://openknowledge.worldbank.org/bitstreams/305d0670-964b-5a28-ae6d-dc3eed574b81/download>

Endnotes :

- ¹ Décret exécutif n° 20-254 du 15 septembre 2020 portant création du comité national de labellisation des « Start-up », « Projet innovant » et « Incubateur ».
- ² Loi n° 19-14 du 11 décembre 2019 portant loi de finances pour 2020 ; Loi n° 20-07 du 4 juin 2020 portant loi de finances complémentaire pour 2020.
- ³ Loi n° 21-06 du 8 juin 2021 portant loi de finances complémentaire pour 2021.
- ⁴ Loi n° 23-22 du 24 décembre 2023 portant loi de finances pour 2024 ; Loi n° 24-08 du 29 février 2024 modifiant et complétant la loi n° 23-22 du 24 décembre 2023 portant loi de finances pour 2024.
- ⁵ Loi n° 20-16 du 31 décembre 2020 portant loi de finances pour 2021 ; Loi n° 21-06 du 8 juin 2021 portant loi de finances complémentaire pour 2021.