International Journal of Economics, Business and Social Science Research

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

ALAALI WACC (A-WACC): A TAILORED APPROACH TO COST OF CAPITAL ESTIMATION IN CAPITAL-INTENSIVE INDUSTRIES

HASAN MOHAMED HUSAIN ALAALI, AIA, CPA, IPA - Fellow Member
Affiliation: DFAS Research Center, ORCID: 0009-0007-2489-9435

https://doi.org/10.37602/IJEBSSR.2026.4501

ABSTRACT

Introduction: The weighted average cost of capital is widely used in corporate valuation, capital budgeting, and financing decisions, yet its practical reliability depends on whether the underlying equity and debt cost estimates adequately reflect changing risk conditions. This issue is particularly relevant in capital-intensive industries, where substantial financing requirements, leverage exposure, earnings volatility, and sensitivity to sector and macroeconomic conditions can materially alter the firm's financing environment.

Methods: This study develops Alaali WACC (A-WACC) as a theoretical extension of conventional WACC tailored to cost-of-capital estimation in capital-intensive industries. The model preserves the traditional debt-equity weighting structure while introducing explicit adjustments to the cost of equity and cost of debt. Equity adjustments incorporate earnings volatility, leverage-related risk, and firm-specific risk, while debt adjustments incorporate credit risk, sector-specific borrowing conditions, and macroeconomic or systemic risk. The model specifies the adjustment architecture, parameter relationships, assumptions, and comparative-static expectations.

Results: The theoretical formulation predicts that increases in firm-specific, leverage-related, credit, sector, or systemic risk raise the relevant financing-cost components and, consequently, A-WACC, while improvements in those conditions reduce the corresponding adjustments. The model therefore produces a condition-dependent cost of capital in which identifiable changes in risk states are transmitted through distinct equity and debt financing channels.

Discussion: A-WACC contributes an integrated and transparent risk-recalibration architecture for cost-of-capital estimation, with particular relevance to capital-intensive firms exposed to changing financing and risk conditions. The model remains theoretical and requires firm-level calibration, sector and cross-country testing, sensitivity analysis, and direct comparison with conventional WACC before any claim of empirical superiority or predictive improvement can be established.

Keywords: Alaali WACC; A-WACC; weighted average cost of capital; capital-intensive industries; cost of equity; cost of debt; firm-specific risk; systemic risk; dynamic cost of capital.

1.0 INTRODUCTION

The weighted average cost of capital (WACC) is a central component of corporate financial decision-making. It is widely used as a discount rate in firm and project valuation, as a benchmark for capital-budgeting decisions, and as a measure of the financing cost associated

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

with a firm's combination of debt and equity. The theoretical foundations of the relationship between financing structure and the cost of capital originate with Modigliani and Miller (1958), who demonstrated capital-structure irrelevance under restrictive perfect-market assumptions. Once corporate taxation is introduced, however, debt financing can generate tax advantages that affect firm value and financing decisions (Modigliani & Miller, 1963).

Consequently, estimating the cost of capital is closely connected to assumptions about leverage, taxation, risk, and the composition of corporate financing.

These considerations are particularly important in capital-intensive industries, where firms typically require substantial and recurring investment in long-lived productive assets and may depend heavily on external financing. Large financing requirements can increase the importance of leverage, borrowing costs, refinancing conditions, and changes in credit-market accessibility. At the same time, cyclical demand, commodity-price movements, operating leverage, and substantial fixed-cost structures can materially change earnings and financial risk. Cost-of-capital estimation in such environments therefore depends not merely on selecting an appropriate WACC formula, but on whether the underlying financing-cost estimates remain representative as the firm's risk conditions change.

In practical applications, WACC depends critically on the estimation of the cost of equity and cost of debt. These inputs are not necessarily stable. Fama and French (1997) demonstrate substantial uncertainty in estimating industry costs of equity, indicating that expected-return estimates can contain considerable imprecision. Such uncertainty becomes particularly important when WACC is applied to firms characterized by high capital requirements, volatile earnings, substantial leverage, or changing financing conditions. A cost-of-capital estimate based on inputs that inadequately respond to changes in the firm's risk environment may therefore become less representative of the financing conditions actually confronting the firm.

The problem extends beyond cost-of-equity estimation. Corporate leverage itself can influence financing costs, while the appropriate leverage position may change as firm-specific and external conditions evolve. The Alaali Optimal Leverage Model (ALOM) conceptualizes optimal leverage as condition-dependent rather than permanently fixed, with the appropriate leverage position responding to changes in financial benefits, volatility, default exposure, liquidity pressure, and systemic risk (Alaali, 2025b). This creates an important connection between leverage optimization and cost-of-capital estimation: if the firm's leverage and risk configuration changes dynamically, the financing costs associated with that configuration should also be capable of recalibration.

Empirical research further demonstrates that the relationship between leverage and the cost of capital is more complex than a mechanically fixed WACC calculation may imply. Frank and Shen (2016) show that the relationship between the cost of capital and capital structure depends materially on how the cost of equity is estimated. Jagannathan et al. (2016) likewise document substantial variation in how firms estimate and apply the cost of capital in practice. These findings highlight an important distinction between the WACC formula itself and the estimation of its underlying inputs. The conventional WACC identity remains theoretically useful; the challenge addressed in this study concerns whether its equity and debt cost

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

components adequately reflect changing firm-specific, industry-specific, leverage-related, and macro-financial risk conditions.

This study develops Alaali WACC (A-WACC) as a risk-adjusted extension of the conventional WACC structure, with particular application to capital-intensive industries. A-WACC retains the fundamental debt-equity weighting logic of WACC while introducing explicit adjustments to the cost of equity and cost of debt. The adjusted cost of equity incorporates earnings volatility, leverage-related exposure, and firm-specific risk, while the adjusted cost of debt incorporates credit risk, sector-specific borrowing conditions, and macroeconomic or systemic risk. Rather than applying a general risk premium directly to the final discount rate, A-WACC separates these effects into identifiable equity and debt transmission channels. The objective is not to replace established cost-of-capital theory, but to provide a structured mechanism through which conventional WACC inputs can be recalibrated when economically relevant risk conditions change.

The principal contribution of A-WACC is therefore not the proposition that risk affects the cost of capital, which is already established in corporate finance. Its contribution is the development of an explicit risk-state attribution and transmission architecture within the conventional WACC structure. The model identifies which risk condition changes, specifies whether that condition operates through the equity or debt financing channel, and allows its effect on the aggregate cost of capital to be separately estimated and tested. Under neutral risk conditions, the adjustments disappear and A-WACC converges to conventional WACC, thereby preserving conventional WACC as the model's benchmark rather than treating it as a competing framework. Its particular relevance to capital-intensive industries arises from the combination of substantial financing requirements and exposure to multiple, potentially changing sources of financial risk.

The remainder of the paper reviews the theoretical literature and identifies the specific architectural and operational gap addressed by A-WACC, establishes the rationale and theoretical foundations of the model, develops its adjusted equity and debt components and integrated specification, examines its implications for capital-intensive firms, and establishes the validation and sensitivity requirements necessary for future empirical testing.

2.0 LITERATURE REVIEW AND THEORETICAL GAP

The theoretical foundation of WACC is closely connected to the development of modern capital structure theory. Modigliani and Miller (1958) established that, under perfect capital-market assumptions, firm value is independent of capital structure. Their framework provided a benchmark against which the consequences of real-world market imperfections could subsequently be examined. Modigliani and Miller (1963) incorporated corporate taxation and demonstrated that the tax deductibility of interest creates a financing benefit from debt. This modification established a direct theoretical connection between leverage, taxation, firm value, and the cost of capital.

Subsequent research demonstrated that the tax benefits associated with debt cannot be considered independently of other financing effects. DeAngelo and Masulis (1980) show that non-debt tax shields can affect optimal leverage and reduce the universality of simple debt-tax predictions. Miles and Ezzell (1980) further demonstrate that valuation and the appropriate cost

ISSN 3048-8125

of capital depend on assumptions concerning financing policy and leverage. These contributions indicate that WACC is not simply an arithmetic combination of debt and equity costs; its interpretation depends on the financing policy and economic assumptions underlying those components.

These issues become particularly important in capital-intensive industries, where firms typically commit substantial resources to long-lived assets and may depend heavily on debt and external equity financing. High fixed-capital requirements can increase exposure to refinancing conditions, interest-rate movements, credit availability, and changes in leverage. At the same time, sector cyclicality, operating leverage, commodity or input-price movements, and large fixed-cost structures can generate substantial variation in earnings and financial risk. Cost-of-capital estimation in such industries therefore requires particular attention to whether the underlying financing-cost inputs remain representative as firm and external conditions change.

The cost of equity introduces an important source of estimation uncertainty. Fama and French (1997) examine industry costs of equity and find substantial imprecision in their estimation. This is particularly relevant to WACC because relatively small changes in estimated required equity returns can materially affect the resulting discount rate and valuation. Industry differences also imply that firms cannot necessarily be evaluated adequately through generalized equity-risk assumptions. Risk exposure, operating characteristics, asset structures, and financing requirements vary across sectors, creating a theoretical basis for industry-sensitive cost-of-capital estimation and particular relevance for capital-intensive firms.

The debt component presents a related problem. Structural corporate finance models demonstrate that borrowing costs and debt capacity are connected to default exposure and financing structure. Leland (1994) integrates corporate debt, tax advantages, default risk, and optimal capital structure, showing that the benefits of debt must be evaluated against endogenous financial-distress considerations. As leverage, credit quality, and default exposure change, the economic cost associated with debt can also change. This relationship is especially important for firms requiring substantial debt financing to support large capital investments. The debt-cost component therefore represents a state-sensitive financing input rather than an economic quantity that should necessarily remain unchanged across materially different risk environments.

Capital structure is also dynamic rather than isolated from the firm's external environment. Korajczyk and Levy (2003) demonstrate that macroeconomic conditions and financial constraints influence capital structure choices. Hackbarth, Miao, and Morellec (2006) extend this logic by showing theoretically that macroeconomic conditions affect credit risk and optimal capital structure. These findings are important for cost-of-capital estimation because changes in the macroeconomic state can simultaneously affect borrowing conditions, default exposure, investor required returns, and sustainable leverage. For capital-intensive firms, whose financing requirements may extend across long investment horizons, such changes can have particularly important implications for the cost and availability of capital.

The dynamic leverage issue is directly relevant to A-WACC. The Alaali Optimal Leverage Model (ALOM) treats optimal leverage as conditional on the evolving balance between financing benefits and financial risks rather than as a permanently fixed target (Alaali, 2025b). If leverage changes in response to volatility, default exposure, liquidity conditions, or systemic shocks, the financing-cost consequences of that leverage position may also change. Cost-of-capital estimation and leverage optimization are therefore analytically connected, although they remain distinct decision problems.

Systemic risk creates an additional transmission channel. The Alaali Systemic Risk Index (ASRI) represents systemic-risk conditions within the broader financial modelling architecture (Alaali, 2025a). Within A-WACC, ASRI has a narrower function: it provides a defined systemic-state input through which changes in economy-wide or market-wide risk can be transmitted into financing-cost recalibration. ASRI does not replace conventional market-risk measures; rather, it provides a separately identifiable systemic-risk channel whose financing-cost sensitivity can subsequently be estimated and tested.

The broader literature confirms that cost-of-capital estimation remains challenging. Graham and Leary (2011) identify persistent difficulties in explaining financing behaviour and reconciling theoretical predictions with observed corporate decisions. Frank and Shen (2016) demonstrate that conclusions concerning investment, leverage, and WACC depend materially on the method used to estimate the cost of equity. Jagannathan et al. (2016) further document substantial differences in corporate discount-rate practices, including the use of discount rates exceeding theoretically estimated costs of capital. Collectively, these findings emphasize that the critical issue is not merely the weighted-average identity itself, but the estimation and responsiveness of the financing-cost inputs entering it.

Existing research therefore already addresses the individual theoretical mechanisms relevant to A-WACC. Tax effects, leverage, default risk, industry variation, cost-of-equity estimation uncertainty, macroeconomic conditions, and dynamic financing behaviour are established research areas. Accordingly, the theoretical gap addressed here is not the absence of risk-sensitive cost-of-capital theory, nor is it the absence of individual adjustments for risk.

The more precise gap is architectural and operational: these established mechanisms do not by themselves provide a unified recalibration structure in which identifiable changes in firm-specific risk, earnings volatility, leverage exposure, credit quality, sector financing conditions, and systemic or macroeconomic risk are mapped separately into the equity and debt components of WACC and then recombined within a common cost-of-capital architecture. This limitation is particularly relevant to capital-intensive firms because multiple financing and operating risk channels can change simultaneously while large investment commitments make valuation and financing decisions highly sensitive to the estimated cost of capital. The distinction matters because simply adding existing risk factors to WACC would constitute aggregation rather than a substantive model contribution.

A-WACC addresses this gap through a dual-channel conditional recalibration architecture tailored to the financing characteristics of capital-intensive industries. Rather than applying an undifferentiated risk premium to the final WACC, the model separates risk transmission into an equity-cost channel and a debt-cost channel. The equity channel captures earnings-volatility, leverage-related, and firm-specific risk adjustments, whereas the debt channel captures credit-risk, sector-specific credit-spread, and macroeconomic or systemic-risk adjustments. Each channel operates through benchmark-relative risk deviations and explicit sensitivity parameters before the adjusted financing costs are recombined through the conventional capital-weighting structure

This architecture creates a capability analytically distinct from simply adding multiple risk factors to conventional WACC: risk-state attribution and transmission. A-WACC identifies which risk state has changed, specifies the financing channel through which the change operates, and traces its effect into the aggregate cost of capital. Because the individual transmission channels remain separately identifiable, the model also permits their direction, magnitude, statistical significance, stability, and incremental contribution to be independently tested. A-WACC is therefore decomposable, condition-dependent, and empirically falsifiable.

The model also establishes a clear boundary relationship with conventional WACC. When the identified risk variables remain at their defined benchmark states, no incremental adjustment is generated and A-WACC converges to conventional WACC. Conventional WACC therefore functions as the neutral-risk benchmark nested within the proposed architecture rather than as a competing model that A-WACC seeks to replace. The theoretical proposition is instead that material deviations from benchmark risk conditions may require identifiable recalibration of Ke, Kd, or both.

This distinction defines the model's theoretical novelty. A-WACC preserves the established debt-equity weighting identity but transforms the estimation architecture beneath that identity into a structured state-dependent system. Consequently, the model generates directly testable propositions: changes in specific risk states should produce identifiable changes in Ke_adj or Kd_adj through their assigned transmission channels; these effects should propagate predictably into A-WACC; and the resulting conditional cost-of-capital estimates should provide measurable incremental information relative to the conventional benchmark. Failure to observe these relationships would constitute evidence against the relevant propositions of the model.

Accordingly, the central research question is:

RQ: How can the conventional WACC architecture be extended to systematically and separately recalibrate the cost of equity and cost of debt for capital-intensive firms in response to changing firm-specific, leverage-related, industry-specific, credit, and systemic or macroeconomic risk conditions while preserving its established capital-weighting structure?

Answering this question provides the basis for the formal A-WACC architecture developed in the subsequent sections. The contribution is therefore not the already-established proposition that risk affects the cost of capital. It is the development of an explicit, decomposable, and testable mechanism for translating multiple changing risk states through distinct financing channels into a condition-dependent cost of capital, with particular application to the financing characteristics and risk exposures of capital-intensive industries.

3.0 RATIONALE FOR MODEL DEVELOPMENT

The rationale for A-WACC arises from a practical limitation in cost-of-capital estimation: a single WACC estimate may become less representative when the financial and risk conditions

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

underlying its components change materially. This limitation is particularly relevant in capital-intensive industries, where substantial fixed-asset investment, long investment horizons, large financing requirements, and potentially significant reliance on debt can amplify the consequences of changes in financing conditions. The conventional WACC structure remains theoretically valid as a weighted combination of equity and after-tax debt costs, but its usefulness depends on the quality and responsiveness of the inputs used to estimate those costs. If firm risk, leverage exposure, credit conditions, sector financing conditions, or the external environment changes while the underlying inputs remain insufficiently responsive, the resulting WACC may no longer adequately represent the firm's prevailing financing environment.

Cost-of-equity estimation provides one source of this problem. Fama and French (1997) demonstrate considerable uncertainty in industry cost-of-equity estimates, indicating that required-return estimation can vary substantially across industries and estimation approaches. Earnings volatility can further alter investors' assessment of firm risk. This issue can be especially consequential for capital-intensive firms exposed to cyclical demand, substantial operating leverage, commodity-price movements, or large fixed operating commitments. A firm experiencing increasingly unstable earnings may therefore face a materially different equity-risk environment even when its conventional estimation parameters have not yet adjusted sufficiently to reflect that deterioration.

Debt financing creates a parallel issue. Borrowing costs depend on firm credit quality, leverage, and prevailing credit-market conditions. Korajczyk and Levy (2003) show that financing decisions are related to macroeconomic conditions and financial constraints, while Hackbarth, Miao, and Morellec (2006) demonstrate that macroeconomic states can affect credit risk and optimal capital structure. These effects are particularly relevant to capital-intensive firms because large investment programmes may require substantial and recurring external financing. Consequently, equivalent nominal debt positions can have different financing-cost implications under expansionary, recessionary, or stressed conditions.

The relationship between leverage and financing costs makes explicit recalibration particularly important. ALOM treats optimal leverage as condition-dependent, allowing the appropriate leverage position to respond to volatility, default exposure, liquidity pressure, and systemic risk (Alaali, 2025b). A-WACC addresses the corresponding cost-of-capital problem: changes in leverage-related risk and the broader financial environment can alter the compensation required by equity investors and creditors. A-WACC and ALOM therefore address distinct but analytically connected dimensions of corporate financing: A-WACC estimates condition-dependent financing costs, whereas ALOM addresses condition-dependent leverage optimization.

Systemic conditions provide an additional motivation. ASRI supplies a structured representation of systemic-risk conditions that can serve as an explicit systemic-state input within A-WACC (Alaali, 2025a). Its function is not to replace conventional market-risk measures, but to provide a separately identifiable systemic-risk channel whose transmission into financing costs can be parameterized and empirically tested. For capital-intensive firms with long-duration investments and significant refinancing exposure, distinguishing systemic deterioration from firm-specific deterioration may be particularly important.

Practical evidence also indicates that corporate discount-rate estimation differs materially across firms and applications (Jagannathan et al., 2016). A-WACC therefore replaces undifferentiated discretionary adjustment with a risk-state attribution and transmission structure tailored to cost-of-capital estimation in capital-intensive industries. Rather than modifying the final WACC through a general premium, the model maps identifiable risk deviations into separate equity and debt channels before recombining the adjusted financing costs within the conventional WACC weighting architecture. This provides the rationale for a model that is simultaneously condition-dependent, decomposable, and empirically falsifiable.

4.0 THEORETICAL FOUNDATIONS

A-WACC retains the fundamental theoretical structure of WACC while introducing a state-dependent architecture beneath its financing-cost components. The starting point remains the proposition that the overall cost of capital reflects the required returns of debt and equity providers weighted by their respective contributions to firm financing. Modigliani and Miller (1958) established the benchmark relationship between capital structure, firm value, and the cost of capital under perfect-market assumptions. Their subsequent incorporation of corporate taxation demonstrated that interest deductibility creates a tax advantage to debt financing and therefore affects the economic relationship between leverage and firm value (Modigliani & Miller, 1963).

Financing policy is consequently relevant to the interpretation of WACC. Miles and Ezzell (1980) demonstrate that valuation and discount-rate treatment depend on assumptions concerning leverage policy. This consideration has particular importance in capital-intensive industries because substantial long-term investments can be financed through materially different combinations of debt and equity over the life of the assets. A-WACC preserves the conventional market-value debt and equity weights and the after-tax treatment of debt. Its theoretical departure occurs beneath this weighting identity: the costs assigned to equity and debt are treated as financing components capable of explicit recalibration when identifiable risk states deviate from defined benchmarks.

The cost of equity represents the return required by shareholders for bearing the risk associated with the firm's residual cash flows. Its estimation, however, is subject to considerable uncertainty. Fama and French (1997) document substantial imprecision in industry cost-of-equity estimates, highlighting the difficulty of representing required equity returns through a single stable estimate. This problem can become more significant where capital intensity is accompanied by earnings cyclicality, operating leverage, or substantial exposure to sector-specific conditions. A-WACC therefore begins with an established baseline cost of equity and introduces three conceptually distinct adjustment channels: earnings-volatility risk, leverage-related risk, and residual firm-specific risk. These channels do not replace established expected-return models. Instead, they provide an explicit mechanism for translating changes in defined equity-risk states into adjustments to the baseline estimate.

The cost of debt follows a parallel theoretical structure. Leland (1994) establishes the relationship among debt financing, tax benefits, default exposure, and optimal capital structure. As credit quality and default exposure change, creditors may require different compensation for bearing financial risk. For capital-intensive firms, this relationship is particularly

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

consequential because substantial debt requirements can increase exposure to refinancing costs, credit spreads, and deterioration in debt-servicing capacity. A-WACC consequently begins with a baseline borrowing cost and separates subsequent recalibration into firm credit risk, sector-specific credit conditions, and macroeconomic or systemic risk. This decomposition permits the source of a change in the adjusted debt cost to remain identifiable rather than being absorbed into an undifferentiated financing premium.

External conditions constitute an important transmission layer. Hackbarth, Miao, and Morellec (2006) demonstrate that macroeconomic conditions influence credit risk and optimal capital structure, providing a theoretical basis for allowing changes in the external financial state to affect financing costs. Capital-intensive firms may be particularly exposed to this transmission because financing commitments and investment horizons can extend across different macroeconomic and credit cycles. A-WACC incorporates this mechanism through an explicitly parameterized systemic-risk channel. ASRI can provide the standardized systemic-state input to this channel (Alaali, 2025a), while the magnitude of its transmission into financing costs remains an empirical parameter rather than a predetermined universal effect.

The leverage channel connects A-WACC with ALOM while preserving analytical separation between the models. ALOM conceptualizes optimal leverage as dynamically responsive to changes in financing benefits and risks (Alaali, 2025b). A-WACC does not mechanically use an ALOM-generated leverage target as its capital weight. Observed or externally specified capital structure instead provides the weighting basis, while leverage-related risk can affect the adjusted cost of equity. This prevents mechanical circularity between leverage optimization and cost-of-capital estimation. An iterative A-WACC–ALOM equilibrium can subsequently be investigated as a separate empirical extension.

The distinction between the WACC identity and the estimation architecture beneath it is fundamental. Frank and Shen (2016) demonstrate that conclusions concerning WACC and corporate investment can depend materially on the approach used to estimate the cost of equity, while Jagannathan et al. (2016) document substantial heterogeneity in firms' practical discount-rate choices. A-WACC addresses this estimation layer by specifying explicit risk-state transmission mechanisms rather than altering the fundamental economic meaning of WACC. This distinction is especially relevant to the model's stated application to capital-intensive industries: A-WACC does not assume that capital intensity itself mechanically increases the cost of capital; rather, capital intensity increases the practical importance of accurately identifying and transmitting the financing risks to which such firms are exposed.

The theoretical architecture therefore follows a benchmark–deviation–transmission–recombination sequence. Conventional market-based estimates establish baseline equity and debt costs. Relevant risk variables are measured as deviations from defined benchmark states. Separate sensitivity parameters transmit those deviations into the appropriate equity or debt financing component. The resulting adjusted financing costs are then recombined using conventional market-value capital weights and the corporate tax adjustment. Under neutral benchmark conditions, the incremental adjustments disappear and A-WACC converges to conventional WACC. This nesting property establishes conventional WACC as the baseline case within the A-WACC architecture and provides the theoretical foundation for applying the model to capital-intensive industries in the formal specification developed in the following section.

5.0 MODEL DEVELOPMENT

The Alaali WACC (A-WACC) operationalizes the theoretical architecture developed in the preceding sections by retaining conventional WACC as the benchmark while introducing a structured dual-channel mechanism for recalibrating equity and debt financing costs. The model is constructed through four sequential stages: establishing baseline financing costs, identifying deviations in relevant risk conditions from defined benchmarks, transmitting those deviations through estimable sensitivity parameters, and recombining the adjusted financing costs using conventional capital weights.

This structure enables A-WACC to identify not only whether the cost of capital changes, but also the source of the change, the financing channel through which it operates, and its resulting contribution to the aggregate cost of capital. This attribution function is particularly relevant in capital-intensive industries, where large financing requirements, leverage exposure, sector-specific borrowing conditions, and sensitivity to macroeconomic shifts can materially affect both equity and debt costs.

5.1 Conventional WACC Benchmark

The conventional benchmark is:

$$\mathbf{WACC = (E / V \times Ke) + (D / V \times Kd \times (1 - T))}$$

where:

- E = market value of equity;
- D = market value of debt;
- V = E + D;
- Ke = baseline cost of equity;
- Kd = baseline pre-tax cost of debt; and
- T = corporate tax rate.

A-WACC preserves this weighting and tax structure, consistent with the established relationship between debt financing and corporate taxation (Modigliani & Miller, 1963) and the importance of financing-policy assumptions in WACC-based valuation (Miles & Ezzell, 1980).

The general A-WACC equation is:

$$\mathbf{A\text{-}WACC = (E / V \times Ke\_adj) + (D / V \times Kd\_adj \times (1 - T))}$$

The distinction between conventional WACC and A-WACC therefore lies in the estimation architecture underlying the financing-cost components. A-WACC makes Ke and Kd explicitly responsive to identifiable changes in relevant risk conditions while preserving the established capital-weighting structure.

5.2 Adjusted Cost of Equity

The adjusted cost of equity begins with a baseline equity cost, Ke_base, estimated using an established asset-pricing approach. A-WACC introduces three explicit equity-risk adjustment channels:

Ke_adj = Ke_base + EVA + LRA + FSRA

where:

- **EVA** = earnings-volatility adjustment;
- **LRA** = leverage-risk adjustment; and
- **FSRA** = firm-specific risk adjustment.

Each adjustment represents an incremental risk premium expressed in percentage-point terms, allowing its contribution to Ke_adj to be separately estimated and tested.

The earnings-volatility adjustment is:

EVA = β_EV × EV

where EV represents normalized abnormal earnings volatility relative to an explicit benchmark and β_EV represents the sensitivity of required equity return to changes in that volatility. The benchmark may be based on the firm's historical volatility, relevant industry volatility, or another empirically justified reference. A neutral benchmark state produces EV= 0; deterioration produces a positive deviation, while improvement may produce a negative deviation where the empirical specification permits symmetric adjustments.

The expected relationship is:

EV increases → EVA increases → Ke_adj increases

This channel is particularly relevant in capital-intensive firms where high fixed operating commitments, cyclical demand, or commodity-price exposure can generate material changes in earnings stability.

The leverage-risk adjustment is:

LRA = β_L × LR

where LR represents leverage-related risk relative to a defined benchmark and β_L captures the sensitivity of equity financing costs to leverage-related risk. This channel recognizes that changes in financial leverage can alter the risk borne by residual claimants. ALOM provides the related dynamic leverage architecture, although A-WACC does not require an ALOM-generated leverage target in its baseline specification (Alaali, 2025b).

The firm-specific risk adjustment is:

FSRA = β_F × FSR

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

where FSR represents normalized firm-specific risk not adequately captured by the baseline equity-cost model, EV, or LR, and β_F represents its equity-cost sensitivity. The empirical construction of FSR must satisfy a non-duplication condition: risk already represented through EV or LR should not be reintroduced through FSR.

Combining the components gives:

Ke_adj = Ke_base + β_EV(EV) + β_L(LR) + β_F(FSR)

The β coefficients are not assumed to be universal constants. They are estimable transmission parameters whose magnitude may vary across firms, industries, markets, and periods. This treatment is particularly important given the substantial uncertainty associated with cost-of-equity estimation across industries (Fama & French, 1997).

5.3 Adjusted Cost of Debt

The debt channel follows the same architecture but incorporates risk conditions directly relevant to creditors:

Kd_adj = Kd_base + CRA + SCSA + MSRA

where:

- **Kd_base** = baseline pre-tax borrowing cost;
- **CRA** = credit-risk adjustment;
- **SCSA** = sector-specific credit-spread adjustment; and
- **MSRA** = macroeconomic/systemic-risk adjustment.

The credit-risk adjustment is:

CRA = γ_CR × CR

where CR measures firm credit-risk deviation from an explicit benchmark and γ_CR represents the sensitivity of borrowing costs to that deviation. The theoretical basis follows the relationship among debt value, default exposure, and financing structure established by Leland (1994).

The sector-specific credit-spread adjustment is:

SCSA = γ_SC × SC

where SC represents the difference between prevailing sector borrowing conditions and a reference credit-market condition, while γ_SC determines the transmission of that difference into the firm's borrowing cost. This component is particularly important for capital-intensive industries because large debt requirements can make firms more sensitive to sector-specific credit conditions, refinancing spreads, and changes in lender risk appetite.

The macroeconomic/systemic-risk adjustment is:

MSRA = γ_SYS × SYS

where SYS represents the standardized systemic-risk state and γ_SYS represents the sensitivity of the firm's borrowing cost to systemic conditions. The inclusion of this channel is consistent with the theoretical relationship between macroeconomic conditions, credit risk, and financing structure (Hackbarth, Miao, & Morellec, 2006).

Within A-WACC, systemic conditions may be operationalized using ASRI:

SYS = Standardized ASRI

Accordingly:

MSRA = γ_SYS × Standardized ASRI

ASRI therefore enters A-WACC through a defined transmission mechanism rather than being added directly to WACC as an arbitrary premium (Alaali, 2025a). Standardization is necessary because the raw level of a systemic-risk index does not itself represent a financing-cost percentage.

The complete debt-cost specification is:

Kd_adj = Kd_base + γ_CR(CR) + γ_SC(SC) + γ_SYS(Standardized ASRI)

5.4 Integrated A-WACC Specification

Substituting the adjusted equity and debt components produces:

A-WACC = (E / V)[Ke_base + β_EV(EV) + β_L(LR) + β_F(FSR)] + (D / V)[Kd_base + γ_CR(CR) + γ_SC(SC) + γ_SYS(Standardized ASRI)](1 − T)

This constitutes the core A-WACC specification.

The architecture creates two identifiable transmission channels:

Equity-risk states → Ke_adj → Equity contribution to A-WACC

Debt and systemic-risk states → Kd_adj → After-tax debt contribution to A-WACC

This separation is central to the model. An adjustment applied directly to the final discount rate cannot identify whether the change originated from earnings instability, leverage exposure, firm-specific equity risk, credit deterioration, sector borrowing conditions, or systemic stress. A-WACC preserves this information by transmitting each risk state through an explicitly defined financing channel.

For capital-intensive firms, this decomposition is especially useful because multiple risk channels can move simultaneously. A deterioration in sector borrowing conditions may raise Kd_adj even when firm-specific equity risk remains stable, while an earnings shock may affect

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

Ke_adj without necessarily producing an equivalent change in credit conditions. A-WACC preserves these distinctions instead of collapsing them into a single unexplained premium.

Systemic risk enters the debt channel in the baseline specification. Future empirical evidence may justify a separate systemic-equity coefficient if systemic conditions are shown to affect the cost of equity independently after controlling for the existing equity-risk channels.

5.5 Model Construction Logic, Assumptions, and Comparative Statics

A-WACC follows a benchmark–deviation–transmission–recombination logic.

First, Ke_base and Kd_base establish conventional financing-cost benchmarks. Second, each risk variable measures deviation from a defined reference state. Third, β and γ coefficients translate those deviations into financing-cost adjustments. Fourth, the resulting adjusted financing costs are recombined using conventional market-value capital weights.

This construction produces an important boundary condition:

If EV = LR = FSR = CR = SC = SYS = 0, then Ke_adj = Ke_base, Kd_adj = Kd_base, and A-WACC = conventional WACC.

Thus, conventional WACC is nested within A-WACC as the neutral-risk benchmark.

The model requires five principal assumptions. First, market-value capital weights are used where reliable values are available. Second, adjustment variables are measured relative to explicit benchmarks. Third, overlapping risk channels must be controlled to prevent double counting. Fourth, β and γ coefficients require empirical estimation and are not universal constants. Fifth, the magnitude and statistical significance of each transmission channel remain empirical questions rather than assumptions of the model.

The principal comparative-static predictions are:

Higher EV → Higher Ke_adj → Higher A-WACC

Higher LR → Higher Ke_adj → Higher A-WACC

Higher FSR → Higher Ke_adj → Higher A-WACC

Higher CR → Higher Kd_adj → Higher A-WACC

Higher SC → Higher Kd_adj → Higher A-WACC

Higher ASRI, when γ_SYS > 0 → Higher Kd_adj → Higher A-WACC

These directional propositions make the architecture empirically falsifiable. Persistent absence of the predicted transmission effects, opposite directional relationships, unstable coefficients, or failure to provide incremental explanatory value would weaken the corresponding A-WACC propositions.

Volume: 04, Issue: 05, September - October 2026
ISSN 3048-8125

5.6 A-WACC versus Conventional WACC

Dimension	Conventional WACC	A-WACC
Capital weighting	Debt and equity weights	Same
Tax treatment	After-tax debt cost	Same
Cost of equity	Conventional estimate	Baseline Ke plus explicit equity-risk adjustments
Cost of debt	Conventional borrowing cost	Baseline Kd plus explicit debt-risk adjustments
Firm-specific risk transmission	Depends on underlying estimation method	Explicitly parameterized
Sector credit conditions	May enter indirectly	Separate debt-cost channel
Systemic-risk state	May enter indirectly	Explicit standardized channel
Risk decomposition	Not inherent to WACC identity	Explicit and attributable
Neutral-state outcome	Conventional WACC	Collapses to conventional WACC
Relevance to capital-intensive industries	Depends on input specification	Explicit treatment of financing, leverage, sector, and systemic risk channels
Empirical requirement	Established estimation procedures	Additional calibration and validation required

The contribution is therefore not additional arithmetic complexity. It is risk-state attribution and transmission: A-WACC specifies where a changing risk condition enters the financing architecture, how it affects the relevant financing component, and how that effect reaches the aggregate cost of capital.

5.7 Relationship Between A-WACC and ALOM

A-WACC and ALOM address distinct but connected financial decisions. A-WACC estimates the condition-dependent cost of financing, whereas ALOM determines a condition-dependent leverage target (Alaali, 2025b). To avoid circularity, A-WACC uses observed or externally specified E/V and D/V weights in its baseline formulation and does not require ALOM to generate them.

A future integrated system could operate iteratively: an initial capital structure generates A-WACC; financing costs inform leverage optimization; the revised leverage position changes financing weights and potentially leverage-related risk; and recalculation continues until a predefined convergence criterion is satisfied. Such an A-WACC–ALOM equilibrium constitutes a future extension and is neither assumed nor validated in the present model.

5.8 Hypothetical Application

The directional behaviour of A-WACC can be illustrated through three hypothetical financial states relevant to capital-intensive firms:

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

Scenario	Earnings Volatility	Leverage Risk	Credit Risk	Sector Credit Conditions	Systemic Risk	Expected A-WACC Direction
Stable Conditions	Low	Low	Low	Favourable	Low	Lower
Moderate Stress	Moderate	Moderate	Moderate	Neutral	Moderate	Intermediate
Systemic Stress	High	High	High	Adverse	High	Higher

Under stable conditions, relatively small adjustments leave A-WACC close to conventional baseline WACC. Under moderate stress, deterioration across equity and debt risk channels increases the corresponding financing costs. Under systemic stress, simultaneous deterioration in earnings stability, leverage exposure, credit quality, sector financing conditions, and systemic risk produces the largest predicted increase.

These scenarios are illustrative and do not constitute empirical A-WACC estimates. Firm-specific outputs require empirical construction of EV, LR, FSR, CR, and SC; standardization of the systemic-risk measure; and estimation or calibration of the β and γ coefficients.

5.9 Validation and Sensitivity Protocol

A-WACC generates propositions that can be tested directly against conventional WACC. Empirical validation should proceed through several complementary stages.

Parameter validation should estimate β_EV, β_L, β_F, γ_CR, γ_SC, and γ_SYS and examine their expected signs, statistical significance, temporal stability, and heterogeneity across firms and sectors.

Construct validation should determine whether EV, LR, FSR, CR, SC, and SYS represent empirically distinguishable risk dimensions. Correlation, multicollinearity, and alternative-specification tests should be used to identify potential double counting among adjustment channels.

Sensitivity analysis should vary each risk input independently and jointly to determine whether A-WACC behaves consistently with its theoretical comparative statics and whether the resulting cost of capital becomes excessively sensitive to particular variables or parameters.

Benchmark validation should compare A-WACC directly with conventional WACC using identical firms, periods, capital weights, and baseline financing-cost assumptions. Predefined evaluation criteria may include valuation error, financing-cost forecasting, investment prediction, or other appropriate outcomes.

Stress validation should examine whether the incremental explanatory or predictive value of A-WACC differs between normal and stressed financial environments. This test is particularly relevant because the architecture is designed to respond to material deviations from baseline risk conditions.

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

For capital-intensive industries, validation should additionally examine whether the model performs differently across firms with varying capital intensity, debt reliance, asset duration, and sector cyclicality. This would test whether the model's stated sectoral relevance is empirically supported rather than assumed.

Finally, **out-of-sample predictive validation** should determine whether estimated A-WACC parameters retain explanatory or predictive value outside the calibration sample.

A-WACC therefore establishes a testable model architecture rather than evidence of empirical superiority. The model would receive substantive empirical support only if its proposed risk channels are distinguishable, their transmission parameters are identifiable and sufficiently stable, and the resulting A-WACC provides incremental explanatory, valuation, or predictive value relative to conventional WACC. Failure to satisfy these conditions would constitute evidence against the relevant propositions of the model rather than merely a need for mechanical recalibration.

6.0 MODEL IMPLICATIONS

A-WACC has implications for corporate valuation, capital budgeting, financing policy, and financial-risk monitoring because each of these decisions depends, directly or indirectly, on the estimated cost of capital. Graham and Harvey (2001) show that firms widely employ discounted cash flow techniques and cost-of-capital estimates in capital-budgeting decisions. A-WACC implies that the usefulness of such estimates depends not only on the conventional weighting structure but also on whether the underlying financing-cost inputs remain representative of prevailing risk conditions.

For corporate valuation, A-WACC introduces a condition-dependent discount-rate logic. Material changes in earnings volatility, leverage-related risk, firm-specific risk, credit quality, sector borrowing conditions, or systemic risk can be transmitted through their designated financing channels into Ke_adj or Kd_adj. The resulting change in A-WACC is therefore attributable to identifiable risk-state deviations rather than to an undifferentiated discretionary premium. This decomposition is particularly relevant where relatively small changes in the discount rate materially affect estimated firm or project value.

The same principle applies to capital budgeting. Frank and Shen (2016) demonstrate that the relationship between investment and WACC depends materially on how the cost of equity is estimated. A-WACC addresses this estimation layer by distinguishing baseline financing costs from explicit risk adjustments. Decision-makers can therefore observe whether a change in the estimated cost of capital originates from the equity channel, the debt channel, or simultaneous deterioration across both.

A-WACC also has implications for financing decisions. Graham and Leary (2011) emphasize that observed capital structures reflect interactions among firm characteristics, financing conditions, and adjustment behaviour. This creates a natural analytical connection with ALOM, which treats optimal leverage as condition-dependent (Alaali, 2025b). A-WACC estimates the condition-dependent financing cost, whereas ALOM addresses the condition-dependent leverage position. Future integration could therefore examine the feedback between financing

Volume: 04, Issue: 05, September - October 2026
ISSN 3048-8125

costs and leverage optimization without making the two models mechanically dependent in the present formulation.

Dynamic monitoring may be particularly relevant for capital-intensive and cyclical industries, where substantial financing requirements coexist with potentially rapid changes in earnings, credit spreads, leverage exposure, and external conditions. A-WACC provides a decomposable structure for monitoring how such changes propagate into the estimated cost of capital. ASRI can support this process by supplying the standardized systemic-state input to the systemic-risk transmission channel (Alaali, 2025a).

These implications remain theoretical until empirical calibration and validation are completed. Jagannathan et al. (2016) document substantial heterogeneity in corporate discount-rate practices, reinforcing the importance of distinguishing a structured theoretical adjustment mechanism from validated estimation superiority. A-WACC makes risk adjustments explicit, attributable, and testable, but it does not establish that they improve upon conventional WACC. Operational use therefore requires valid risk measures, estimated sensitivity coefficients, benchmark specification, double-counting controls, sensitivity analysis, and direct empirical comparison with conventional WACC.

7.0 CONCLUSION AND FUTURE RESEARCH

This paper develops Alaali WACC (A-WACC) as a condition-dependent extension of conventional WACC. The model preserves the established debt-equity weighting and tax structure while introducing explicit mechanisms for recalibrating the underlying costs of equity and debt in response to changing risk conditions.

The principal theoretical contribution of A-WACC is its dual-channel risk-state attribution and transmission architecture. Earnings volatility, leverage-related exposure, and firm-specific risk are transmitted through the equity-cost channel, while credit risk, sector-specific financing conditions, and systemic or macroeconomic risk are transmitted through the debt-cost channel. These adjusted financing costs are subsequently recombined within the conventional WACC structure. Under neutral benchmark conditions, the adjustments disappear and A-WACC converges to conventional WACC. A-WACC therefore nests rather than replaces the conventional model.

This architecture makes the source of cost-of-capital variation decomposable and empirically testable. The contribution is not the established proposition that financial risk affects required returns, but an explicit mechanism for identifying which risk state changes, through which financing channel it operates, and how that effect propagates into the aggregate cost of capital. This positioning is consistent with evidence that financing behaviour and cost-of-capital estimation vary across firms and financial environments (Graham & Leary, 2011; Jagannathan et al., 2016).

The present study remains theoretical. A-WACC has not demonstrated empirical superiority, predictive improvement, or greater valuation accuracy relative to conventional WACC. Its validity depends on whether the proposed risk constructs can be operationalized distinctly, whether the sensitivity parameters can be reliably estimated, and whether the resulting

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

adjustments provide incremental explanatory or predictive information without material double counting.

Future research should therefore estimate A-WACC at the firm level and test its parameters, constructs, sensitivity, and stability. Direct benchmark comparisons with conventional WACC should evaluate predefined outcomes such as valuation error, financing-cost forecasting, and investment prediction. Cross-sector and cross-country studies should test parameter heterogeneity, while normal-versus-stress comparisons should determine whether the model provides greater incremental information when risk conditions depart materially from their benchmarks. Out-of-sample testing is also necessary to establish predictive robustness.

Future work may additionally integrate A-WACC with dynamic leverage optimization to examine the iterative relationship between financing costs and capital structure. Ultimately, A-WACC should be regarded as an empirically falsifiable cost-of-capital architecture: its contribution will be supported only if its proposed transmission channels are identifiable and its condition-dependent estimates provide measurable incremental value relative to the conventional benchmark.

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Appendix A – DFAS-FEP Authorship Classification and Compliance:

This manuscript complies with the DFAS-FEP Protocol, a structured authorship governance framework introduced by the author (Alaali, 2025c)

DFAS-FEP (Dynamic Financial Applied Meta-Science – Future Engine Prototype Protocol) provides an ethical protocol to ensure transparent and accountable authorship in AI-assisted financial research. It defines and enforces the distinction between fully human-generated content and AI-supported elements to uphold integrity, intellectual responsibility, and traceability across all components of this manuscript.

This classification directly supports the ethical architecture of the DFAS-IFRS Code of Ethics, which applies DFAS-FEP standards to financial disclosures influenced by artificial intelligence.

For reference, see the published DFAS-FEP Protocol: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5260517

Appendix A.1 – (DFAS-FEP) Authorship Classification Table for This Manuscript

Manuscript Component	DFAS–FEP Class	Justification
Alaali WACC (A-WACC) Core Model Architecture	**Class 1**	The conceptualization of **A-WACC** as a condition-dependent extension of conventional WACC that preserves the established debt–equity weighting and tax structure while introducing explicit recalibration of the underlying equity and debt financing costs was fully conceptualized by the author.

Dual-Channel Risk-State Attribution and Transmission Architecture	**Class 1**	The architecture separating changing risk conditions into identifiable **equity-cost and debt-cost transmission channels**, rather than applying an undifferentiated risk premium directly to the final discount rate, was independently developed by the author.
Benchmark–Deviation–Transmission–Recombination Logic	**Class 1**	The sequential architecture establishing baseline financing costs, measuring risk variables relative to defined benchmark states, transmitting deviations through estimable sensitivity parameters, and recombining the adjusted financing costs through conventional capital weights was independently structured by the author.
Adjusted Cost of Equity Architecture	**Class 1**	The specification of **Ke_adj** as the baseline cost of equity plus separately identifiable **Earnings-Volatility Adjustment (EVA), Leverage-Risk Adjustment (LRA), and Firm-Specific Risk Adjustment (FSRA)** was independently developed by the author.
Earnings-Volatility Adjustment (EVA)	**Class 1**	The formulation of **EVA = β_EV × EV**, including benchmark-relative abnormal earnings volatility and an estimable sensitivity parameter transmitting earnings-volatility changes into the adjusted cost of equity, was independently developed by the author.
Leverage-Risk Adjustment (LRA)	**Class 1**	The formulation of LRA = β_L × LR as a separately identifiable transmission channel through which leverage-related risk affects the adjusted cost of equity was independently developed by the author.
Firm-Specific Risk Adjustment (FSRA)	**Class 1**	The formulation of FSRA = β_F × FSR, together with the non-duplication condition preventing risks already represented through earnings volatility or leverage risk from being reintroduced through firm-specific risk, was independently structured by the author.
Adjusted Cost of Debt Architecture	**Class 1**	The specification of Kd_adj as the baseline borrowing cost plus separately identifiable Credit-Risk Adjustment (CRA), Sector-Specific Credit-Spread Adjustment (SCSA), and Macroeconomic/Systemic-Risk Adjustment (MSRA) was independently developed by the author.

Credit-Risk Adjustment (CRA)	**Class 1**	The formulation of CRA = γ_CR × CR, linking benchmark-relative firm credit-risk deviations to borrowing-cost adjustments through an estimable transmission parameter, was independently developed by the author.
Sector-Specific Credit-Spread Adjustment (SCSA)	**Class 1**	The formulation of SCSA = γ_SC × SC, which explicitly transmits changes in sector-specific borrowing conditions into the firm's adjusted cost of debt, was independently developed by the author.
Macroeconomic/Systemic-Risk Adjustment (MSRA)	**Class 1**	The formulation of MSRA = γ_SYS × SYS as an explicit systemic-risk transmission channel into the adjusted cost of debt was independently developed by the author.
ASRI Systemic-State Integration Mechanism	**Class 1**	The integration of standardized ASRI as the systemic-state input within A-WACC, with systemic risk transmitted through an estimable financing-cost sensitivity parameter rather than added directly to WACC as an arbitrary premium, was independently structured by the author.
Integrated A-WACC Specification	**Class 1**	The complete mathematical architecture integrating the adjusted equity and debt components within the conventional market-value capital-weighting and tax structure was independently developed by the author as the core A-WACC specification.
Neutral-Risk Nesting Condition	**Class 1**	The boundary condition under which all benchmark-relative risk deviations equal zero and A-WACC converges to conventional
		WACC was independently specified by the author, establishing conventional WACC as the nested neutral-risk benchmark.
A-WACC Assumption and Non-Duplication Architecture	**Class 1**	The model assumptions concerning market-value capital weights, explicit benchmark states, prevention of overlapping risk channels, empirical estimation of transmission coefficients, and empirical determination of channel magnitude and significance were independently structured by the author.
A-WACC Comparative-Statics Architecture	**Class 1**	The directional propositions connecting changes in earnings volatility, leverage risk, firm-specific risk, credit risk, sector credit conditions, and systemic risk to their

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

		respective financing-cost components and ultimately to A-WACC were independently developed by the author.
A-WACC versus Conventional WACC Comparative Architecture	**Class 1**	The structured comparison distinguishing A-WACC from conventional WACC across financing-cost estimation, explicit risk transmission, sector conditions, systemic-risk treatment, risk decomposition, neutral-state behavior, and empirical requirements was independently structured by the author.
A-WACC–ALOM Analytical Separation and Future Equilibrium Logic	**Class 1**	The distinction between condition-dependent financing-cost estimation through A-WACC and condition-dependent leverage optimization through ALOM, together with the proposed future iterative equilibrium mechanism and safeguards against mechanical circularity, was independently structured by the author.
Hypothetical Risk-State Application Architecture	**Class 1**	The use of stable, moderate-stress, and systemic-stress states to illustrate the directional operation of A-WACC while explicitly distinguishing illustrative scenarios from empirical estimates was independently structured by the author.
A-WACC Validation and Sensitivity Protocol	**Class 1**	The integrated validation architecture covering parameter validation, construct validation, sensitivity analysis, benchmark validation, stress validation, capital-intensity heterogeneity, and out-of-sample predictive validation was independently developed by the author.
Narrative Structure and Analytical Exposition	**Class 2**	AI assistance was limited to controlled linguistic refinement, clarity, and structural presentation.
Tables, Equations, and Model Presentation	**Class 2**	The substantive model architecture, equations, parameters, relationships, and comparative logic were author-designed; AI assistance was restricted to formatting and presentation refinement.
Literature Review and Cross-Referencing	**Class 2**	Literature interpretation and theoretical integration were author-directed; AI assistance was limited to citation and reference alignment.

Volume: 04, Issue: 05, September - October 2026

ISSN 3048-8125

Appendices and Compliance Documentation	**Class 2**	AI assistance was restricted to formatting and structural consistency.

Overall Manuscript Classification: Class 2 – AI-Assisted, Author-Validated

Core Model, Risk-Transmission Architecture, Mathematical Specification, and Validation Protocol: Class 1 – Fully Human-Authored

Additional Clarifications

Human-Originated Content (Class 1): All substantive contributions including A-WACC, the Dual-Channel Risk-State Attribution and Transmission Architecture, Benchmark–Deviation–Transmission–Recombination Logic, Adjusted Cost of Equity Architecture, EVA, LRA, FSRA, Adjusted Cost of Debt Architecture, CRA, SCSA, MSRA, ASRI Systemic-State Integration Mechanism, Integrated A-WACC Specification, Neutral-Risk Nesting Condition, assumption and non-duplication architecture, comparative statics, A-WACC versus conventional WACC comparative architecture, A-WACC–ALOM analytical separation and future equilibrium logic, hypothetical risk-state application architecture, and the A-WACC Validation and Sensitivity Protocol were independently conceptualized and developed by the author.

AI-Assisted Content (Class 2): AI tools were used only for non-substantive linguistic refinement, formatting, presentation, and citation alignment.

Integrity Safeguards: All AI-assisted content was manually reviewed and validated under **DFAS-FEP v1.6**, with authorship classification and traceability documentation maintained.

Appendix B – Version History Log (VHL)

Version 1.0 – First Published in SSRN on March 20, 2025.

• **SSRN.** https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5179813

• The original manuscript introduced **Alaali WACC (A-WACC)** as a risk-adjusted extension of conventional WACC designed to incorporate firm-specific, industry-specific, and macroeconomic risk considerations into cost-of-capital estimation.

• **Alaali-ACS: 0 | Classification: Class II – AI-Assisted, Author-Validated**

Version 2.0 – Revised August 26, 2026.

• The manuscript was substantially revised to formalize the **Dual-Channel Risk-State Attribution and Transmission Architecture**, **Benchmark–Deviation–Transmission–Recombination Logic**, **Adjusted Cost of Equity Architecture**, **EVA, LRA, and FSRA**, **Adjusted Cost of Debt Architecture**, **CRA, SCSA, and MSRA**, **ASRI Systemic-State Integration Mechanism**, **Integrated A-WACC Specification**, **Neutral-Risk Nesting**

Condition, non-duplication safeguards, comparative statics, **A-WACC–ALOM analytical separation and future equilibrium logic**, hypothetical risk-state application architecture, and the **A-WACC Validation and Sensitivity Protocol**. The revised manuscript also explicitly positions conventional WACC as the nested neutral-risk benchmark and clarifies that A-WACC remains theoretical and requires empirical calibration and validation before any claim of empirical superiority. The manuscript's substantive conceptual architecture, model specifications, risk-transmission mechanisms, mathematical relationships, assumptions, comparative statics, and validation design were fully human-authored. AI tools were used exclusively for non-substantive support functions, limited to layout adjustments, citation formatting, and controlled phrasing refinements, in full compliance with **DFAS-FEP v1.6** presentation standards.

• **Alaali-ACS: 0 | Classification: Class II – AI-Assisted, Author-Validated**

