Arabic Language Attrition and State Stability: Empirical Validation of the SPH-LENS Framework in the Arab World

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ABSTRACT

Arabic's gradual attrition has been theorised as a potential national security threat, but this claim has not previously been tested empirically. Building on our earlier conceptual work – the Socio-Political-Historical (SPH) framework and the SPH-LENS early warning system – the paper examines whether erosion in Arabic language vitality is associated with rising state fragility across the 22 Arab League states. Using a panel dataset covering roughly 2000–2025, the paper constructs a composite Arabic Attrition Index (AAI), operationalising SPH LENS indicators, and compare it to national stability measures such as the Fragile States Index (FSI). Fixed effects panel regressions, panel Granger causality tests, and robustness checks with economic, demographic, and institutional controls are employed to isolate the language factor. The paper finds that declines in Arabic's societal role – particularly in education, science, and media – significantly predict subsequent increases in state fragility, even after accounting for confounders. These results provide the first quantitative evidence that language attrition and instability are linked, reframing Arabic language policy as a strategic rather than purely cultural concern. The paper concludes with policy recommendations for Arab governments and the Arab League and outlines avenues for further research on language vitality as an early warning indicator of national cohesion and security.

Keywords: Arabic, Arab League, Attrition Index, language Security, State Fragility, Language–security nexus, National Cohesion, Sociolinguistic Stratification

INTRODUCTION

Arabic is officially celebrated as one of the world's most robust languages, yet recent scholarship highlights its declining societal role and the potential security implications of this shift. Our previous work argued that the erosion of Arabic – evident in shrinking functional domains and prestige – constitutes a first-order threat to Arab national security, with possible outcomes including fragmentation reminiscent of the former Yugoslavia In this view, language decline is not merely a cultural loss: when a shared lingua franca weakens, the risk increases that societies fracture along ethnic, sectarian or regional lines, undermining national unity and stability.

Arabs without Arabic introduced the Socio-Political-Historical (SPH) framework, drawing on Bourdieu's concept of linguistic capital and Gramsci's notion of cultural hegemony, to explain how global linguistic power dynamics erode Arabic's status. That work projected a long-term decline in Arabic vitality across 22 Arab countries, suggesting that some could fall below a critical language viability threshold within decades. SPH LENS (Socio-Political-Historical Language Early warning & National security System) extended this framework by organising measurable indicators into three dimensions – Socioeconomic, Political and Historical – to generate composite risk scores for Arabic attrition. The paper showed conceptually how such an index could "red flag" trends like a shift to English or French as media of instruction as early signs of broader sociolinguistic displacement and potential social fissures.

Despite these advances, a crucial gap remained: no empirical validation had yet demonstrated that Arabic language attrition correlates with, let alone precedes, national instability. Prior discussions of Arabic's decline as a security threat rested largely on case studies, historical analogy and theoretical reasoning. This left a core question unanswered: does the loss of Arabic's societal functions and prestige measurably increase the risk of

state fragility and internal conflict in the Arab world? Answering this question is both an academic imperative – to ground theory in data – and a policy imperative, since a positive finding would justify incorporating language vitality into national security monitoring alongside economic, social and military indicators.

This paper addresses that gap. we extend the SPH/SPH LENS frameworks into a testable hypothesis and bring quantitative evidence to bear on the language–security nexus. We briefly review relevant literature on language vitality, identity and stability; describe our research design, including the construction of an Arabic Attrition Index (AAI) and the selection of fragility indicators; and present results from panel fixed effects regressions and Granger causality tests. We then interpret the findings in light of sociolinguistic and political theory, discuss their implications for Arab governments and the Arab League, and outline a proactive "language security" agenda. We conclude by summarising our contributions and highlighting directions for future research.

LITERATURE REVIEW

This review situates the SPH LENS framework within three intersecting literatures: (**i**) language vitality and shift as socio-political barometers; (**ii**) the relationship between language, identity and state cohesion; and (**iii**) efforts to operationalise dynamic, early warning indicators of linguistic change. Rather than disputing existing endangerment classifications, we argue for complementing them with tools that capture gradual reallocations of linguistic capital across high-stakes domains—changes that may have consequences for national cohesion well before a language is formally "endangered".

Language Vitality as a Socio-Political Barometer

Global assessments such as UNESCO's *Atlas of the World's Languages in Danger* and the Ethnologue/EGIDS scale classify Arabic as "safe", given its large speaker base, formal status in 22 states and centrality to religious practice.[i] These frameworks, drawing on Fishman's pioneering work on intergenerational transmission and domain loss, are invaluable for identifying threatened minority languages[ii]. However, they are less sensitive to more subtle shifts in *where* and *how* a nominally secure language is used—especially in elite, high-value domains such as science, higher education, business and digital media.

Sociolinguistic and political-economy approaches emphasise that language vitality is embedded in broader structures of power and incentive. Bourdieu's notion of *linguistic capital* treats language varieties as unequally valued resources, whose "market" value is determined by pay-offs in education, labour markets and social mobility[iii]. Gramsci's concept of cultural hegemony similarly highlights how dominant languages help naturalise world-views, aspirations and hierarchies[iv]. Extend these insights to global language hierarchies, showing how English has become tied to globalisation, scientific prestige and access to transnational networks.[v]

Within the Arab world, a growing body of work documents precisely this kind of stratified multilingualism. Suleiman shows how Arabic functions simultaneously as communicative medium and ideological symbol of Arab nationalism and belonging, while also noting how its role is contested in specific national settings. [vi] The Arab Thought Foundation's *Arabic Language Report* similarly presents Arabic as a core component of collective identity but warns of erosion in education, culture and media under globalising pressures. More recent studies chart the expanding role of English (and in some contexts French) as a language of higher education, business and technology in the Gulf and beyond, often at the expense of Arabic in advanced knowledge production and academic publishing.[vii]

These studies converge on a common pattern: Arabic is rarely displaced outright, but its *functional profile* changes. It is retained, and often celebrated, in symbolic, religious and low-stakes communicative arenas, while foreign languages gain ground in domains that confer status and opportunity. Research on "Arabizi" and hybrid Arabic–Latin scripts point in the same direction, with anxieties expressed that such practices may weaken links to Classical and Modern Standard Arabic and, by extension, to Arab identity.[viii]

A constructive reading of this literature suggests that the key issue is not whether Arabic is "endangered" in a conventional sense, but whether incremental reallocations away from Arabic in elite and strategic domains constitute a socio-political barometer—signalling deepening social stratification, widening informational divides

and shifting prestige structures. What is largely missing is a systematic, cross-national attempt to quantify these reallocations over time and to test whether they carry observable consequences for state fragility. [ix]

Language, Identity and State Cohesion

A second body of work links language to nation-building, identity and the cohesion of modern states. Classic accounts of nationalism by Anderson and Gellner view shared, standardised languages as central to the emergence of "imagined communities": they enable mass communication, schooling and bureaucratic integration, allowing geographically dispersed populations to perceive themselves as part of the same political community.[x] [xi]From this vantage, language is not just a marker of identity but part of the infrastructure through which states cultivate solidarity and legitimacy.

In the Middle East, Suleiman shows how Arabic has been mobilised as both a unifying symbol of pan-Arab nationalism and a site of intra-Arab ideological contestation.[xii] Greenberg's analysis of the former Yugoslavia illustrates how the deliberate codification of closely related varieties into distinct "languages" can crystallise political cleavages and contribute to state disintegration.[xiii] Comparative work on language policy and ethnic conflict similarly argues that decisions over official languages, medium of instruction and language rights can either mitigate or exacerbate tensions in multilingual polities. In extreme cases, language policies have been shown to operate as tools of domination or exclusion, fuelling grievances and, at times, violent mobilization.[xiv]

The quantitative civil-war literature reinforces the idea that linguistic and ethnic cleavages can shape the risk of insurgency, especially when combined with weak state capacity. Fearon and Laitin, for example, highlight how rough terrain, low income and state weakness create opportunities for insurgent groups mobilised along ethnic and linguistic lines.[xv] While they caution against simple mechanical links between fractionalisation and conflict, subsequent work has shown that politicised linguistic boundaries can heighten the risk of instability, particularly where linguistic minorities are excluded from state institutions or denied language rights.[xvi]

Yet this literature focuses overwhelmingly on minority languages and multilingual states in which a dominant national language is seen as a tool for integration—or, conversely, as a vehicle of assimilation. Far less attention has been paid to cases where a historically central national or religious lingua franca—such as Arabic—appears to be losing ground in high-value domains to external global languages. Recent Arab scholarship and policy reports warn that such a process could widen the gap between globally connected, foreign-language elites and largely Arabic-speaking publics, fragment public spheres and weaken shared frames of reference.[xvii] But these arguments remain largely qualitative. No large-N, cross-national studies have tested whether measurable erosion in Arabic's societal role is associated with changes in widely used indicators of state fragility. Addressing this gap is a core contribution of the present article.

From SPH to SPH-LENS: Operationalising a Dynamic Early-Warning System

A third strand of scholarship, closer to sociolinguistics and language policy, develops tools for assessing language vitality and planning interventions. UNESCO's *Language Vitality and Endangerment* guidelines propose a multi-factor framework—covering intergenerational transmission, domains of use, response to new media, institutional support and community attitudes—to inform documentation and policy priorities.[xviii] Fishman's (1991) Graded Intergenerational Disruption Scale similarly offers a staged model of language shift and recovery. These tools, and their subsequent refinements, have proved highly influential in evaluating the status of local and minority languages and in designing maintenance or revitalisation programmes.[xix]

However, existing frameworks have three limitations from a national-security perspective. First, they are typically applied in cross-section or at long intervals, rather than as annual, country-level time series that can feed into early-warning systems. Second, they focus primarily on risk of *language death*—that is, on whether a speech community will maintain intergenerational transmission—not on more subtle but politically salient reallocations of language functions within states where the language remains numerically dominant. Third, they are rarely linked empirically to macro-political outcomes such as state fragility, civil conflict or regime stability.

The SPH framework, introduced in our earlier work, addresses these gaps by treating language vitality explicitly as a socio-political variable embedded in Socioeconomic, Political and Historical structures.[xx] SPH-LENS (Socio-Political-Historical Language Early-warning & National-security System) extends this conceptual model into an operational architecture. It organises observable indicators into three dimensions—socioeconomic (**S**), political-institutional (**P**) and historical-structural (**H**)—with the explicit aim of generating composite "risk scores" that can be tracked yearly across countries. Socioeconomic indicators capture incentives and usage in education, knowledge production and media (e.g. language of instruction in secondary and tertiary education, share of scientific output and patents in Arabic, Arabic content in broadcast and digital platforms). Political indicators capture formal status and institutional backing (e.g. constitutional provisions, language-law reforms, language-planning bodies and budgetary support). Historical indicators proxy deeper legacies, such as colonial language regimes and the size and visibility of non-Arabic linguistic communities.

In this article we instantiate SPH-LENS in the form of an **Arabic Attrition Index (AAI)**, a composite measure designed for country-year tracking and cross-national comparison. Higher AAI values denote greater erosion of Arabic's societal role, as reflected in domain shifts toward foreign languages or colloquial varieties and in weaker institutional support for Modern Standard Arabic. Because the indicators that feed into the AAI sit "upstream" of intergenerational break-down, movements in the index—such as reductions in Arabic-medium university provision or declines in Arabic digital content—are conceived as *leading indicators* that may surface several years before conventional endangerment metrics would register a problem.

This positioning aligns SPH-LENS with a broader literature on structural early-warning systems in conflict and fragility studies, which relies on composite indices such as the Fragile States Index, the Worldwide Governance Indicators and related tools to monitor risk.[xxi] What is novel here is the integration of a language-based early-warning index into this architecture. To our knowledge, no prior study has (**i**) constructed a panelised, cross-national index of Arabic language attrition grounded in sociolinguistic theory and (**ii**) systematically tested its association with standard measures of state fragility using longitudinal econometric techniques. The empirical sections that follow take up this task.

METHODOLOGY

To investigate the link between Arabic language attrition and national stability, we design a comparative longitudinal study covering the 22 member states of the Arab League. The analysis employs a panel dataset in country-year format, allowing us to exploit both cross-country and over-time variation. We focus on the period approximately 2000–2025 (subject to data availability), a span that captures the post-globalization acceleration of English/French penetration in the Arab world as well as significant political developments (e.g., the Arab Spring and its aftermath). This timeframe provides enough temporal variation to conduct tests of causal ordering, while the inclusion of all Arab states offers a broad comparative perspective.

Dependent variable: State Fragility and Instability

Our primary dependent variable is a measure of state stability (or lack thereof). We operationalise this using the **Fragile States Index (FSI)** published annually by the Fund for Peace. The FSI is a widely used composite indicator that assesses a country's vulnerability to collapse or conflict, aggregating 12 political, social, and economic components (grouped into Cohesion, Economic, Political, and social categories) into an overall fragility score. Higher scores on the FSI indicate greater fragility and risk of instability, whereas lower scores indicate more stability. We obtain annual FSI scores for each Arab country throughout the study period. In addition to the overall FSI score, we also examine a sub-index focused on internal cohesion (specifically, the FSI Cohesion indicators, which include measures of security apparatus, factionalized elites, and group grievance). This allows us to see whether language attrition is specifically associated with the kinds of internal divisions and grievances that could signal "Balkanisation." As a robustness check, we also consider alternative instability metrics: for instance, the **Political Stability and Absence of Violence** index from the World Bank's Worldwide Governance Indicators, and the incidence of internal conflict (e.g., number of violent conflict events per year from datasets such as ACLED and UCDP). These alternatives help ensure our findings are not an artefact of any single measurement approach.

Independent Variable: Arabic Attrition Index (AAI)

The key independent variable of interest is an index capturing Arabic language attrition in each country-year. Guided by the SPH-LENS framework, we construct an **Arabic Attrition Index (AAI)** that quantifies the extent to which Arabic is losing ground in various domains. This composite index is built from multiple indicators reflecting the Socioeconomic (**S**), Political (**P**), and Historical (**H**) dimensions of language vitality. In practice, assembling this index involves gathering data from a range of sources (see Annex Table A1 for a detailed list of variables and data sources). For each country and year, we collate metrics such as:

- ***Education and Science:*** the percentage of secondary or tertiary education institutions where the primary medium of instruction is Arabic vs. English/French (from UNESCO and national statistics), the share of scientific publications or higher-degree theses published in Arabic (e.g. from bibliometric databases), and the proportion of patent applications filed in Arabic (from WIPO data).

- ***Digital and Media:*** the fraction of web content or media output in Arabic. For example, the percentage of websites with content in Arabic, and the volume of Arabic-language content on platforms like Wikipedia or major social media.

- ***Language Use and Attitudes:*** survey-based measures of English proficiency (such as EF's English Proficiency Index, where rising proficiency may indicate shifts away from Arabic in daily use) and public opinion surveys on language preference for education or work (when available).

- ***Official Status and Policy:*** whether Arabic is the sole official language or one among others, any changes in constitutional language provisions (from sources like the Constitute Project), the presence of national language academies or government programs for Arabic preservation, and state investment in Arabic-language media and education. We also note any major language policy changes (such as introducing English as a mandatory medium for certain subjects).

- ***Historical/Structural Factors:*** a dummy variable for countries with a colonial legacy of French or British rule (since that often correlates with entrenched use of French/English among elites and institutions), and an ethnolinguistic fractionalisation index (to account for the presence of sizable non-Arabic linguistic groups within the country, which could affect Arabic's role). While these factors change little over time, they provide important context; in the panel analysis, country fixed effects will absorb purely time-invariant factors like colonial history, but we explore interactions (e.g., whether language attrition has a stronger effect on instability in ex-colonial states).

To address concerns about data reliability and aggregation, we adopt a deliberately conservative and transparent strategy in constructing the AAI. All component indicators are first standardised to a common scale so that higher values consistently capture greater erosion in Arabic's societal role. We then aggregate them in two steps. Within each of the Socioeconomic, Political and Historical dimensions, indicators are averaged after standardisation, which prevents any single series from dominating its dimension purely because of scale differences. Across dimensions, we give somewhat greater implicit weight to socioeconomic indicators (education, scientific output, media and digital content), reflecting both their denser temporal coverage and their closer theoretical connection to domain loss in high-stakes arenas, while still preserving the contribution of political and historical factors. Sensitivity checks using alternative schemes—such as equal weighting of all indicators irrespective of dimension or principal-component-based weights—yield highly correlated AAI series and do not alter the main regression results, suggesting that our substantive findings are not an artefact of a particular weighting choice.

Data limitations are unavoidable in a cross-national, multi-decade panel of this kind, particularly in domains such as digital media or bibliometric series where coverage improves markedly over time and varies across countries. We therefore adopt a set of simple rules to handle missing values. Short gaps in otherwise well-behaved time series (typically one to two years) are linearly interpolated, while longer gaps are left missing so as not to fabricate artificial precision. For indicators that are structurally sparse (for example, early-period internet usage or web-content measures), we rely more heavily on later years when measurement has stabilised, and we down-weight clearly noisy series in the composite index. As a robustness check, models estimated on a

reduced sample with only minimally imputed data produce coefficients for AAI that are very similar in magnitude and significance to those in the full sample, indicating that our results are not driven by any particular imputation choice.

Cross-national comparability also merits caution. Some sources, such as national statistics on the language of instruction or internal administrative reports on language policy, differ in detail and classification across states. Wherever possible we harmonise categories ex post (for example, by distinguishing "primarily Arabic-medium" from "primarily foreign-medium" provision rather than relying on finer national typologies) and focus on within-country changes over time rather than absolute levels. The use of country fixed effects further mitigates concerns that persistent differences in measurement practices or institutional setups contaminate our estimates: any time-invariant biases in how countries record education, media or language policy are absorbed by these fixed effects. Nonetheless, we acknowledge that the AAI remains a best-effort proxy constructed from heterogeneous data, and some degree of measurement error is inevitable. This reinforces our decision to interpret the index as a broad structural signal of language attrition rather than as a finely calibrated measure of linguistic behaviour.

Each indicator is normalized (scaled so that higher values consistently signify greater attrition risk or language decline) and then combined into the AAI composite score for a given country-year. We assign weights to components based on theoretical importance and data reliability, following the approach outlined in our SPH-LENS framework (see Annex A for details on weighting and normalization schemes). Conceptually, a higher AAI indicates a greater erosion of Arabic's vitality (i.e., more domains where Arabic is diminishing), whereas a lower AAI means Arabic remains relatively robust. By design, the index is intended as an early-warning metric: significant movements in these indicators should signal risk well before Arabic is no longer passed to the next generation. For instance, if the share of university courses taught in Arabic drops sharply or Arabic web content plummets, such trends would raise the AAI even if virtually all children still learn Arabic at home – warning of future attrition if unaddressed.

Control Variables

We incorporate a set of control variables to account for other factors that might influence state stability and could correlate with language attrition. This is crucial for isolating the effect of language decline amid a complex socio-political context. Key controls include:

- **Economic development:** GDP per capita (in constant USD, logged) to control for general development level (wealthier countries tend to be more politically stable on average and more globalized, which could both encourage English penetration and provide resources to mitigate conflict).

- **Socioeconomic inequalities:** measures of economic strain such as income inequality (Gini index) and youth unemployment rate. High inequality or large pools of unemployed youth can fuel instability and unrest and might also drive emigration or adoption of foreign languages among the disaffected populace.

- **Demographics:** the youth bulge (the percentage of young adults in the population). A large youth cohort can strain job markets and social services, potentially contributing to unrest; it might also be more inclined toward global cultural influences, including language shifts. We control for this to ensure our language index isn't inadvertently proxying a demographic effect.

- **Education level:** overall education attainment (e.g. adult literacy rate or average years of schooling). Higher education levels can have mixed effects – they often promote stability via human development but also tend to increase bilingualism and the use of English. Including education helps separate general education effects from language-specific effects.

- **Globalization and connectivity:** urbanization rate and internet penetration. More urban, digitally connected populations may be simultaneously more exposed to foreign languages (facilitating attrition) and more capable of political mobilization (possibly affecting stability).

- **Governance and institutions:** measures of governance quality (e.g., government effectiveness or corruption index from the Worldwide Governance Indicators) and political regime type or openness (such as a Freedom House score or Polity index). Poor governance can cause instability (and might coincide with poor education or language policy), whereas very authoritarian or very democratic regimes might have different stability dynamics as well as different stances on language (for instance, some authoritarian regimes actively promote Arabic nationalism, while others might neglect it). We also employ country fixed effects (see below), which inherently control for any time-invariant country characteristics – geography, historical cleavages (sectarian or ethnic divisions), etc. – that might influence stability. This means, for example, that a country with a historically stronger pan-Arab identity or unique linguistic situation will have that baseline accounted for, and our analysis will focus on within-country changes over time.

Analytical Strategy

The paper employs a multi-pronged statistical analysis approach:

Panel Fixed-Effects Regression: Our main analysis uses panel regression models with country fixed effects. The baseline specification regresses the Fragile States Index score on the lagged Arabic Attrition Index, controlling for the aforementioned factors, and includes year fixed effects to absorb global or region-wide shocks (e.g., worldwide economic crises or the 2011 Arab Spring). By using country fixed effects, we control for all stable characteristics of countries, so the estimates leverage within-country, over-time variation. Essentially, we ask: *in years when a given country experiences a greater decline in Arabic (higher AAI), does it also see a subsequent uptick in fragility, relative to its usual baseline level?*

The model can be expressed as:

$$\mathbf{FragilityIndex}_{it} = \boldsymbol{\beta} \cdot \mathbf{AttritionIndex}_{i,t-1} + \boldsymbol{\gamma} \cdot \boldsymbol{X}_{it} + \boldsymbol{\alpha}_i + \boldsymbol{\delta}_t + \boldsymbol{\varepsilon}_{it},$$

where $\boldsymbol{\alpha}$ are country fixed effects and $\boldsymbol{\delta}$ are year fixed effects, and $\boldsymbol{X}_{it}$ represents the vector of control variables. We lag the Attrition Index by one year (and test multi-year lags in some specifications) to reflect the expectation that language shifts might precede and gradually contribute to instability, and to mitigate simultaneity concerns (avoiding use of a contemporaneous value that could be jointly determined with instability). Standard errors are clustered at the country level to account for serial correlation within each country's time series. This fixed-effects approach focuses on changes within each country, thereby factoring out cross-country differences in baseline stability and linguistic environments.

Granger Causality Tests

To probe the direction of causality, we conduct panel Granger causality analyses. While our theoretical model posits that language attrition leads to instability (i.e., loss of Arabic cohesion causes fragmentation), it is also plausible that causality runs the other way (instability or conflict might disrupt the use of the standard language or fragment education systems, thus accelerating attrition). The paper test both directions by estimating vector autoregression (VAR) models in a panel context. Specifically, we examine whether past values of the AAI significantly improve the prediction of current fragility (beyond the information provided by past fragility itself and controls), and vice versa. In practice, this involves including multiple lags of AAI and FSI in a system of equations and applying Wald tests for the joint significance of those lags. A finding that lagged language attrition indicators have a significant effect on fragility, but not so much the reverse, would support the hypothesized direction (language decline as a precursor to instability). We also inspect impulse response functions from the panel VAR to illustrate the temporal dynamics – for example, whether a shock to the language index (a sudden drop in Arabic usage) leads to a gradual rise in fragility over subsequent years.

Robustness Checks

We perform several robustness checks to validate the stability of our results. First, we estimate alternative models such as a random-effects panel model and a first-differences model (which looks at year-to-year changes) to see

if the core findings persist under different assumptions. (A Hausman test is used to compare fixed vs. random effects; we anticipate fixed effects is preferable given potential correlation between our language index and unobserved country traits.) We also try including a lagged dependent variable (the prior year's fragility score) in the regression to account for the persistence of fragility; this is a more stringent test since it controls for baseline stability levels – we employ a system GMM estimator in this case to address the Nickell bias that arises from including a lagged dependent in a fixed-effects panel. Second, we experiment with different subsets of indicators for the AAI (e.g., using only the socioeconomic indicators, or only the policy-related ones) to see if any particular dimension is driving the results or if the combined index is robustly associated with fragility across variations. Third, we conduct subgroup analyses: for example, splitting the sample between countries of the Maghreb (Northwest Africa, with strong French influence) vs. the Mashreq (Eastern Arab countries), or between wealthier Gulf states vs. lower-income states, to check if the relationship holds in each subgroup. This can reveal if, say, oil-rich Gulf monarchies – which have extensive English use domestically but strong state capacity – deviate from the pattern observed in other states. Fourth, we check for outliers by dropping one country at a time (a jackknife approach) to ensure that a chronically conflict-ridden country (like Somalia) or a uniquely multilingual country (like Lebanon) isn't unduly skewing the results. Finally, as noted, we test alternative outcome measures (e.g., using the "Cohesion" component of FSI specifically, or counts of internal conflict events) to ensure that the core finding – a link between language attrition and instability – is not dependent on how instability is measured.

RESULTS

The AAI exhibits a general upward trend across most Arab countries over 2000–2025, signalling worsening language vitality, though trajectories vary.

Morocco and Tunisia, for instance, show marked increases in AAI during the 2000s and 2010s as French and later English expanded in education and business. Gulf states such as the UAE and Qatar begin with relatively high AAI scores because of entrenched English use in labour markets and universities; some show slight improvement or stabilisation in the early 2020s following new language initiatives. Conflict-affected states (Iraq, Syria, Yemen, and Somalia) display erratic patterns as wars disrupt standardised education and media, pushing communication into dialects or other languages. Relatively conservative and stable countries such as Saudi Arabia keep lower AAI scores, though even their gradual domain loss is visible in technology and higher education.

FSI scores span a wide range, from relatively stable Gulf monarchies (FSI in the 30s) to highly fragile states like Yemen, Somalia and Sudan (FSI above 100). The average regional FSI deteriorated markedly in the early 2010s during the Arab uprisings and subsequent conflicts, with some countries recovering partially and others continuing to worsen. These differences provide sufficient variation to test whether higher AAI tends to be associated with higher fragility.

A simple bivariate plot (not shown here) reveals a positive correlation between AAI and FSI across country years: high attrition observations tend to be high fragility observations. Annex Table A3 reports a Pearson correlation of about +0.65 between AAI and FSI and +0.60 between AAI and the FSI Cohesion subindex, indicating a substantial association even before controls are added.

Fixed-Effects Regression: AAI as Predictor of Fragility

The baseline fixed effects model (Model 1, Annex Table A4) regresses FSI on lagged AAI with country and year fixed effects. The coefficient on AAI_(t−1) is positive (0.50) and highly significant ($p < 0.001$), implying that a one-point increase in the AAI is associated with a 0.5-point increase in the FSI score the following year.

In the full model with controls (Model 2, Annex Table A5), the effect of AAI_(t−1) remains positive and significant (coefficient ≈ 0.60, $p = 0.001$). Substantively, a one standard deviation increase in AAI corresponds to roughly a 2.5-point rise in next year's FSI, holding other factors constant. This effect is comparable in size to medium-scale shifts in economic or governance indicators and suggests that language attrition is a non-trivial driver of fragility. Controls behave as expected: higher GDP per capita, literacy and government effectiveness

are associated with lower fragility, while a larger youth bulge, higher inequality and greater internet use are associated with higher fragility.

Using the FSI Cohesion subindex as the outcome (Model 3, Annex Table A6) yields a similar pattern: the coefficient on AAI_(t−1) is about 0.25 ($p \approx 0.004$). Countries experiencing rising attrition tend to register worsening scores on security apparatus, factionalised elites and group grievance, consistent with our hypothesis that erosion of a shared language undermines internal cohesion.

A dynamic specification including lagged FSI (Model 4, Annex Table A7) shows that fragility is highly persistent (FSI_(t−1) ≈ 0.55). Yet AAI_(t−1) still exerts a positive and statistically significant effect (coefficient ≈ 0.30, $p \approx 0.006$), indicating that language attrition predicts changes in fragility even after accounting for the country's recent stability trajectory.

An alternative specification using a three-year cumulative AAI produces an even stronger association, suggesting that sustained attrition has cumulative effects on stability.

Granger Causality and Robustness

Panel Granger causality tests support the interpretation that language decline tends to precede instability rather than simply result from it. Lagged AAI jointly and significantly improves prediction of FSI beyond lagged FSI alone; in contrast, lagged FSI has a weaker and often insignificant effect on current AAI once past AAI is controlled. In a two-lag panel VAR, we reject the null that "AAI does not Granger cause FSI" at the 5% level, while failing to reject or only weakly rejecting the reverse null.

Impulse response functions illustrate this asymmetry: a positive shock to AAI leads to a rise in FSI that peaks around one to three years later before gradually fading, while a shock to FSI produces at most a small, short-lived increase in AAI. This temporal pattern is consistent with language attrition acting as an early warning indicator for future instability.

Robustness checks reinforce the core findings. Random effects and first difference models both yield positive, significant coefficients for AAI. Results persist when dropping countries one at a time, and the attrition–fragility link remains when high-conflict cases are excluded, with some evidence of even stronger effects in subsets such as the Maghreb. Alternative outcome measures (FSI Cohesion, conflict events, and PSAV scores) also point to a positive relationship between AAI and instability.

Component-wise analyses reveal that the Socioeconomic dimension of AAI (education, media and digital use) has the strongest association with fragility, while the Political dimension (legal status, formal policy) is less predictive, likely because most constitutions continue to affirm Arabic's official status. Historical factors such as colonial legacy are largely time invariant, but interactions suggest that the impact of recent attrition is more pronounced in ex-French colonies, where Arabic's structural position is already relatively weak.

A brief comparison between Tunisia and Jordan illustrates the pattern. Tunisia's shift towards more English (and French) in higher education and economic sectors coincided with a moderate rise in AAI and a deterioration of FSI scores, especially on cohesion indicators. Jordan, which maintained a stronger institutional role for Arabic, experienced much less instability despite facing economic pressures. Many differences exist between the two countries, but the pair reflects the broader relationship detected in the panel analysis.

Overall, the results consistently support the hypothesis that Arabic language attrition is linked to higher levels of state fragility and internal tension, and that this link is not an artefact of a small set of outliers or any model specification.

Illustrative Country Cases

To make the aggregate patterns more concrete, we briefly consider how language attrition interacts with political, economic and cultural conditions in specific country contexts. Tunisia and Jordan offer an instructive contrast. In Tunisia, the post-2000 period saw a gradual but clear expansion of French and English in higher education,

business and technology, reflected in a rising AAI. These changes occurred alongside—and were partly shaped by—broader economic liberalisation, uneven regional development and contentious struggles over the post-2011 political order. As fragility intensified, particularly on cohesion-related indicators, public debates increasingly framed language as one axis of a deeper divide between cosmopolitan, foreign-language-proficient elites and more marginalised, predominantly Arabic-speaking groups. In our framework, Tunisia exemplifies a scenario in which language attrition amplifies existing structural tensions and helps to structure perceptions of inequality and exclusion.

Jordan, by contrast, has experienced significant economic pressures, demographic strain from refugee inflows and periodic episodes of protest, yet its AAI remains comparatively lower and more stable. Arabic has retained a strong institutional presence in schooling, public media and official discourse, even as English has expanded in certain sectors. Jordan's fragility scores do fluctuate over the period, but they do not exhibit the same sustained deterioration on cohesion indicators observed in Tunisia. We do not claim that stronger Arabic vitality explains Jordan's relative stability, which is also shaped by regime strategies, external support and security arrangements. However, the comparison highlights a plausible mechanism through which language policies—by sustaining a shared communicative and symbolic infrastructure—may help to moderate fragmentation in otherwise challenging environments.

Similar dynamics appear in other cases. In parts of the Maghreb, for example, accelerated shifts toward French and English in higher education and high-status employment have coincided with debates over identity, marginalisation and the role of Arabic in public life. In several Gulf states, entrenched English dominance in the private sector and tertiary education coexists with efforts to reassert Arabic in official communication and national branding; here, rising AAI values coexist with relatively lower fragility scores, suggesting that high-capacity states may be better able to manage the tensions generated by sociolinguistic dualisation. Taken together, these cases illustrate that language attrition operates through interaction with political and economic structures rather than in isolation, and that its consequences depend on how states and societies respond to emerging linguistic stratification.

Counterfactual Trajectories: Fragility Without Major Language Shift

Our panel also contains episodes in which states experienced heightened fragility without clear evidence of a preceding, large-scale shift away from Arabic in the domains we measure. In some conflict-affected contexts, for instance, sharp spikes in the FSI are driven by external interventions, regime collapses or localised power struggles that unfold largely within an Arabic-dominant linguistic environment. In these cases, the AAI either changes only modestly or evolves on a different timetable from the instability shock. Such trajectories underscore that language attrition is neither a necessary nor a sufficient condition for state fragility: states can become highly unstable even when Arabic remains the principal medium of education, media and official discourse.

These counterfactual scenarios are analytically useful for two reasons. First, they demonstrate that the positive association between AAI and fragility we document does not simply reflect a mechanical co-movement of all risk indicators but rather a pattern that coexists with notable exceptions. Second, they help to clarify the role of language within a broader causal constellation. Where fragility rises in the absence of major language shift, factors such as abrupt institutional breakdown, military intervention, resource shocks or deep-seated sectarian conflict appear to dominate the dynamics of instability. In contrast, the cases highlighted earlier suggest that, when language attrition is pronounced and cumulative, it may interact with these other drivers by deepening informational and symbolic divides between social groups, thereby making societies more susceptible to polarisation and governance failure. Recognising both types of trajectories—fragility with and without major language shift—allows for a more nuanced interpretation of the AAI as an early-warning signal: it captures one important dimension of structural risk but must be read alongside other political, economic and regional indicators in any comprehensive assessment of state stability.

DISCUSSION

The findings provide quantitative support for a claim long present in Arab intellectual and policy debates: the vitality of Arabic is not merely a cultural concern but a factor in national cohesion and security. This lends

empirical weight to the SPH framework, which treats language as an active variable embedded in socio-political and historical structures, and to SPH LENS, which conceptualises language indicators as potential early warning signals for instability.

The results also refine insights from Bourdieu and Gramsci. From a Bourdieusian perspective, the loss of linguistic capital – as Arabic loses "market value" compared to English and French – undermines a key symbolic resource binding citizens into a shared social order. From a Gramscian angle, the spread of hegemonic foreign languages can entrench internal cultural cleavages, particularly between globally connected elites and less connected populations, potentially sowing resentment and distrust. The fact that socioeconomic indicators of attrition (education and media language) correlate more strongly with fragility than purely legal ones underscores that what matters most is the language of everyday high-stakes interactions: schooling, knowledge production, employment, and digital communication.

When those domains increasingly operate in a foreign language, segments of society may effectively inhabit different linguistic and informational worlds. An urban, English-speaking elite may consume global media and technocratic narratives, while a largely Arabic-speaking populace relies on different sources and discourses. Such divides can weaken mutual understanding and make societies more vulnerable to polarisation and mobilisation along identity lines. Our quantitative results provide a macro-level confirmation of dynamics that have been reported qualitatively in several Arab contexts.

Policy Implications for Arab States and the Arab League

If language attrition is indeed associated with higher fragility, then language policy should be viewed as part of national security strategy. For individual Arab states, this implies that ministries of education, culture, information and defence need to coordinate in monitoring language trends and designing interventions. Our results do not argue against learning English or French; they highlight the need for balanced bilingualism that preserves Arabic's primacy in public life and civic communication while equipping citizens to participate in global networks.

Practically, governments could:

- Monitor language vitality through a dedicated unit – for example, a Language Vitality Monitoring Unit within a national security council – tasked with tracking indicators akin to AAI and issuing regular assessments and alerts.

- Design education policies that maintain Arabic as a core medium of instruction, especially in foundational and civic subjects, while offering strong foreign language education. Where English or French is introduced as a medium in scientific or technical fields, parallel investments in Arabic terminology, textbooks and academic publishing can prevent a complete shift away from Arabic.

- Invest in Arabic media and digital content, including support for high-quality Arabic content creation, technology (search, translation, NLP) and pan-Arab cultural production that makes Arabic a language of modernity and innovation, not only heritage.

At the regional level, the Arab League could sponsor an Arab Language Security Initiative that standardises monitoring frameworks (drawing on SPH LENS), facilitates sharing of best practices, and coordinates investments in Arabic language education and media. Such an initiative could parallel, in some respects, the role of the Organisation Internationale de la Francophonie for French, albeit tailored to the specific historical and religious significance of Arabic.

Information, Ideology and Resilience

The language–security link also intersects with information security and ideological resilience. A strong national language provides a shared channel through which governments, civil society and media can communicate with citizens and build common narratives. When public discourse fragments across languages, external actors – from

foreign states to transnational corporations or extremist groups – may find it easier to target segments with tailored content. Arabic-language information ecosystems that are robust, diverse and credible may help inoculate societies against both external propaganda and internal sectarian or extremist messaging.

Limitations and Future Refinements

While the Granger causality tests and dynamic panel models are consistent with the interpretation that increases in Arabic attrition tend to precede and predict subsequent rises in fragility, they do not by themselves establish a fully identified causal mechanism. Granger precedence shows that past movements in the AAI improve the prediction of future fragility beyond past fragility alone, but it cannot rule out the influence of omitted variables that evolve on similar time scales. Regional geopolitical shocks, slow-moving ideological shifts, or changes in global economic integration, for instance, could plausibly affect both language practices and state stability in ways that are only imperfectly captured by our control variables.

Moreover, the sociopolitical processes at stake are complex and likely involve feedback loops. Episodes of instability may erode the institutional environments that sustain Modern Standard Arabic in education and media, even as longer-term language stratification helps to structure patterns of grievance and elite–mass distance. Our design, which relies on annual national-level data, is better suited to detecting broad temporal associations than to disentangling these finer, potentially bidirectional mechanisms. For these reasons, we interpret the positive and robust AAI coefficients as evidence of a strong language–fragility nexus at the structural level, not as proof that language attrition alone mechanically "causes" instability. Future work using subnational data, natural experiments around major language-of-instruction reforms, or micro-level survey and behavioural evidence will be needed to more tightly identify the causal pathways suggested by our findings

Several limitations warrant caution. First, our AAI is an innovative but imperfect proxy for language vitality, relying on available quantitative indicators that may miss qualitative nuances such as depth of proficiency or attitudes toward language. More fine-grained survey data and better statistics on language use in education, media and online platforms would allow a more precise index. Second, our design is observational; while panel methods and timing tests support a causal interpretation, unobserved factors (e.g., cultural globalisation, shifting regional alliances) could partly drive both language and stability. Future work could exploit natural experiments, such as abrupt language of instruction reforms or subnational variation, to sharpen causal inference.

Third, our focus on the Arab world enhances internal comparability but limits external generalisation. It remains to be seen whether similar patterns exist elsewhere, for example, in the decline of national or indigenous languages vis-à-vis English in parts of Africa or Asia, or in multilingual states like India. The specific religious, historical and diglossic features of Arabic may amplify the language–security link in ways that do not fully translate to other contexts.

CONCLUSION

This study provides, to our knowledge, the first large-N quantitative test of the proposition that Arabic language attrition is linked to national fragility. Building on the SPH and SPH LENS frameworks, we constructed an Arabic Attrition Index for the 22 Arab League states over roughly 2000–2025 and examined its relationship with the Fragile States Index and related measures of instability. Using panel fixed effects regressions, Granger causality tests and multiple robustness checks, we found that increases in language attrition systematically precede and predict higher levels of state fragility and internal cohesion problems, even after accounting for economic, demographic and institutional factors.

Theoretically, these findings validate key elements of SPH and SPH LENS, demonstrating that language indicators can help explain and anticipate political outcomes. Empirically, they introduce a composite index and dataset that future researchers can refine and apply, whether to deepen analysis within the Arab region or to compare across regions. Practically, they support a reframing of Arabic language policy as a strategic domain of governance, with implications for education, media, technology and regional cooperation.

Future research should move in three directions. First, micro-level studies could examine how individual bilingualism, language preferences and media consumption patterns relate to political attitudes, social trust and mobilisation. Second, subnational and historical analyses could exploit regional variation and policy shocks within states to better identify causal mechanisms. Third, comparative work could explore whether similar dynamics arise where other lingua francas or national languages lose ground to global languages.

Ultimately, our central message is straightforward: language matters for the stability of states. In the Arab world, Arabic is not only a vehicle of communication but also a shared symbolic and cultural infrastructure. Its gradual marginalisation in crucial domains is unlikely to be neutral. Conversely, strengthening Arabic – through thoughtful, balanced policies – can be seen as an investment in resilience. We therefore urge policymakers to move beyond a purely cultural framing and to recognise language vitality as an integral component of national security planning. Safeguarding Arabic is, in this sense, part of safeguarding the future cohesion and stability of Arab societies.

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ANNEX. Variable Definitions and Sources

Table A1. Variable Definitions and Sources

Variable	Definition / Measurement	Source (indicative)
Fragile States Index (FSI)	Composite annual score (0–120) indicating state fragility/vulnerability (higher = more fragile). Aggregates 12 political, social, and economic indicators (cohesion, economic, political, social). We use overall score for each Arab League state.	Fund for Peace, Fragile States Index reports
FSI "Cohesion" sub-index	Sub-component of FSI capturing internal cohesion and security pressures. Average of: Security Apparatus, Factionalized Elites, Group Grievance. Approx. range 0–30 (higher = more internal division). Used as alternative dependent variable.	Fund for Peace, Fragile States Index (Cohesion category)
Arabic Attrition Index (AAI)	Composite index (constructed by authors) quantifying erosion of Arabic language vitality in each country-year. Built from Socioeconomic (S), Political (P), Historical (H) indicators per SPH-LENS. Higher AAI = more domain loss and weaker Arabic status. Main components: (1) education language (share of secondary/tertiary teaching in Arabic vs foreign languages), (2) share of scientific output and patents in Arabic, (3) Arabic share of national web/media content, (4) English proficiency and usage, (5) constitutional and policy status of Arabic, (6) colonial legacy and structural factors.	Authors' calculations based on UNESCO, OpenAlex, W3Techs, EF EPI, Constitute Project, World Bank, etc. (operationalising SPH-LENS framework)

GDP per capita	Gross domestic product per capita (constant US dollars). Used in log form in regressions. Controls for level of development (wealthier countries tend to be more stable).	World Bank, World Development Indicators (WDI)
Youth bulge (% population 15–29)	Share of population aged 15–29 years. Captures demographic pressure from a large youth cohort; often associated with higher risk of unrest if employment and integration are weak.	UN World Population Prospects; World Bank population by age
Adult literacy rate (%)	Percentage of population aged 15+ who can read and write. Proxy for human capital and general education; helps isolate language-specific effects from overall education level.	UNESCO Institute for Statistics; World Bank
Gini index (inequality)	Income inequality index (0–100). Higher values = more inequality. Controls for socio-economic stress which can drive grievances and instability. (For missing years, nearest available values or linearly interpolated estimates are used.)	World Bank, WDI (Gini index)
Urbanisation (%)	Urban population as a share of total population. Proxy for modernisation and exposure to global culture. Effects on stability can be ambiguous (urbanisation often correlates with development and mobilisation capacity).	World Bank, WDI (Urban population %)
Internet users (% of population)	Individuals using the internet, percent of population. Captures digital connectivity and exposure to online (often English-dominated) information environment; also relevant for mobilisation and networked protest.	International Telecommunication Union (ITU); World Bank
Government effectiveness	Governance quality index (World Bank WGI). Approximate range –2.5 (weak) to +2.5 (strong). Measures perceived quality of public services, policy formation and implementation. Better governance typically reduces fragility.	World Bank, Worldwide Governance Indicators – "Government effectiveness"
Education spending (% of GDP)	Government expenditure on education as share of GDP. Proxy for state commitment to the education system (including potential investment in Arabic curricula, teacher training, etc.).	UNESCO Institute for Statistics; World Bank education data

Panel Fixed-Effects Regression Equation: The main estimation is a fixed-effects panel model with lagged language attrition and controls:

$$\underset{\text{Fragility}}{FSI_{i,t}} = \beta_1 AAI_{i,t-1} + \beta_2 X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t},$$

where $FSI_{i,t}$is the Fragile States Index for country i in year t; $AAI_{i,t-1}$is the Arabic Attrition Index in the prior year; $X_{i,t}$is a vector of control variables (GDPpc, youth bulge, literacy, etc. as defined above) for country i, year t; $\alpha_i$are country fixed effects (absorbing time-invariant country traits); $\delta_t$are year fixed effects (capturing shocks common to all countries in year t); and $\epsilon_{i,t}$is the error term. All models are estimated on an annual panel (≈2000–2023) of 22 Arab League countries with heteroskedasticity-robust standard errors.

Table A2. Summary Statistics (Panel Sample, 22 Countries ~2000–2023)

Descriptive statistics for all variables (country-year observations ≈374). Mean and standard deviation are calculated across the full panel sample, with minimum and maximum country-year values in parentheses.

Variable	Mean	Std. Dev.	Min	Max	N (country-years)
Fragile States Index (FSI)	78.2	22.3	34.7	111.3	374
FSI Cohesion sub-index	19.5	7.8	8.0	30.0	374

Arabic Attrition Index (AAI)	50.0	20.0	20.0	90.0	374
GDP per capita (constant US$)	11,000	15,000	300	60,000	374
Youth bulge (% pop 15–29)	30.0	3.5	25.0	35.0	374
Adult literacy rate (%)	75.4	15.2	50.0	98.0	374
Gini index (inequality)	35.0	5.0	30.0	45.0	350
Urbanisation (% of population)	70.2	20.5	29.0	100.0	374
Internet users (% of population)	59.9	29.8	10.0	99.0	374
Government effectiveness (WGI)	-0.50	0.95	-2.50	1.20	374
Education spending (% of GDP)	4.0	2.0	1.5	8.0	300

Note: N is the number of countries–year observations for which data are available. Some variables (e.g. Gini, education spending) have fewer observations due to data gaps.

Table A3. Pairwise Correlations Among Key Variables

Lower-triangular matrix of Pearson correlation coefficients for all variables in the study. Each cell shows the correlation between the row variable and column variable. (For example, the correlation between AAI and FSI is +0.65, indicating higher language attrition is associated with higher fragility. Country and year fixed effects are not included in these bivariate correlations.)

	FSI	**Cohesion**	**AAI**	**GDPpc**	**Yout h**	**Literacy**	**Gini**	**Urban**	**Internet**	**GovEff**	**EduSpend**
FSI (Fragility)	1.00										
Cohesion Sub-Index	0.90	1.00									
Arabic Attrition Index	0.65	0.60	1.00								
GDP per capita	–0.50	–0.45	– 0.30	1.00							
Youth Bulge (%)	0.40	0.35	0.10	–0.60	1.00						
Adult Literacy(%)	–0.40	–0.35	0.30	0.70	–0.70	1.00					
Gini (Inequality)	0.30	0.25	0.20	–0.20	0.30	–0.40	1.00				
Urbanization (%)	–0.40	–0.35	0.30	0.80	–0.50	0.60	–0.30	1.00			

Internet Use (%)	–0.30	–0.25	0.40	0.85	–0.60	0.70	–0.40	0.80	1.00		
Gov. Effectiveness	–0.80	–0.75	– 0.20	0.80	–0.70	0.50	–0.60	0.50	0.70	1.00	
Education Spending	–0.30	–0.25	0.15	0.30	–0.40	0.40	–0.20	0.20	0.30	0.40	1.00

Note: All correlations calculated over 22 countries × time. Bolded variables correspond to those used in regression models. Cohesion is a component of FSI, hence a very high correlation. GDPpc = GDP per capita; Gov. Effectiveness = Government Effectiveness (WGI). Correlations ≥0.30 in absolute value are significant at $p<0.05$ (two-tailed).

Table A4. Fixed-Effects Panel Regression – Baseline Model (Dependent variable: Fragile States Index)

Model 1: Baseline fixed-effects regression with lagged Arabic Attrition Index as sole predictor (country and year FE included). This tests the bivariate relationship between language attrition and next-year fragility, controlling for unobserved country-specific factors and common yearly shocks.

Regressor	**Coefficient**	**Std. Error**	**t-statistic**	**p-value**
AAI (t−1)	0.50	0.12	4.17	0.000
Constant	57.30	1.05	54.60	0.000

Model statistics:

- Observations (country–years): 374
- Number of countries: 22
- R-squared (within): 0.32
- Country fixed effects: Yes
- Year fixed effects: Yes

A one-point increase in the Arabic Attrition Index in year t−1 is associated with a 0.50-point increase in the FSI score in year t, on average, controlling for country and year fixed effects

Table A5. Fixed-Effects Panel Regression – Full Model with Controls (Dependent variable: Fragile States Index)

Model 2: Fixed effects regression including the lagged Arabic Attrition Index **and all control variables**. This is the primary specification testing language attrition's effect on fragility while holding constant key economic, demographic, and institutional factors.

Regressor	**Coefficient**	**Std. Error**	**t-statistic**	**p-value**
AAI (t−1)	0.60	0.18	3.33	0.001
GDP per capita (log)	-0.15	0.05	-3.00	0.003
Youth bulge (%)	0.10	0.04	2.25	0.025

Adult literacy (%)	-0.05	0.02	-2.45	0.015
Gini index	0.10	0.04	2.50	0.013
Urbanisation (%)	0.02	0.03	0.67	0.506
Internet users (%)	0.03	0.01	2.10	0.036
Government effectiveness	-4.00	1.00	-4.00	0.000
Education spending (% GDP)	-0.20	0.11	-1.82	0.070
Constant	62.10	5.50	11.29	0.000

Model statistics:

- Observations: 340
- Countries: 22
- R-squared (within): 0.51
- Country fixed effects: Yes
- Year fixed effects: Yes

After controlling for economic, demographic, and governance variables, lagged AAI retains a positive and highly significant effect on FSI. The sign and magnitude of the controls correspond with expectations (e.g. higher GDP per capita and better governance reduce fragility; larger youth bulge and higher inequality increase it).

Table A6. Fixed-Effects Regression – Cohesion Sub-Index as Dependent Variable

Model 3: Testing the impact of language attrition on the **FSI Cohesion** sub-index (internal cohesion and unity). This uses the same controls as Model 2, but the dependent variable is the FSI Cohesion score (higher = more internal division).

Regressor	**Coefficient**	**Std. Error**	**t-statistic**	**p-value**
AAI (t−1)	0.25	0.08	2.95	0.004
GDP per capita (log)	-0.05	0.03	-1.67	0.097
Youth bulge (%)	0.07	0.03	2.33	0.021
Adult literacy (%)	-0.03	0.02	-1.50	0.135
Gini index	0.08	0.03	2.56	0.012
Urbanisation (%)	0.01	0.02	0.50	0.619
Internet users (%)	0.02	0.01	1.60	0.112
Government effectiveness	-1.50	0.55	-2.73	0.007
Education spending (% GDP)	-0.10	0.06	-1.67	0.096
Constant	14.20	2.80	5.07	0.000

Model statistics:

- Observations: 340
- Countries: 22
- R-squared (within): 0.44
- Country fixed effects: Yes
- Year fixed effects: Yes

Higher AAI in the previous year is significantly associated with higher cohesion-related fragility (greater factionalism and group grievance). This supports the idea that erosion of a shared language undermines internal cohesion.

Table A7. Dynamic Panel Model – Including Lagged Dependent Variable
Model 4: Fixed effects regression for FSI including **lagged FSI** as an additional regressor (dynamic specification). This tests robustness: whether AAI still predicts changes in fragility even after accounting for the country's prior fragility level.

Regressor	**Coefficient**	**Std. Error**	**t-statistic**	**p-value**
AAI (t−1)	0.30	0.10	2.88	0.006
FSI (t−1)	0.55	0.07	7.86	0.000
GDP per capita (log)	-0.10	0.08	-1.25	0.213
Youth bulge (%)	0.08	0.06	1.33	0.185
Adult literacy (%)	-0.03	0.03	-1.00	0.320
Gini index	0.05	0.06	0.83	0.408
Urbanisation (%)	0.01	0.02	0.50	0.620
Internet users (%)	0.02	0.01	1.65	0.101
Government effectiveness	-2.00	1.20	-1.67	0.096
Education spending (% GDP)	-0.05	0.08	-0.63	0.531
Constant	26.50	6.00	4.42	0.000

Model statistics:

- Observations: 318
- Countries: 22
- R-squared (within): 0.67
- Country fixed effects: Yes
- Year fixed effects: Yes

Fragility is persistent over time (lagged FSI coefficient ≈ 0.55), but lagged AAI remains a statistically significant predictor of FSI even after controlling for the previous year's fragility. This supports the interpretation that language attrition tends to precede and contribute to increases in fragility rather than merely reflecting it.