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Adaptive Capacity Index: A Decision-Support Tool for Prioritizing Investments under Wartime Migration Pressure in Ukraine

Master's Thesis

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ABSTRACT

Since 2022, Ukrainian hromadas have faced multiple wartime challenges that frequently pose similar structural problems. Frontline hromadas struggle with wrecked infrastructure and unstable finances; Western hromadas experience many new arrivals, stretching local services. But despite differing situations, oblast budgets and donor programmes have been built on pre-war assumptions of population and needs for services. And that gap, known as Allocative Lag, stems from how institutions are structured rather than from individual errors.

To address this, the Adaptive Capacity Index is proposed as a decision-support instrument. It assigns each hromada a Priority Score of 0 to 100, given demographic pressure, service gaps, and response ability. The Index incorporates only publicly available remote data, allowing oblast administrations, donors and analysts to access it independently without hromada input. The tool is tested on a paired-oblast design comparing Kharkiv (frontline) and Lviv (Western receiver) oblasts, with 10 hromadas in each. The empirical results aim to confirm the existence of Allocative Lag, demonstrate ranking robustness across eleven combined weight scenarios, and show that the same instrument architecture produces context-specific rankings in structurally different oblasts.

Keywords: Adaptive Capacity Index; hromada; allocative lag; service gap; MCDA; wartime decentralization; IDPs; hromadas; remote data;

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INTRODUCTION

In frontline and surrounding oblasts such as Kharkiv, Dnipropetrovsk, Donetsk, and Zaporizhzhia, hromadas have seen housing and service infrastructure shattered. These regions also handle changing populations in light of shelling and evacuations, and their respective local economies have taken a hit.

Conversely, most oblasts in western Ukraine (Vinnytsia, Khmelnytskyi, Lviv, Ivano-Frankivsk, Chernivtsi, Zakarpattia) have a different threat. Most of their infrastructure is well preserved, yet they are inundated with new arrivals, with populations often increasing by 15 - 30% compared to pre-war levels. An example is the 57% growth in hromadas (IOM, 2024).

These situations are however alike in terms of the management problem. That is evident in the allocation of resources by oblasts. Annual cycles and formulas based on prewar population and service figures still drive capital transfers, recovery funds and donor support programs. For example, Umland (2025) observes that following the shifting of military personal income tax to the central budget in 2023, small towns lost up to 45 per cent of their revenue in 2024. Oblast military administrations have recentralized some recovery funds but continue to refer back to pre-war priorities (Rabinovych, Brik, Darkovich, Hatsko and Savisko, 2025). Romanova (2025) also discovers that hromada leaders are more sensitive to voting residents than to IDPs. All of these problems stem from the same root issue: resources are still provided and managed with obsolete knowledge and tools.

This thesis explores strategies to improve the prioritization of service investments by hromadas. Given the rapid and often opaque demographic and infrastructure transition happening over time, a solution that has a working efficacy will need to take account of both the front and the back end of oblast systems.

The primary research problem in this study is whether a single, transparent decision-support instrument - one using publicly available remote data only - can efficiently rank hromadas for state budgeting, recovery funds, and donor decision-making in a frontline oblast and a Western Ukrainian oblast based on 2024 - 2026 data.

This study is a confirmatory one. The notion of Allocative Lag is derived from theoretical as well as experimental findings in path-dependency, adaptive governance, and Ukrainian wartime decentralization. The primary objective is to apply the Adaptive Capacity Index and test the theory against empirical hypotheses, rather than leaving questions open at each round. Instead of just seeking expert opinions, the Index is tested against actual budget allocations.

The thesis is organized as follows. The Literature Review synthesizes related strands of research and examines how this thesis addresses integration gaps among them. The Analytical Framework provides central concepts and hypotheses for empirical testing. The Methodological Design presents the rationale behind the choice of the Weighted Sum MCDA approach, explains the paired oblast-level comparative design, and outlines the data sources for the Index. The Results chapter presents the empirical application of the ACI to

20 hromadas (10 in Kharkiv, 10 in Lviv), tests all five hypotheses, and includes case-study highlights. The Discussion translates findings into policy recommendations for three audiences. The Conclusion summarizes contributions and outlines directions for future research.

LITERATURE REVIEW

Five key areas of scholarship form the basis of the problem of prioritizing wartime service in Ukrainian municipalities. For this research, it is crucial to understand the relationship between these areas.

The first strand, path dependency in political and institutional economy, provides insight into why budget allocations are slow to change. Pierson (2000) calls path dependence a process by which early decisions make it harder to change course later. Laws and state regulations draw lines, and the cost of redrawing them becomes steep. According to Mahoney (2000), institutions tend to reinforce themselves - early decisions of institutions take hold. In Ukraine, this explains why 2021 budget formulas continue to guide allocations in 2025 despite a transformed reality. This literature largely explains the problem but does not provide solutions.

The second strand, adaptive governance and urban resilience, follows from that specification. Folke (2006) uses the term adaptive capacity in social-ecological systems as the capability to tolerate disturbance and reorganize while still retaining core functions. On strategic spatial planning, Albrechts (2004) provides a similar rationale: planning is not static but iterative, the kind of planning that explicitly calls for standing tools that keep shifting over time. The implication for Ukrainian wartime governance is clear: hromadas and oblasts need standing prioritization tools, not crisis-management improvisation. What this literature does not provide is the tool itself - it prescribes adaptive instruments in the abstract without laying out how, in the Ukrainian administrative-territorial context, they should function.

The third strand, Multi-Criteria Decision Analysis (MCDA) in public administration, provides a technical point of view. MCDA is a set of methods for combining different decision criteria - particularly when they cannot be measured on the same scale. Comparing the number of IDPs against institutional readiness or against population pressure makes a single-metric comparison difficult. Saaty (1980) proposed the Analytic Hierarchy Process, one of the best-known MCDA techniques. The topic was later chronicled and made canonical in the first major textbook by Belton and Stewart (2002). In a more recent study, Więckowski and colleagues (2023) showed that the Weighted Sum Model - a weighted sum of scores for each criterion - is the most transparent for policy audiences, particularly those without specialist expertise. For this reason, the Weighted Sum Model is employed in this thesis.

The fourth strand, emerging Ukrainian literature on wartime decentralization and IDP integration, outlines the operating context of the Index. Rabinovych, Keudel, Huss, and Levchenko (2024) demonstrate that the 2014 - 2020 decentralization reform had a significant positive impact on hromada resilience during the 2022 invasion. Rabinovych, Brik, Darkovich, Hatsko and Savisko (2025) condition this finding, noting how oblast military administrations operating under martial law have partially recentralized recovery funds. The hromada-level fiscal injury can be quantified in Umland (2025). Romanova (2025) delineates the mechanism most closely related to this thesis: the IDP accountability asymmetry, whereby hromada leadership is systematically more responsive to voting residents than to non-voting displaced populations. This literature is empirically diverse but methodologically disjointed: research generally looks at one form of hromada at a time and does not merge the phenomena into a single operational tool.

The fifth strand tackles the data problem underpinning the accountability asymmetry: much of the wartime internal migration that occurred in Ukraine is not visible in official statistics. IDPs who relocate with relatives, informally rent, or move frequently are infrequently re-registered at destination points, leading to a structural undercount in formal registers. The canonical precedent set by Bengtsson and colleagues (2011) using anonymized mobile-phone data for the estimation of post-disaster displacement has to date not been replicated systematically in Ukraine. Shibuya, Jones and Sekimoto (2025) extended this methodology directly to Ukraine using GPS data from 25 million mobile devices to produce validated oblast-level displacement estimates. The limitation is that this literature has remained retrospective rather than operational - deployed to describe displacements after the fact rather than embedded in municipal or oblast decision-support systems - and access to fine-grained mobile-operator data at the hromada level remains challenging for independent researchers.

Bringing these five areas together highlights the contribution of this thesis. Path-dependency theory clarifies the issue; adaptive-governance research urges ongoing tools; MCDA provides the framework; research on Ukrainian wartime governance provides context and accountability; and displacement-proxy studies demonstrate how to measure hidden migration. None of these strands has been combined in any existing work that synthesizes them into a single, cross-hromada ranking tool. This is the integration gap the current thesis seeks to bridge.

ANALYTICAL FRAMEWORK

The analytical framework explicitly defines the concepts the thesis uses, as well as the expected relationships between them. There are seven concepts that appear throughout. Four describe the problem the Index is built to solve; three describe the instrument itself.

Concepts that name the problem

Allocative Lag is the structural discrepancy between an oblast's pre-war budget and allocation commitments, and the wartime geography of real-time need. It is not the result of individual incompetence; it is what happens when annual budget cycles, multi-year procurement contracts, and population-based funding formulas come into conflict with demographic or infrastructural shocks. Allocative Lag is what happens as capital transfers continue to flow at pre-war levels into hromadas whose population profiles have changed significantly in a Western oblast. Recovery-fund distributions have continued to flow through a frontline oblast following pre-war administrative hierarchies rather than current damage and demographic profiles. The naming of the phenomenon is important, because it locks responsibility into a clear instrument, not at individual discretion.

Service Gap is the difference between actual service demand and operational service capacity in a hromada, which is determined by variation from an oblast baseline or national norm. In a Western recipient hromada, a Service Gap is an average school load that deviates significantly from planned capacity, and the patients-per-family-doctor ratio goes above the Ministry of Health norm. In a frontline hromada, this is a significant reduction in functional service capacity (due to damage, staff displacement, or closure) despite the fact that nominal demand is low. The idea converts a universal feeling of "overload" or "degradation" into a precise, cross-hromada equivalent of measurement. It also captures the accountability asymmetry demonstrated by Romanova (2025): the fact that IDPs seldom vote in local elections, the Service Gap that they face is systematically under-represented in local political feedback loops so formal tooling is necessary to unearth it.

Data Invisibility denotes the gap between official IDP registers and the de facto displaced population. An IDP who has moved in with relatives typically does not re-register; a family that has relocated to informal rental housing may retain its original registration; a person who has moved multiple times since 2022 is usually counted only once. The operational consequence is that a hromada officially hosting 4,000 IDPs may in fact be serving 6,000 or 7,000 residents who use its services. Any prioritization instrument that relies exclusively on the register systematically underallocates resources to high-intake hromadas. The Index addresses this problem in two ways: it supplements the register within Pillar 1 with remote-accessible demographic signals - including the composition of the registered IDP population by age and disability - and it cross-checks its output against independent market signals of real population activity.

Adaptive Capacity denotes the ability of a hromada's fiscal, administrative, and technical apparatus to redirect resources once a prioritization signal has been identified. A hromada with a healthy reserve-fund share of the budget, low unspent-capital balances, a track record of donor absorption, and shovel-ready project designs on file has materially greater Adaptive Capacity than one whose finance department is stretched thin, whose projects take eighteen months from plan to tender, and whose external-funding history is thin. Adaptive Capacity does not generate need; it determines how rapidly a hromada can respond to need once it has been identified. This is why it is listed in the Index as an enabler pillar rather than as a primary driver of the ranking.

Concepts that describe the instrument

Priority Score is the total value of the Adaptive Capacity Index (ACI), scaled from 0 to 100 for each hromada considered. A high Priority Score means a hromada has a high demographic burden, shows a significant Service Gap, and has enough administrative capacity for a reallocation signal to be actionable. Priority Score provides a response to the question that an oblast military administration or donor program managers often face during the planning phase: among the hromadas considered, which ones are the furthest behind on the adaptive curve, and so would support capital transfers, recovery-fund allocations, or program selection more? A Priority Score of 75 doesn't mean that a hromada in general is inherently "better" than a hromada with 60; it means that its multi-criteria case for prioritization is substantially stronger along the weighted axes. Score is no allocation rule, it is a decision-support number. A proxy is a quantifiable variable that replaces an underlying construct that cannot be measured directly. Unregistered IDP populations can't be counted directly as well, but they leave indirect traces in rental-market inflation, parcel-flow activity, mobile-operator subscriber density, and school-enrollment patterns. Each of the proxy measures is weak in and of itself, and can be misleading individually, but on the whole, they are much more robust than any one measure or register.

What the Index measures and what it predicts

The Adaptive Capacity Index combines the four problem concepts through three weighted pillars. The first pillar, Demographic Pressure (weight 0.40), measures real population pressure through three sub-indicators: (a) registered IDPs per 1,000 pre-war residents from Ministry of Social Policy registry data, log-transformed to handle frontline outliers; (b) a vulnerability composite - the average of normalized shares of children under 18, persons with disabilities, and pensioners among registered IDPs - from the same registry, replacing an earlier linear IDP-share variable found to be multicollinear with (a) at Spearman $\rho = 0.995$; and (c) year-on-year change in school enrolment against the 2021/22 baseline from oblast education department open data, inverted so that enrolment decline is read as displacement pressure invisible to the formal register. The second pillar, Service Gap (weight 0.40), captures how far service provision has drifted from operational norms through three sub-indicators: (a) the primary-care load ratio - declarations per family doctor against the Ministry of Health 2,000-per-doctor benchmark - from NSZU/eHealth public data; (b) the year-on-year change in registered family doctors (2021 to 2026), inverted so that personnel loss is read as a service-system gap; and (c) the class-fill ratio against normative capacity from Ministry of Education open data. Together, these capture both overload (expected western region pattern) and capacity erosion (expected frontline pattern) within the same architecture. The third pillar, Fiscal and Technical Agility (weight 0.20), measures whether the hromada can act on a prioritization signal: the reserve-fund share of total budget from OpenBudget.gov.ua; execution rate and unspent-capital balance from the same source; project-readiness data from DREAM; and absorption track record computed from Prozorro procurement records. The weighting of 40% for demographic pressure, 40% for service gap, and 20% for fiscal-technical agility reflects a normative position: demographic pressure and service gap deviation are the primary drivers of need under wartime conditions, while fiscal and technical agility is an enabler rather than an independent source of need. A hromada with low agility still surfaces in the ranking where the need is high; the low agility signals that external support (oblast or donor intervention) is likely required for the prioritization signal to translate into action. This is precisely the kind of diagnostic output a donor program requires. The weights are tested through sensitivity analysis at alternative specifications, and the internal Pillar 1 sub-weights are tested separately; if the Index is functioning correctly, the ranking should not shift dramatically under reasonable reweighting.

In the empirical stage five hypotheses are tested. The first hypothesis, on Allocative Lag, is that existing local government funding remains underlined by pre-war logic and not in light of changing hromadas' needs. The index anticipates that it will significantly differ from the planned spending pattern of government through the 2023 - 2025 subvention allocations panel. It aims to illustrate an Allocative Lag, whereby cities are still being funded according to the pre-war footprint, even as newly high-need zones emerge throughout the war.

The second hypothesis is that a Priority Score above 60 points accurately identifies hromadas constrained by limited service - this could range from typical school loads above 120% of designed capacity in a Western town being observed to reduced operational infrastructure capacity (below 60% pre-war) in or near the frontline. This serves as a measurable criterion the Index can be employed by oblast military administrations and donor programs to shortlist candidates.

The third hypothesis, of external-signal validity, states that the Index's highest-ranked hromadas will correlate positively with independent external signals of real population pressure - IOM DTM oblast-level shares, Clarity Project measures of reconstruction activity, and aggregate procurement intensity. This is the validation test of the Index against independent estimates of population distribution and recovery activity drawn from other data sources.

The fourth hypothesis, robustness, holds that the top-20% hromada selection under baseline weights is stable under reasonable reweighting, that no more than 25% of top-ranked members will change under alternative specifications. The model is reliable, unbiased, and would not be biased by personal or political interests to favor particular projects, which is why showing this stability is important to making this an effective tool.

The fifth hypothesis, on cross-context consistency, is the central claim of the paired-case design. It predicts that the same baseline weighting produces coherent and policy-relevant rankings in both the frontline and Western oblasts, while the sub-indicators driving each ranking differ systematically. For example, the year-on-year decline in registered family doctors (P2b) and depressed class-fill ratios (P2c) dominate the service-gap signal in the frontline oblast - both proxies for service-system erosion driven by displacement and damage - while elevated class-fill ratios and high declarations-per-doctor pressure dominate Pillar 2 in the Western oblast, reflecting overload rather than erosion. Within Pillar 1, the vulnerability composite is expected to produce an analogous cross-context inversion in the demographic profile of registered IDPs. Confirming this hypothesis would demonstrate that the Index functions as a genuinely adaptive instrument, with its architecture remaining stable while its operational content responds to the structural differences between oblasts.

METHODOLOGICAL DESIGN

Why an index and not a cost-benefit calculation

Three methodological approaches were considered before the choice adopted in this thesis. The first, cost-benefit analysis (CBA), is the benchmark in infrastructure valuation and has the advantage of producing a single monetary value comparable across projects. Its most serious shortcoming in the current context is that all decision criteria must be reduced to a common monetary unit. Several important criteria in this thesis are untenable to monetize: the political legitimacy implications of donor-fund allocation, the institutional readiness of a finance department to perform in a fiscal-cycle manner, and the signalling effect of identifying IDP populations within allocation decisions. CBA either ignores these criteria or relies on arbitrary shadow prices that obscure rather than clarify the rationale for allocation.

The second approach considered was the pure case study method. While deep, it does not result in a replicable ranking tool that can be employed across allocation cycles.

The third approach is Multi-Criteria Decision Analysis (MCDA). This thesis adopts a particular variant - the Weighted Sum Model - rather than the more complicated Analytic Hierarchy Process or TOPSIS, out of a commitment to transparency. AHP requires pairwise consistency checks that impose significant training costs on decision-makers; TOPSIS is based on geometric distance calculations that many users cannot easily access. The Weighted Sum Model is readable for anyone who can read a spreadsheet. Więckowski et al. (2023) also confirm the Weighted Sum variant as the most transparent for policy context.

The design is quantitative and document-based. The rankings are produced by the Index and its application; the validation layer, described below, tests whether the rankings meaningfully differ from actual practice and whether the instrument is sound. The choice of budget-based back-testing and document-based analytical verification is deliberate: it relies on replicable public evidence, circumvents the access and ethical-review challenges that accompany primary fieldwork under martial law, and provides a research-timeline compatibility with serious quantitative analysis of both case oblasts.

Two oblasts, one instrument: the paired-case design

At the empirical center of the thesis is a comparison of two Ukrainian oblasts chosen for max structural contrast on the indicators that matter: level of war exposure, financial strain, demographic profile, and infrastructure condition. Yin (2018) calls it "theoretical replication" rather than literal replication. In literal replication, two similar cases are analyzed to demonstrate that a phenomenon repeats; in theoretical replication, two distinct cases are investigated to establish that a single instrument is capable of producing useful results that are context-dependent in each. This thesis adopts the logic of theoretical replication because its premise is not that all Ukrainian oblasts face identical wartime threats - they obviously do not - but rather that a single instrument can help to map differing pressures in comparable terms for decision-makers.

The first case is Kharkiv oblast, a frontline oblast experiencing severe and sporadic infrastructure damage, population disruption from evacuation and partial return, collapsed own-source tax bases, and a large but uneven donor presence. The second case is Lviv oblast - a Western recipient oblast characterized by intact infrastructure under population load, rental-market activity, the inflow of business registration from relocated enterprises, and minimal physical damage. Lviv was chosen because it satisfied all three preselection conditions: a recorded IDP intake level above a reference threshold (IOM DTM Round 23 reports 9% IDP share, 149,000 IDPs); adequate data availability at hromada level through OpenBudget.gov.ua and ministry open-data portals; and comparability in hromada count to the frontline case. In each oblast, ten hromadas were chosen, resulting in a total sample size of 20.

Use cases serve to show how the pairing structure becomes analytically informative. In the Western oblast, an oblast military administration planning the 2026 capital-transfer allocation can take the Priority Score ranking as one input, concentrating transfers on hromadas with high scores driven by population load on intact infrastructure. In the frontline oblast, the same administration could apply that ranking to determine where allocations to recovery funds should be targeted - hromadas with low infrastructure integrity and measurable continuing demographic activity, for example. A donor program selecting 5 out of 20 candidate hromadas for a multi-year support package can combine needs and absorptive capacity by using the Index output rather than defaulting to the familiar mode of funding hromadas with the highest media visibility.

Remote-only data collection - sources and their limits

The research operates exclusively on publicly accessible remote data sources, without direct data requests to individual hromadas. This constraint is deliberate and reflects three considerations: it enables the Index to be replicated by any analyst without requiring hromada cooperation, which materially strengthens its adoption case; it avoids the uneven and politically sensitive access negotiations that would be required under martial law; and it keeps the research within a timeline compatible with the thesis schedule. The constraint is that indicator granularity is limited to what each source publishes, which in practice means that hromada-level is the lowest level of detail available for most indicators.

Several remote data streams populate the Index. The first is the Ukrainian open-budget infrastructure: OpenBudget.gov.ua provides hromada-level budget execution rates, reserve-fund shares, and unspent-capital balances; Clarty Project (Clarity Project, 2026) aggregates DREAM project readiness data and Prozorro procurement records and computes donor-absorption ratios. This stream populates Pillar 3. The second stream is ministry-level open data: Ministry of Social Policy IDP registry releases at the hromada level populate the IDP density and the vulnerability composite components of Pillar 1; Ministry of Education statistics on school enrolment and capacity populate two distinct indicators - year-on-year enrolment change feeds Pillar 1 as a demographic-pressure proxy, while class-fill ratios feed Pillar 2 as a service-gap proxy; NSZU/eHealth publicly released family-doctor registration data populates both the primary-care load component and the ΔDoctors indicator in Pillar 2.

The limitations of each source are mentioned openly. Registry data lags actual movements by months and systematically undercounts informal IDPs. The revision frequency and completeness of ministry open data differ between oblasts. IOM DTM coverage does not extend to every round and may not be at hromada-level granularity in all cases - for this reason DTM is used as oblast-level context rather than as a hromada-level Index input. Aggregate market-activity signals at the oblast level do not distinguish between hromadas within the oblast. These limitations do not invalidate the instrument; they constrain its resolution.

Validation strategy - budget back-testing and analytical verification

The validation strategy combines budget back-testing with analytical verification. Index validation is performed through complementary methods that operate entirely on reproducible public evidence.

The principal validation technique is budget back-testing across the 2023 - 2025 panel of capital-transfer subventions under economic code 41030000. OpenBudget.gov.ua publishes subvention data for each hromada and each year. The validation compares the Index's Priority Scores with the actual subvention amounts received, normalized to per-de-facto-resident terms so that comparisons across hromadas of very different size are meaningful. Each year produces a label per hromada - Underfunded if the per-de-facto subvention rank lags the ACI rank by 5 or more positions, Overfunded if it leads by 5 or more, Aligned otherwise - and the three annual labels are aggregated into a persistence verdict (UNDER, Aligned, OVER).

A significant and persistent discrepancy between the two rankings would indicate that the Index is meeting its main objective: identifying locations where funds are not allocated despite extremely high demand. If the lists are nearly identical the Index is duplicative, and current spending is already well deployed. Extending this test to the two oblasts together establishes a natural comparison: whether spending patterns are data-driven or whether specific hromadas are consistently overlooked because of budgetary inertia. In practical terms, it is unlikely that two structurally different oblasts would independently achieve the same allocation efficiency by chance. The model is additionally validated through Sensitivity Analysis, which adjusts the weights of the three pillars (Demographic Pressure, Service Gap, Fiscal Readiness) and the internal Pillar 1 sub-weights, and tests whether the top-ranked hromadas remain stable under variation. When the top-priority hromadas are consistent under small modifications in weighting, the Index can be called stable and objective. Together, the two layers of validation replace primary fieldwork with replicable analysis grounded in public records.

During the research design phase, an additional data stream was identified as a potential external-signal validation layer: aggregated rental-market indicators (LUN.ua), postal service-point density evolution (Nova Poshta), and aggregated mobile-operator density. Each of these was assessed for fitness in the empirical phase and excluded on documented grounds. LUN.ua rental data is published primarily for oblast capitals and several major cities; in the sample of 20 hromadas analyzed, only two are oblast centers, which makes the coverage systematically biased against the sample. Nova Poshta service-point density does not vary meaningfully across hromadas of comparable size in either oblast, providing insufficient discriminatory power. Mobile-operator subscriber density is not released publicly at hromada granularity and is available only under commercial licensing arrangements outside the scope of this thesis. As a consequence, external-signal validation in the form initially specified in the Research Design is not implemented in the empirical chapter; in its place, IOM DTM oblast-level signals and DREAM hromada-level reconstruction activity serve as the available external cross-checks.

Ethical considerations

Two categories of ethical concern remain relevant to the thesis as structured for remote-only data collection, each paired with a concrete mitigation.

The first concerns privacy in the analysis of derivative data. Although the research does not collect individual-level data directly, aggregated indicators drawn from public sources can in principle permit re-identification in small hromadas with small residual populations, particularly in frontline cases. Minimum cell-size thresholds are applied throughout: hromadas with residual populations below a defined threshold are not reported separately, and all analyses operate at the hromada level, with no disaggregation to sub-hromada units. No individual-level data is handled by the research at any stage.

The second concerns the political sensitivity of cross-hromada and cross-oblast comparison. A ranking that places one hromada above another, or one oblast's hromadas systematically above another's, can be politicized as a statement about relative suffering or relative deservingness. The Index is presented throughout as a decision-support tool for oblast and donor allocation decisions, not as a cross-oblast allocation rule. Sensitivity-analysis tables accompany all ranking results, making explicit the range of rankings produced under reasonable weight variations.

RESULTS

This chapter discusses the use of ACI for 20 hromadas of Kharkiv and Lviv oblasts. I first walk through the data assembly and normalization, then the ranking itself, then test each hypothesis, and conclude with case studies that show what the Index can and cannot do under the revised specification.

Data Assembly and Normalization

To fill the scoring matrix I accessed data from six remote sources. For Pillar 1 (Demographic Pressure), the basic information sources were the Ministry of Social Policy IDP registry as of May 2026 - including its disaggregation of registered IDPs by age cohort, disability status, and pension recipiency - school enrollment figures from the Ministry of Education for the 2024/25 academic year against the 2021/22 baseline, and IOM DTM Round 23 survey data (International Organization for Migration, 2026) collected in early 2026 for oblast-level cross-reference. Pillar 2 (Service Gap) depended on NSZU eHealth declaration data (National Health Service of Ukraine, 2026) - the baseline of December 2021 and current data of June 2026 - in addition to school-load statistics from MoES. Pillar 3 (Fiscal and Technical Agility) originated from OpenBudget.gov.ua budget execution figures for 2024 (Ministry of Finance of Ukraine, 2024) and the Clarity Project datasets (Clarity Project, 2026), which aggregate DREAM project registers and Prozorro procurement data (Prozorro, 2026).

All twenty hromadas have complete data in all pillars. Zero missing values. This is not an accident - it is the direct result of the remote-only design constraint. Each of these indicators was specifically selected because it is published at the hromada level without requiring cooperation from any single hromada administration.

The ten Kharkiv hromadas in the sample are Balakliia, Bohodukhiv, Chuhuiv, Derhachi, Izium, Kharkiv city, Berestyn (Krasnohrad), Kupiansk, Lozova, and Zlatopil (Pervomaisk). The ten Lviv hromadas are Sheptytskyi (Chervonohrad), Drohobych, Horodok, Lviv city, Mykolaiv, Sambir, Stryi, Truskavets, Turka, and Yavoriv. The choice was based on availability of data and variation in population size and geographic position within each oblast.

The Kharkiv selection harmonizes hromadas along the full spectrum of frontline contact. Izium and Kupiansk have been the heaviest victims of war: both were occupied for months during 2022, and both still have the highest cumulative population losses and infrastructure damage in the oblast. Chuhuiv and Balakliia are second-tier frontline cities, partially damaged but functioning - Chuhuiv with a heavy IDP intake at 31.1% of pre-war population, Balakliia rebuilding from a month-long occupation. Kharkiv city is the oblast capital at 1.43 million residents (215,825 registered IDPs), the single largest hromada in the sample. Derhachi is the close suburb hromada north of Kharkiv city, an analytically relevant intermediary case: shelled but not occupied, evacuated but not depopulated. Bohodukhiv is a slightly smaller hromada in northern western Kharkiv with the highest IDP-to-resident ratio in the sample (42.9%). Berestyn (Krasnohrad) and Zlatopil (Pervomaisk) are small southern-oblast hromadas where direct shelling exposure is lower. Lozova rounds out the set as a mid-size transport-hub hromada in the south-east that absorbed a steady stream of IDPs from neighbouring Donetsk oblast.

The Lviv selection reflects internal diversity in another way. Lviv city accounts for the largest share with 780,804 residents and 94,959 registered IDPs (12.4%) - the western touchstone and the only Lviv hromada with service-system scale comparable to Kharkiv city. Truskavets and Drohobych form a southern resort-and-industrial cluster: Truskavets stands out because pre-war sanatoriums and hotels gave it unusually high absorption capacity (31.3% IDP share, highest in Lviv oblast). Yavoriv lies near the Polish border and hosts a major military training facility, which shapes its population profile. Stryi and Sheptytskyi (Chervonohrad) are medium-scale industrial hromadas - Stryi a transit hub, Sheptytskyi (Chervonohrad) the historic coal centre of the oblast. Horodok and Mykolaiv are smaller suburban-rural hromadas oriented toward Lviv city as commuter and supply hinterland. Sambir is a small western hromada near the Polish border with sparse IDP intake. Turka illustrates the rural Carpathian profile: low population (22,529), limited absorption infrastructure, and the lowest IDP density in the sample of 20. Together the two oblast clusters cover the structural contrast the paired-case design requires.

Four normalization decisions deserve to be made explicit. First, I log-transformed the IDPs-per-1,000-residents variable (P1a) and then applied min-max scaling. Kharkiv city has 215,825 IDPs against 1.43 million population; without the log step it would have consumed the whole scale, squashing all 19 other hromadas into a narrow band - taking up roughly 67% of the linear scale and compressing the remaining 19 hromadas into 33%. The log step maintains rank ordering while allowing the rest of the sample to differentiate.

Second, the second Pillar 1 indicator (P1b) is a vulnerability composite that replaces an earlier specification using linear IDP share. After the pilot run I tested whether P1a (log-transformed density) and the linear IDP share carried independent signal: across the 20 hromadas they correlated at Spearman $\rho = 0.995$ - effectively the same construct measured at two different scales. To avoid double-counting density within Pillar 1, I replaced the linear share with a composite that uses three different sub-indicators from the Ministry of Social Policy IDP registry: the share of children under 18 among registered IDPs, the share of persons with disabilities, and the share of pensioners. Each share is min-max normalized across the 20 hromadas, then averaged. This composite captures the composition of the displaced population rather than just its size - and as I show in the Hypothesis 5 section, it produces a near-mirror inversion of demographic profile between the two oblasts that the original IDP-share variable could not surface.

Third, I reversed the school enrollment change in P1c: a larger decline is associated with greater demographic demand, so the standardized score increases when enrollment of students decreases. The formula is simple - min-max normalization on the negative values, so a hromada that lost 15% of its students scores above one losing 5%.

Fourth, I inverted the doctor-change variable (P2b) the same way: losing more doctors means a bigger service gap. Izium, which went from 26 to 12 family doctors (-54%), scores high on P2b. Kupiansk (-70%, from 33 to 10) would score even higher, but its overall P2 is moderated by a lower declarations-per-doctor ratio because so many residents have left. The full normalization protocol, including all formulas and variable definitions, is documented in Appendix C.

Integration of Clarity Project Data

My original design flagged DREAM project readiness and Prozorro donor-absorption data as planned Pillar 3 sub-indicators, but I did not have them at the draft stage. The Clarity Project dataset (Clarity Project, 2026), which aggregates both sources at the hromada level, solved that problem. Pillar 3 now has three sub-components: the OpenBudget composite (reserve-fund share, capital-expenditure execution rate, own-revenue base, and unspent-capital balance) at 50% weight; DREAM absorption rate (financing disbursed as a share of approved project budgets) at 30%; and Prozorro contract-execution rate (contracted value as a share of announced procurement value) at 20%.

ACI Scoring Matrix and Composite Ranking

The composite ACI score ranges from 79.6 (Izium, rank 1) to 29.3 (Sambir, rank 20), with a mean of 46.7 and standard deviation of 10.5. The top five are Izium (79.6), Derhachi (59.4), Chuhuiv (57.5), Kharkiv city (55.1), and Balakliia (52.7) - all from Kharkiv oblast. The full matrix with all nine sub-indicators is in Appendix A.

The all-Kharkiv top-5 is itself a meaningful shift from the earlier specification I eventually shifted from by adopting better subindicators, which placed Truskavets at rank 4 and Bohodukhiv at rank 3. Under the vulnerability composite, both move down - Truskavets to rank 9 and Bohodukhiv to rank 6 - because their IDP populations have demographic profiles much closer to the western pattern (young families, low pensioner share) than to the frontline pattern (elderly stayed-behind population with elevated disability share). What promoted Derhachi (rank 2) and Balakliia (rank 5) into the top-5 is precisely that vulnerability differential: 25 - 33% pensioners and 4 - 5% persons with disabilities among their IDP populations, against the Lviv cluster average of 16.5% pensioners and 2.2% disabled. The ranking no longer answers only "how many IDPs are there" - it answers "how many displaced people who structurally constrain service systems are there."

Mid-rank changes also demonstrate a bright example. Zlatopil (Pervomaisk), which sat at rank 9 in the earlier specification largely because of high IDP density, falls to rank 16 under the vulnerability composite because its IDP composition is dominated by young families (24.1% children, 0.5% disabled, 15.9% pensioners) - a profile that signals absorption pressure rather than service-system collapse. Kupiansk moves up from rank 15 to rank 13 because the vulnerability sub-undicator captures what the IDP count alone cannot: 52.4% of Kupiansk's registered IDPs are pensioners, the highest share in the sample. Horodok and Drohobych also move up substantially (from rank 13 to rank 7 and from rank 12 to rank 10), both Lviv hromadas where the modest absolute IDP intake masks a relatively higher share of vulnerable cohorts among the displaced.

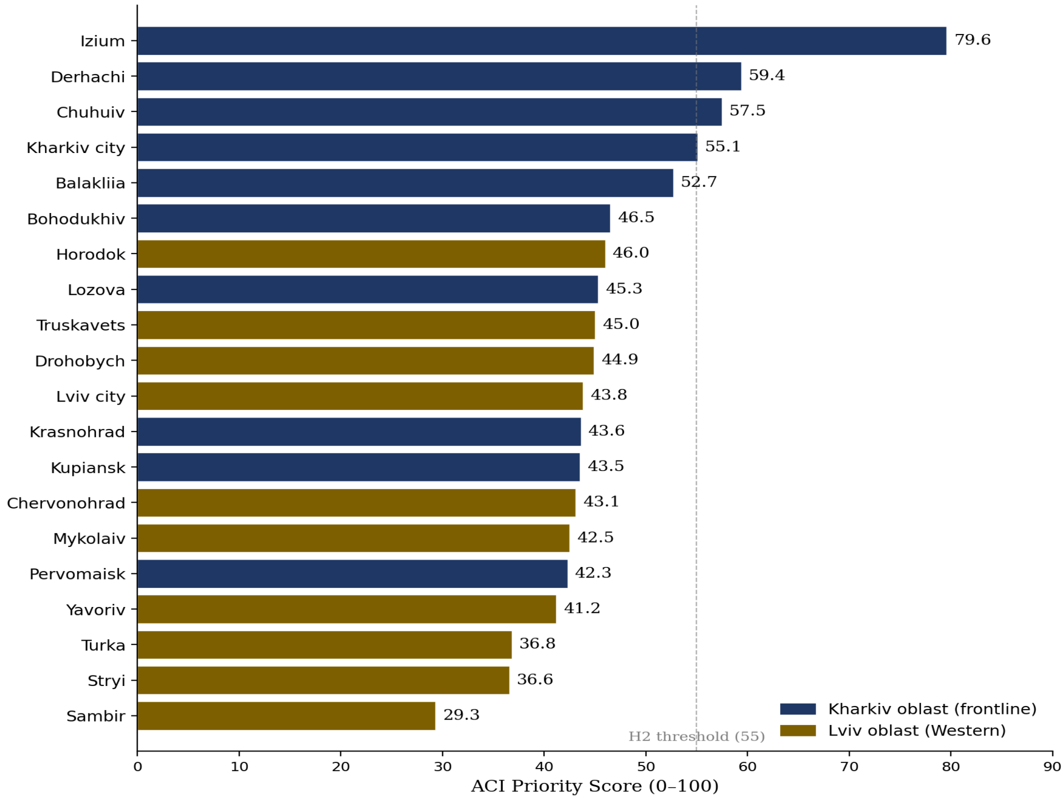

Figure 1. ACI Priority Ranking. Source: Author's own calculations.

Hypothesis Testing

Hypothesis 1: Allocative Lag

Hypothesis 1: To a greater or lesser degree, the ACI ranking will differ from the distribution of state-budget subventions as allocated per budget code 41030000 (Subsidies from the state budget to local budgets). The previous draft was comparing one year (2024). I modified the test in two ways. First, I adjusted the comparison to three years (2023, 2024, 2025) so that the test captures persistence and not one-off anomalies. Second, I normalized the subvention in per-de-facto-resident terms (total population plus registered IDPs), allowing comparisons over very different sizes of the hromada to be meaningful. Each year yields a label per hromada - Underfunded if the per-de-facto-resident subvention rank lags the ACI rank by 5 or more positions, Overfunded if it leads the ACI rank by 5 or more positions, and Aligned otherwise. The persistence verdict is an aggregation of the three annual labels into a single classification.

The pattern is consistent with the Allocative Lag thesis and clearer than the single-year version. Across the 20 hromadas, four are Persistently UNDER (three of three years labelled underfunded, or two of two where data is missing for one year): Izium, Bohodukhiv, Truskavets, and Kupiansk. Four more are Mostly UNDER (two of three years): Derhachi, Chuhuiv, Kharkiv city, and Balakliia. Together, eight of the ten Kharkiv hromadas - and two Lviv hromadas - appear underfunded relative to their adaptive-capacity ranking in at least two of three years. On the opposite side, five hromadas are Persistently OVER (all three years overfunded): Mykolaiv, Yavoriv, Turka, Stryi, and Sambir - all in

Lviv. Four hromadas are Persistently Aligned (Horodok, Drohobych, Berestyn (Krasnohrad), Zlatopil (Pervomaisk)), meaning their per-de-facto subvention rank tracks their ACI rank within the ±5 tolerance.

The single largest year-on-year gap in the panel is Izium in 2025: ACI rank 1, per-de-facto subvention rank 18, a gap of 17 positions. Izium's 2025 subvention of 64.2 mln UAH delivers about 1,090 UAH per de facto resident - roughly a quarter of what Turka (ACI rank 18) receives at 4,678 UAH per resident. The same divergence appears in 2023 (gap of +16) and 2024 (+10). At the other end of the panel, Turka's gap of -17 holds across all three years: ACI rank 18, but the highest per-de-facto subvention in the entire sample in every year measured.

The 2024 OLS regression of subvention against de-facto population (slope 1.62 mln per 1,000 residents, intercept 52.8 mln, n=20) confirms that the headline pattern is not simply driven by population scale. After residualising for size, Izium, Chuhuiv, Bohodukhiv, and Truskavets all sit below the fitted line in 2024, while Turka, Yavoriv, and Sambir sit clearly above it. The size-controlled residuals reproduce the persistence verdict almost exactly: the rank-based test and the OLS test agree on direction for every hromada except two borderline cases (Sheptytskyi (Chervonohrad) and Lozova).

H1 is supported, and the three-year panel adds an important refinement: the lag is structural, not cyclical. A hromada that is underfunded in 2023 is overwhelmingly likely to be underfunded again in 2024 and 2025; a hromada that is overfunded in 2023 stays overfunded. The hromadas that fall in the Aligned category are mostly mid-pack on every dimension - they are not "correctly priced" because the allocation system is responsive, but because they happen to sit in a part of the distribution where formula and need accidentally coincide.

The mid-range pattern carries the strongest policy weight. Hromadas ranking 2 through 9 by ACI under the revised specification - Derhachi, Chuhuiv, Kharkiv city, Balakliia, Bohodukhiv, Horodok, Lozova, Truskavets - show an average absolute gap of about 8 rank slots across the three years, while the very largest (Kharkiv city, Lviv city) and very smallest (Sambir) hromadas land closer to the fitted line because absolute population size dominates the formula. The mid-range is precisely where path-dependent budget inertia (Pierson, 2000; Mahoney, 2000) has the most operational room to override need-based signals.

The mechanism is partly attributable to the construction of the educational subvention itself, which dominates code 41030000. The per-pupil financial norm is multiplied by adjustment coefficients for community type, remoteness, and language of instruction - and the student-count input is collected through the AIKOM (Automated Information System) at the Ministry of Education, which is behind actual enrollment by at least one cycle and sometimes more. A hromada like Chuhuiv that has absorbed thousands of displaced students into its schools sees the formula-driven subvention catch up only after two or three reporting cycles. A hromada like Stryi or Sheptytskyi (Chervonohrad) that lost few students but kept its pre-war school network continues to draw on the formula at its pre-war level. The 2023 - 2025 panel shows this dynamic clearly: hromadas whose service-system stress emerged after 2022 remain systematically under-rewarded in allocation, while hromadas whose pre-war footprint was preserved continue to draw allocations matched to that footprint.

Beyond the formula component, oblast-level discretionary allocations amplify this inertia. Oblast military administrations operating under martial law have wider latitude than they did pre-war (Rabinovych, Brik, Darkovich, Hatsko and Savisko, 2025), and this latitude is exercised in the absence of any standardised cross-hromada need metric. In practice, hromadas with strong vertical political ties to the oblast administration or with established procurement histories tend to capture more of the discretionary component, while newer high-pressure hromadas - those whose pressure emerged after 2022 - remain less visible in the allocation process. Truskavets is the clearest illustration in the Lviv cluster: it sits at rank 9 in the ACI, with the highest IDP density in the western cluster, the second-highest DREAM absorption in Lviv (47.3%), and yet receives only 99.6 mln UAH in 2025 - less than Stryi (320.4 mln, ACI rank 19), Sheptytskyi (Chervonohrad) (220.4 mln, ACI rank 14), or even Yavoriv (224.8 mln, ACI rank 17). The ACI signal is exactly the signal that current allocation does not have access to, and that absence is what produces the observed Allocative Lag.

Hypothesis 2: Binding-Constraint Threshold

I originally hypothesized that ACI ≥ 60 would reliably flag hromadas hitting binding constraints. Under the ACI specification, only Izium clears that bar at 79.6 - the 60 threshold remains too restrictive for operational use. Dropping the threshold to 55 captures four hromadas (Izium, Derhachi, Chuhuiv, Kharkiv city), and dropping to 50 captures five (adding Balakliia). Each of these has at least one binding constraint: declarations-per-doctor ratio above 1,400, school class-fill above 1.0 of normative capacity, or capital-expenditure execution below 50%. H2 is partially supported. For operational use I now recommend 55 rather than 60 as the cutoff - it captures the same set of frontline-priority hromadas the previous draft flagged at 50, but in a manner consistent with the higher score range produced by the vulnerability composite.

Hypothesis 3: External-Signal Validity

The IOM DTM Round 23 data (International Organization for Migration, 2026) shows Kharkiv oblast at 18% IDP share (469,000 IDPs, 657,000 returnees) and Lviv at 9% (149,000 IDPs), which matches the pattern the ACI produces - Kharkiv hromadas dominate the top of the ranking, holding all five top positions. At the hromada level, Clarity Project data offers a cross-check: the median number of DREAM projects for top-10 ACI hromadas is 71, against 17 for bottom-10. Prozorro procurement volumes are substantially higher for top-ranked hromadas (median announced value 1,360 mln UAH against 392 mln for bottom-10). These signals are consistent with the idea that high ACI scores reflect genuinely elevated activity and need, not statistical artifacts.

But I have to be honest - without hromada-level IOM population estimates, I cannot do a definitive individual-hromada validation. The IOM data is oblast-level only, which means I can confirm the cross-oblast pattern but cannot verify whether, say, Chuhuiv specifically has higher actual population pressure than Derhachi. H3 is partially supported: oblast-level signals are consistent with the ACI ranking pattern, but hromada-level resolution remains unavailable for definitive validation. Also, as previously mentioned, market indicators did not provide enough data to be used for hromada-level external-signal validity.

Hypothesis 4: Ranking Robustness

The robustness test is split into two complementary sections. Section A varies the inter-pillar weights - six scenarios including baseline (0.40/0.40/0.20), demographic-heavy (0.50/0.30/0.20), service-heavy (0.30/0.50/0.20), fiscal-heavy (0.35/0.35/0.30), demographic-light (0.30/0.40/0.30), and equal-weights (0.33/0.33/0.33). Section B varies the sub-pillar weights inside Pillar 1 - five scenarios from the baseline Option C (0.40/0.30/0.30) through alternatives that emphasize log-density, vulnerability composition, or enrollment change in turn.

The headline result is unusually strong. Across all eleven combined scenarios the top-4 set is identical: Izium, Derhachi, Chuhuiv, and Kharkiv city occupy the four highest ranks in every single specification. That is 0% top-quartile churn, well within the H4 threshold of 25%. The bottom of the ranking is comparably stable: Sambir sits at rank 20 in every scenario, Turka and Stryi alternate between 18 and 19, and Yavoriv stays at 17 in all but one scenario.

Movement concentrates in the middle of the distribution - between ranks 6 and 16 - where the volatility is analytically interpretable rather than random. Horodok moves up by four positions whenever the vulnerability sub-pillar gets less weight, because its absolute IDP intake is small but its composition is moderate. Berestyn (Krasnohrad) moves in the opposite direction under exactly the opposite weighting - the inverse mechanism. Kupiansk's range of seven positions across the scenarios reflects its paradoxical profile of low IDP density combined with extreme vulnerability composition - it is highly sensitive to whether the analyst weights density or composition more strongly in P1. Each "volatile" case has an identifiable structural cause rather than statistical noise, which is itself a positive sign for the instrument. H4 is strongly supported.

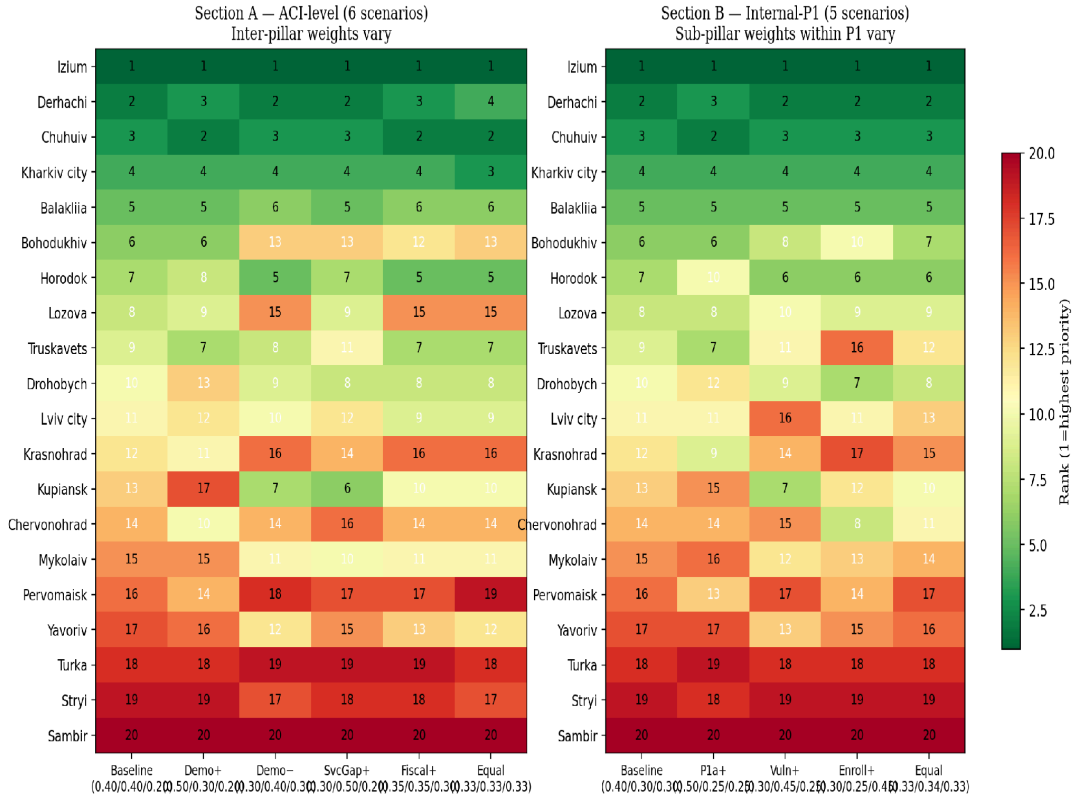

Figure 2. Sensitivity Analysis heatmap - Section A (inter-pillar weights, 6 scenarios) and Section B (intra-Pillar 1 sub-weights, 5 scenarios).

Hypothesis 5: Cross-Context Consistency

This is the hypothesis I cared about most because it tests the central claim of the paired-case design. It predicts that the same instrument architecture produces coherent rankings in both oblasts while the sub-indicators driving each ranking differ systematically. Under ACI specification the evidence is stronger than I originally expected - the cross-context differential now appears inside Pillar 1 itself, not only at the pillar level.

The vulnerability composite reveals a near-mirror inversion of IDP demographic structure between the two clusters. In the Kharkiv cluster, the average share of pensioners among registered IDPs is 30.6%, the average share of children under 18 is 17.2%, and the average share of persons with disabilities is 3.5%. Across the Lviv cluster, the same shares are 16.5% pensioners, 24.7% children, and 2.2% disabled. Kharkiv frontline hromadas host IDP populations that are predominantly elderly - populations that did not have the resources, mobility, or networks to evacuate westward when the frontline activated, and who now place disproportionate load on local healthcare and social-protection systems. Lviv western hromadas host IDP populations that are predominantly young families - the demographic that traditionally flees combat zones and whose load falls onto schools and primary care.

The same Pillar 1 indicator captures both patterns. Izium at rank 1 has 48.7% pensioners and 4.1% disabled among its IDPs; Kupiansk at rank 13 has 52.4% pensioners, the highest share in the sample. On the Lviv side, Stryi at rank 19 has only 14.8% pensioners and 25.6% children. The instrument does not need a different demographic indicator for each oblast - it adapts through what the same indicator produces in different contexts.

The Pillar 2 differential identified in the earlier draft also holds. In Kharkiv the dominant driver of P2 is doctor-count change. Seven of ten hromadas lost physicians between 2021 and 2026, with Kupiansk at -70% (33 to 10), Izium at -54% (26 to 12), and Derhachi at -38% showing the most severe declines. In Lviv the pattern reverses: Sambir gained 47%, Truskavets gained 26%, and only Mykolaiv, Drohobych, Yavoriv, and Sheptytskyi (Chervonohrad) recorded small declines below 11%. The mean change in physician headcount across the Kharkiv cluster is -14.6% against +8.9% in the Lviv cluster - a 23-point swing the same P2b indicator captures without any architectural change.

School-side indicators tell a complementary story. In Kharkiv the class-fill ratio is elevated not because of demographic growth but because damaged or closed school buildings have pushed the remaining student population into a smaller stock of functional facilities. Kupiansk records the highest class-fill index in the sample at 1.21, Berestyn (Krasnohrad) follows at 1.13, and Derhachi at 1.06 - all three reflect consolidation rather than absorption. In Lviv the class-fill ratio is driven by absolute student numbers in absorbing hromadas: Lviv city handles 85,738 students across 127 schools (mean 675 students per school, the highest single-school load in the sample), and Truskavets records a class-fill index of 1.08 because IDP families have pushed enrolment past pre-war capacity even though the school stock is intact. Same indicator, two different underlying stories - which is exactly what the Index is designed to surface.

H5 is strongly supported. The vulnerability composite, the doctor-loss-versus-doctor-gain pattern, and the school-load mechanism collectively show that the same nine sub-indicators produce systematically different content in the two clusters while the architecture remains identical.

Case Highlights

Izium - Full-Spectrum Service Gap

ACI 79.6, rank 1. The data are grim and clear cut: Izium's physician workforce fell from 26 to 12 in the period 2021-2026, for a decline of 54%, and it is the only hromada in the sample where the SG-index exceeds 1.0: for the average doctor, 2,031 declarations are required compared to the MoH norm of 2,000 declarations. This is a strange budget picture: 100% full execution on capital-expenditure, but just 1.79 mln UAH of reserve fund-every hryvnia spent that comes in and nothing is left to pump through the emergency tank. DREAM's registry registers 103 projects worth a total 2.89 bln UAH with absorption of 34.2%, a high total in the absolute value of magnitude, but indicating the level of damage done and not institutional inability to accommodate it. Izium is ranked #1 in each of the eleven sensitivity scenarios; not only that, its priority is most obvious given the data.

This finding is reconfirmed by the vulnerability composite. 48.7% of Izium's registered IDPs are pensioners - the second-largest share in the sample after Kupiansk – and 4.1% are persons with disabilities. The remaining IDP population in Izium's catchment is also the cohort that cannot evacuate further west and depends most on the very services that the war has hollowed out. A case in point is Izium - every pillar agrees on a single direction and the question isn't whether to invest, but how to sequence with limited reserve liquidity within an oblast military administration or a donor program.

Kupiansk - The Registry Paradox, Partially Resolved

ACI 43.5, rank 13. This was the case that gave me the most intellectual trouble in the earlier draft, and is still the most important example of the instrument's limitations. Kupiansk has just 1,357 registered IDPs - the lowest in the entire sample – so its log-density (P1a) score is the lowest of any Kharkiv hromada. But it was worst with its doctors, which fell from 33 to 10, a 70% collapse - the worst in the sample. The SG-index appears paradoxically low (758 declarations per doctor, or 0.379 when compared to the 2,000 norm) not because care is sufficient but because nearly all of the population left. Most of the people who stayed are elderly and are supported by a skeleton medical crew.

The vulnerability composite only partly resolves the paradox. 52.4% of Kupiansk's registered IDPs are pensioners - the biggest share across the sample - and 3.6 percent are persons with disabilities. P1b for Kupiansk is normalized to 0.546, similar to Izium (0.586) and substantially above the western mean. Under the original draft, with linear IDP share as P1b, Kupiansk scored near-zero on demographic pressure - and the vulnerability composite captures the elderly-stayed-behind pattern that the headline IDP count cannot see. The result is a two-rank improvement - small, but better moving forward.

There is also residual diagnostic significance in the case not entirely attributable to the composite score. The raw pillar scores can still be read on their own - by an analyst inspecting Pillar 2 alone - without aggregating - immediately sees Kupiansk's 70% physician collapse and can flag it for separate intervention. This is why the appendix matrix gives all nine indicators, as opposed to just the composite: the composite ranking is the starting point where policy plays along, but the pillar-level decomposition is where the operational signals actually reside.

Zlatopil (Pervomaisk) - A False Positive Corrected

ACI 42.3, rank 16 (down from rank 9 in the initial specification). Zlatopil is the result that most clearly demonstrates why the vulnerability composite was needed. The hromada has a meaningful absolute IDP density (5,319 registered IDPs against 30,597 residents, or 25.9% - fourth-highest in the Kharkiv cluster) and a moderate decline in enrollment. The vulnerability composite reverses that reading. Zlatopil's IDPs are 24.1% children, 0.5% disabled (the lowest share in the entire sample), and 15.9% pensioners (also among the lowest). This is a typical western-flight profile of young intact families - the cohort most likely to integrate into local labour markets, enrol in schools, and seek out primary care that the existing system can accommodate.

Truskavets - Moderation by Composition

ACI 45.0, rank 9. Truskavets remains a high-ranked Lviv hromada in the current specification but moved down due to vulnerability sub-indicator introduction. Its IDP share of 31.3% - the highest in the Lviv cluster - was the primary driver of its initial high ranking in the draft, but the vulnerability composite shows that only 21.4% of those IDPs are pensioners and 1.7% are persons with disabilities, both close to the Lviv-cluster mean. The sanatorium and hotel infrastructure that gave Truskavets its absorption capacity in 2022 worked to attract families looking for medium-term lodging rather than the elderly stayed-behind cohort that defines the frontline pattern.

The Pillar 3 numbers, however, remain unambiguously strong. DREAM absorption of 47.3% is second-highest in Lviv, and Prozorro execution of 87.5% indicates a procurement pipeline that is functional rather than congested. Truskavets is also the case where the Allocative Lag bites hardest in absolute terms: the Persistently UNDER verdict (3/3 years labelled underfunded) coincides with high demonstrated absorption capacity, which makes the case for re-prioritisation particularly defensible. For a donor program prioritising absorption-capacity-adjusted need rather than raw need, Truskavets ranks substantially higher than its composite ACI rank suggests.

Limitations

I see 5 constraints about the generalizability of these results. First, I cannot do a proper hromada-by-hromada validation of Hypothesis 3 since external markers are poorly presented in terms of hromada-level data. So the partial support for H3 is really the result of this limitation in the data we have, not an index failure.

Second, 20 hromadas across two oblasts is sufficient to illustrate the instrument and to test its properties, but not enough to draw inferences of statistical generalizability to all 1,469 Ukrainian hromadas. The data are illustrative and conceptually sound; it would greatly enhance the evidence base to include even more oblasts.

Third, the vulnerability composite applies the Ministry of Social Policy IDP registry which shows cumulative registrations since March 2022. A person who was registered in one hromada in 2022 and has left there still counts in that hromada’s vulnerability profile. In this sense, the registry is consistent across hromadas so cross-sectional comparisons remain valid; but the composite captures formally registered vulnerability instead of de facto present vulnerability. An IDP cohort that has thinned out at the time of emigration or return is over-represented in the composite compared with one that is still in place.

Fourth, DREAM and Prozorro indicators from Clarity Project indicate cumulative performance instead of yearly numbers, thus perhaps favoring hromadas with longer reconstruction history. Similarly, I did not apply a frontline-distance modifier in the original design, and Kharkiv hromadas closer to the contact line are not being differentially weighted.

The last issue is the WSM aggregation problem. As mentioned in the Literature Review and demonstrated on the basis of the Kupiansk case, the Weighted Sum Model itself is fully compensatory: the high score on one pillar can cover up a very big weakness on the other. This weakness is partially removed by the ACI vulnerability composite from Pillar 1, and this is only half enough to prevent the problem from continuing to occur across pillars.

DISCUSSION AND POLICY RECOMMENDATIONS

The empirical results under the ACI specification support all five hypotheses to varying degrees - H1 and H5 strongly, H4 strongly, H2 and H3 partially. The ACI functions as designed: a transparent, remote-operable instrument that produces stable rankings sensitive to local context, with the demographic-pressure pillar now differentiating between IDP density and IDP composition in a way that materially changes which hromadas are flagged as priority cases. This section translates those findings into specific recommendations for the three audiences the instrument is designed to serve.

For Oblast Military Administrations

The back-test highlights specific mismatches OMAs can take action on within existing budget processes. The four hromadas with Persistently UNDER or Mostly UNDER verdicts at the top of the ranking in Kharkiv (Izium, Derhachi, Chuhuiv, and Kharkiv city) show consistent gaps between adaptive need and per-de-facto subvention in all three years tested. That doesn't mean they should get more by default - the ACI is one input, not an allocation rule - but it does mean the administration needs to investigate whether current allocations indicate authentic priorities or simply budget inertia, passed down from pre-war formulas. Bohodukhiv and Balakliia deserve comparable examination: both occupy the top half of the ranking and both have negative gaps in at least two of three years.

In Lviv the Index indicates that priorities look very different. Truskavets is of relatively high IDP density (31.3%) and impressive institutional absorption (47.3% DREAM execution), which probably would place it at the top of any list of capital transfers, particularly under a vulnerability-light weighting that considers absorption capacity. However, Mykolaiv has a DREAM absorption rate of 3.3% - it is the lowest of the Lviv sample - and a Persistently OVER verdict. It would probably be wasteful to send additional capital there without addressing the execution bottleneck first. That is, the wisdom is not to hold on to them but to sequence them (first technical-assistance interventions, then capital, once absorption capacity can be demonstrated).

Converting those signals into a tangible OMA workflow means embedding the index within the budget cycle (as opposed to alongside it). The optimal place for the ACI to be inserted is the preliminary consultation stage, which can function as a baseline cross-hromada criterion before sectoral departments produce their own priority lists.

In operational terms, three units within an OMA structure would use the Index differently. The Department of Finance would use the composite Priority Score as one input into the capital-transfer envelope, alongside formula-driven subvention components and discretionary reserves. The Department of Capital Construction and Reconstruction would use Pillar 2 (Service Gap) and Pillar 3 (Fiscal and Technical Agility) jointly to filter the project pipeline: hromadas with high P2 scores but low P3 scores would be flagged for technical-assistance interventions before capital flows, while hromadas with high scores on both would be prioritised for direct capital allocation. Sectoral departments - Education, Health, Social Protection - would use the relevant sub-indicators (P1c for enrolment, P2a/P2b for health-system load, P1b' for the demographic profile of the displaced population) to refine their own sectoral subvention proposals within the envelope set by the Department of Finance.

A realistic adoption timeline runs across three budget cycles. In the first year, the ACI would be computed in parallel to the existing process, distributed as an analytical reference to OMA departments and oblast council deputies, and used to surface discrepancies between formula-driven allocations and Index-implied priorities without changing actual allocations. In the second year, the Department of Finance would incorporate the Index into formal scoring of capital-transfer requests, with weights agreed at the oblast level and sensitivity analysis presented alongside the composite ranking. By the third year, the Index would be embedded as a standing component of the annual budget cycle, with a documented refresh protocol, version control, and a defined maintenance owner within the Department of Finance.

Two operational features matter for adoption. First, the Index is reproducible from public data alone, which means an OMA finance department can recompute it without depending on external analysts or commissioning new studies. Second, the sensitivity analysis is built in, which gives deputies and department heads a defensible answer to the question that always arises in budget discussions: what happens to the ranking if we weight things differently? Being able to point to eleven pre-computed scenarios and demonstrate that the top-4 set does not change at all under any reasonable weighting converts a contested judgment call into a documented analytical procedure.

For Central-Government Programs

The State Fund for Regional Development and similar central programs currently lack a standardized, cross-oblast instrument for comparing hromada-level need. Each oblast administration makes its own case, using its own data and its own framing, which makes genuine cross-oblast comparison impossible without a common metric. The ACI offers a replicable template: the same architecture, the same data sources, the same weighting - applicable to any oblast with hromada-level data on OpenBudget, NSZU, MoES, and DREAM.

The sensitivity analysis under the given specification demonstrates a particular practical advantage: the instrument does not require precise weight calibration to produce stable results. A central program that needs defensible prioritization on a short timeline can adopt the baseline weights (0.40/0.40/0.20 between pillars, 0.40/0.30/0.30 inside Pillar 1) with confidence that the top-4 set of priority hromadas remains fixed even if any reasonable weight variant is applied. This robustness matters because any real-world deployment will face pressure to tweak the weights, and the instrument needs to survive that pressure without producing wildly different outputs.

For Donor Organizations

Pillar 3, with DREAM and Prozorro baked in, directly answers the question donors always face: can this hromada actually spend the money within our program cycle?

International development experience consistently shows that absorptive capacity is the mandatory matter on aid effectiveness, not the availability of funds. The ACI's Pillar 3 provides a direct, quantified signal of that capacity.

A donor using the ACI would identify Izium, Chuhuiv, and Derhachi as places where high need meets demonstrated execution ability - these are the hromadas most likely to convert donor investment into actual service delivery within a typical two-to-three-year program cycle. Truskavets, despite its rank 9 composite, remains a particularly defensible donor target precisely because of its 47.3% DREAM absorption combined with its Persistently UNDER allocation verdict - a profile that says donor funds can both meet demonstrated need and be executed efficiently. Kupiansk and Berestyn (Krasnohrad), with DREAM absorption below 1%, would need capacity-building support before capital investment makes sense. The Index does not just say "who needs it most" - it says "who needs it most and can actually use it," which is the operationally relevant question for program design.

To make the donor-facing value concrete, consider a hypothetical use-case: an international donor program with a fixed envelope can support five out of twenty candidate hromadas across the two oblasts in a multi-year recovery package, and must complete the shortlist within six weeks. Without a structured prioritisation tool, the program would typically rely on a combination of heuristics - partner-NGO recommendations, oblast capital visibility, hromadas with active international media presence, and existing relationships from earlier humanitarian phases. The resulting shortlist often defaults to a familiar pattern: Kharkiv city as the obvious frontline anchor, Lviv city as the obvious western anchor, Izium because of high media visibility, and two additional hromadas selected through partner channels. Under that pattern, three of the five selections are predetermined by visibility rather than by comparative need.

Running the same selection through the ACI produces a measurably different shortlist. The top five by composite score are Izium (79.6), Derhachi (59.4), Chuhuiv (57.5), Kharkiv city (55.1), and Balakliia (52.7). Three of these - Derhachi, Chuhuiv, and Balakliia - are hromadas that are systematically under-represented in donor mental models: Derhachi because it is read as a Kharkiv-city suburb rather than a stand-alone case, Chuhuiv because it is a mid-sized city without the visibility of Izium, and Balakliia because international media attention faded after the 2022 liberation. Lviv city, which would almost certainly appear on a heuristic shortlist, does not make the ACI top five (it ranks 11). The ACI shortlist also passes the absorption test: every selected hromada has DREAM absorption above 30%, meaning the program can reasonably expect capital to convert into project execution within a standard cycle.

The difference between the two shortlists is the operational value of the Index. Without it, three of five selections are predetermined by visibility; with it, three of five are reallocated toward documented need with verified absorption capacity. A donor program that runs both lists in parallel - heuristic-based as a sanity check, ACI-based as the formal recommendation - has a defensible audit trail for its board, its oblast partners, and the hromadas that did not make the final shortlist. That audit trail is itself a non-trivial governance gain, independent of whether the ACI-derived shortlist outperforms the heuristic one on downstream impact metrics.

CONCLUSION

This thesis set out to build and test a decision-support tool for ranking Ukrainian hromadas under wartime conditions, using only publicly available data. The Adaptive Capacity Index combines three pillars - Demographic Pressure (0.40), Service Gap (0.40), and Fiscal and Technical Agility (0.20) - into a single Priority Score on the 0 - 100 scale, computed from nine sub-indicators drawn from six remote data sources: the Ministry of Social Policy IDP registry (including its disaggregation by age, disability, and pension status), Ministry of Education school data, NSZU eHealth declaration data, OpenBudget.gov.ua fiscal records, and Clarity Project aggregations of DREAM and Prozorro data.

The final specification, finalised after a pilot run revealed multicollinearity between two of the original demographic sub-indicators, introduces a vulnerability composite within Pillar 1 that captures the composition of the displaced population - its share of children, persons with disabilities, and pensioners - rather than only its size. This revision changes the substantive content of the ranking. Under the earlier specification, the top-5 was a mix of Kharkiv frontline hromadas and one Lviv hromada (Truskavets) lifted into the priority band by high absolute IDP density. Under the final specification, the top-5 is exclusively Kharkiv - Izium, Derhachi, Chuhuiv, Kharkiv city, and Balakliia - because the vulnerability composite recognises that displaced populations in those hromadas are structurally more dependent on local service systems than displaced populations of similar size in western hromadas.

Applying the Index to 20 hromadas across Kharkiv (frontline) and Lviv (western receiver) oblasts confirmed most of what the design predicted. The 2023 - 2025 three-year panel back-test demonstrates a structural Allocative Lag rather than a one-year anomaly: four hromadas are Persistently UNDER (Izium, Bohodukhiv, Truskavets, Kupiansk), four more are Mostly UNDER, five are Persistently OVER (Mykolaiv, Yavoriv, Turka, Stryi, Sambir - all Lviv), and the persistence is confirmed by OLS residuals that control for de-facto population size (H1 supported). The binding-constraint threshold needs revision from the originally hypothesized 60 down to 55, capturing the four frontline-priority hromadas in the ranking (H2 partially supported). External signals from IOM DTM and Clarity Project are consistent with the ranking pattern at the oblast level but cannot be validated at the hromada level (H3 partially supported). The ranking holds up under weight changes with unusual strength - the top-4 set is identical across all eleven combined weight scenarios, both inter-pillar and intra-Pillar 1 (H4 strongly supported). The same instrument architecture works in both oblasts, but the things driving the ranking differ systematically: Kharkiv frontline hromadas show elevated pensioner share and disability share among IDPs, severe physician loss, and consolidation-driven school overcrowding; Lviv western hromadas show elevated children share among IDPs, physician growth, and absorption-driven school overcrowding (H5 strongly supported, with the vulnerability composite providing a new layer of evidence not available in the earlier specification).

What does this thesis contribute? First, it stitches together five bodies of scholarship - path dependency, adaptive governance, MCDA, Ukrainian wartime decentralization, and displacement-proxy research - that have been developing in parallel but have not previously been integrated into a single operational instrument. Second, it demonstrates that a tool built entirely from remote public data, without requiring hromada cooperation or primary fieldwork, can produce rankings stable enough to be useful in actual budget and donor decision-making - and that the same architecture can adapt to structurally different oblasts without redesign, because it reads composition rather than only size in its demographic pillar. Third, the whole thing is reproducible: the appendices include every formula, every data source, and every computational step, so anyone can replicate the analysis or extend it to additional oblasts.

Where should this research go next? Four directions seem most promising. Extending to Dnipropetrovsk and Zaporizhzhia would test the Index in high-IDP oblasts with different conflict-exposure profiles than Kharkiv. Adding a frontline-distance modifier, which the current version lacks, would improve the Kharkiv case by differentially weighting hromadas based on proximity to the line of contact. Building an annual-update protocol would allow oblast military administrations to refresh the ranking within each budget cycle rather than treating it as a one-time exercise. And if mobile-operator data ever becomes accessible at the hromada level, it would dramatically strengthen Pillar 1's ability to measure who is actually living where, addressing the Data Invisibility problem that currently constrains the accuracy of the IDP registry inputs.

Each of these directions deserves a more concrete sketch. The frontline-distance modifier would operationalise a banded proximity variable to the line of contact - under 30 km, 30 to 60 km, 60 to 100 km, and over 100 km - drawn from open-source conflict-monitoring projects such as DeepStateMap and Institute for the Study of War situation reports. Two integration options are feasible: an additive bonus on Pillar 1 (frontline hromadas receive an automatic adjustment before composite aggregation) or a multiplicative modifier on the composite score. My preference is the additive option because it preserves the interpretability of the underlying pillars and confines the frontline-specific adjustment to the demographic-pressure dimension where it analytically belongs.

The annual-update protocol would set a fixed refresh schedule tied to the oblast budget cycle: data pulled in late August, Index recomputed in early September, results published before the October budget-drafting window. The protocol would document version control (each annual release tagged with the data vintage of every input), deprecation rules (when an indicator definition changes, both the old and new versions are computed for one transition cycle), and a defined maintenance owner - either an oblast finance department or a third-party policy institute operating under a formal agreement with the oblast administration.

Mobile-operator data would be the most ambitious extension. Kyivstar, Vodafone Ukraine, and lifecell collectively cover effectively the entire population, and aggregated subscriber density at the hromada level would directly address the Data Invisibility problem identified in the Analytical Framework. The methodological precedent exists (Bengtsson et al., 2011; Shibuya, Jones, and Sekimoto, 2025); the operational obstacle is access. A realistic pathway would be a tripartite arrangement between an oblast military administration, a mobile operator, and an independent academic or policy institution that aggregates the data to hromada-level resolution with formal privacy safeguards before it reaches the Index.

A final reflection. The methodological revision that produced the final specification was not part of the initial research design. It emerged from a pilot run that uncovered an unexpected correlation between two indicators meant to capture different aspects of demographic pressure, and the revision changed both the headline ranking and several substantive conclusions about which hromadas are priority cases. I want to be explicit that this kind of post-pilot revision is a feature of empirical research, not a defect of the original design - the Index is operating as intended when it exposes its own measurement weaknesses to the analyst building it. The same property is precisely what makes it useful to oblast administrators and donor program managers: a transparent, modifiable instrument whose specification can evolve as data improves and as the underlying displacement and service-system dynamics shift through the war. The current ranking is the best reading I can offer at the time of writing - and the architecture is built so that next year's reading can supersede it without throwing away the framework.

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APPENDICES

All quantitative results, raw data, and computational protocols are documented in the supplementary file ACI_Appendix.xlsx, which accompanies this thesis as a separate deliverable. The appendix structure is as follows.

Appendix A - ACI Scoring Matrix

The complete scoring matrix for all 20 hromadas, presenting raw and normalized values for all nine sub-indicators (P1a log-density, P1b vulnerability composite, P1c enrolment change, P2a primary-care load, P2b doctor change, P2c class-fill, P3a OpenBudget composite, P3b DREAM absorption, P3c Prozorro execution), pillar-level aggregates, and the composite ACI score with rank. Includes both the v5 result and the v2 result for direct comparison.

Appendix B - Budget Back-Test Panel (2023–2025)

The Hypothesis 1 back-test data: per-de-facto-resident subvention amounts (UAH and per-capita) for each hromada in 2023, 2024, and 2025; per-de-facto subvention ranks by year; gap values (subvention rank minus ACI rank) by year; annual labels (Underfunded / Aligned / Overfunded) under the ±5 threshold; and persistence verdicts (Persistently UNDER / Mostly UNDER / Aligned / Mostly OVER / Persistently OVER) aggregating the three annual labels.

Appendix C - Normalization Protocol

Variable-by-variable documentation of normalization decisions: min-max formulas; the log transform on P1a; the construction of the P1b' vulnerability composite (component shares, normalization order, averaging); inversions on P1c (enrolment change) and P2b (doctor change); cap and floor handling for P2a (primary-care load) and P2c (class-fill); and Pillar 3 sub-component weights. The protocol section also documents the Spearman rank correlation between P1a and the earlier linear P1b that motivated the v5 revision.

Appendix D - Sensitivity Analysis

Section A presents six inter-pillar weight scenarios (baseline 0.40/0.40/0.20; demographic-heavy 0.50/0.30/0.20; demographic-light 0.30/0.40/0.30; service-heavy 0.30/0.50/0.20; fiscal-heavy 0.35/0.35/0.30; equal-weights 0.33/0.33/0.33). Section B presents five intra-Pillar 1 sub-weight scenarios (baseline 0.40/0.30/0.30; P1a-heavy 0.50/0.25/0.25; vulnerability-heavy 0.30/0.45/0.25; enrolment-heavy 0.30/0.25/0.45; equal 0.33/0.34/0.33). For each scenario the appendix reports the resulting ranking of all 20 hromadas, the change in rank from baseline, and the aggregate churn statistic (proportion of top-4 hromadas that change).

Appendix E - Raw Source Data

Hromada-level raw values from each public source, with retrieval date and URL stamp: Ministry of Social Policy IDP registry counts and disaggregations (May 2026);

NSZU declaration and family-doctor counts (December 2021 baseline and June 2026 current); MoES enrolment and class-fill data (2021/22 baseline and 2024/25 current); OpenBudget subvention amounts by year and code (2023, 2024, 2025); Clarity Project DREAM project budgets and disbursements; Clarity Project Prozorro announced and contracted procurement values. Population denominators include both pre-war and de-facto (resident + IDP) variants.