DIGITAL TRANSFORMATION AND ECONOMIC RESILIENCE: HOW DIGITAL ECOSYSTEMS STRENGTHEN ADAPTIVE CAPACITY IN EMERGING ECONOMIES

Tatiana BUCOS
PhD, Associate Professor,
Academy of Economic Studies of Moldova, Moldova
E-mail: bucos.tatiana@ase.md
ORCID: 0000-0001-6448-6001

Abstract: *The claim that digitalisation strengthens the resilience of emerging economies is widely asserted but rarely tested with the precision the concept demands. This paper distinguishes resilience into a resistance margin (the depth of contraction under a shock) and a recovery margin (the speed, reach, and inclusiveness of the rebound and of relief delivery), and asks which margin national digital ecosystems actually strengthen. Using a comparative policy analysis of six economies (Brazil, India, and Kenya as a global frontier, Estonia as a regional frontier, and Ukraine and Moldova as diagnostic cases) across two sequential shocks (the COVID-19 pandemic and the 2022 energy-and-war disturbance), it triangulates cross-country indicators, within-case process tracing, and existing empirical evidence. Digital maturity does not explain contraction depth: five of the six economies sit in the top GovTech maturity group, yet their 2020 contractions varied widely and tracked lockdown stringency, economic structure, and exposure to energy and conflict rather than any digital indicator. Digital ecosystems instead governed the recovery margin, determining how quickly and how inclusively states reached and paid citizens through interoperable public rails. Moldova has shown it can wire infrastructure into crisis delivery: its 2022 "Ajutor la contor" energy-compensation system auto-targeted around three-quarters of households and cut energy poverty by 43%. But it did so reactively and for a single sector; the task is to institutionalise permanent, pre-positioned, general-purpose rails.*

Keywords: *digital public infrastructure; economic resilience; adaptive capacity; emerging economies; shock-responsive social protection; GovTech; Moldova*

JEL Classification: *O33; O38; O11; H12*

UDC: [330.342.22:004]:330.354 **DOI:** https://doi.org/10.53486/ser2026.01

1. Introduction

Between early 2020 and the end of 2022, many emerging economies absorbed not one large shock but two in quick succession. The COVID-19 pandemic produced the deepest synchronized global contraction since the Second World War, and before recovery was complete, the full-scale invasion of Ukraine in February 2022 triggered an energy-and-food price spike and a wave of inflation that fell hardest on small, import-dependent states. For a country such as Moldova, the two shocks arrived almost back to back: output fell by roughly 8% in 2020 and again by about 5% in 2022, the second decline compounded by an energy crisis, a refugee influx, and a severe drought (World Bank, 2024). The practical question facing policymakers in such economies is no longer whether shocks will come, but what determines how quickly and how inclusively a country can respond when they do.

Over the same period, digital ecosystems moved from the margins of development policy to its centre. Governments across the emerging world accelerated investment in connectivity, digital identity, real-time payment systems, and online public services, and a growing body of commentary has treated this digital build-out as a source of economic resilience in its own right. The intuition is appealing: an economy that can identify, reach, and pay its citizens electronically should be better placed to cushion a downturn and to recover from it. During the pandemic this intuition appeared to be vindicated at scale, as states delivered emergency

cash to hundreds of millions of people through digital channels that had been built, in most cases, well before the crisis (Gentilini et al., 2022).

Yet the claim that digitalisation makes emerging economies more resilient is asserted far more often than it is tested, and it is rarely stated precisely enough to be testable. Resilience is not a single quantity. An economy can resist a shock shallowly, recover from it quickly, or transform its structure in response, and these are distinct margins that need not move together (Martin, 2012). A digital ecosystem that accelerates recovery is doing something quite different from one that limits the initial contraction, and conflating the two produces both overclaiming and disappointment. This paper therefore reframes the question. Rather than asking whether digitalisation makes economies more resilient, it asks *which margin of resilience* digital ecosystems actually strengthen, *through what mechanism*, and *what follows for policy* in an emerging economy that has invested in digital infrastructure but has not yet reaped a clear resilience dividend.

To answer these questions the study compares six economies that span three models of digital infrastructure and two very different shocks. Brazil, India, and Kenya serve as a global frontier that establishes the mechanism; Estonia serves as a regional frontier that shows the architecture is reachable by a small post-Soviet state; and Ukraine and Moldova serve as diagnostic cases read against that frontier, with Moldova as the focal case. The central finding is that digital maturity does not explain how deeply these economies contracted – the resistance margin tracked lockdown policy, economic structure, and exposure to energy and conflict, not any digital indicator. What digital ecosystems demonstrably governed was the recovery margin: how quickly, how widely, and how inclusively states could deliver relief, and the structural transformation that interoperable payment rails set in motion. The policy variable that carries this dividend is not connectivity or a broad portfolio of e-services but interoperable public rails wired into crisis delivery, a design choice as available to a small economy as to a large one.

The paper's contribution is to connect four literatures that rarely meet (economic resilience, digital public infrastructure, shock-responsive social protection, and GovTech maturity) and to use that synthesis to produce an actionable diagnosis. For Moldova, the conclusion is specific and encouraging: the country has already built the infrastructure layer that places it among the more digitally mature states in its region, and the remaining task is the narrower one of connecting that infrastructure to crisis-response functions. The argument proceeds as follows. Section 2 reviews the four literatures and locates the gap. Section 3 sets out the comparative methodology, the two-shock window, and the way resilience and adaptive capacity are operationalised. Section 4 presents the evidence and discussion across the six cases. Section 5 draws conclusions and policy implications, with particular attention to Moldova.

2. Literature Review

2.1 Economic resilience: from a single outcome to a multi-margin construct

The concept of economic resilience entered mainstream economics largely through the study of how regions and countries respond to recessions and disasters, and its most useful feature for the present argument is that it was never meant to be a single number. Martin (2012) distinguished several dimensions of resilience (resistance to a shock, the speed and extent of recovery, and longer-run reorientation) and argued that an economy can perform well on one

dimension and poorly on another. Martin and Sunley (2015) later cautioned that the term risks becoming a catch-all unless these dimensions are kept analytically separate. A parallel strand, rooted in disaster economics, made a similar move: Rose (2007) separated inherent from adaptive resilience and emphasised the capacity to maintain function during and after a shock rather than simply to avoid losses. Briguglio et al. (2009) added the policy-facing insight that vulnerability and resilience are distinct, so that an economy may be highly exposed to shocks yet build offsetting resilience through deliberate institutional choices.

Running through this literature is the absorptive–adaptive–transformative typology articulated most influentially by Béné et al. (2012), which this paper adopts. Absorptive capacity is the ability to cope without structural change; adaptive capacity is incremental adjustment; transformative capacity is systemic reconfiguration. Hallegatte (2014), writing for the World Bank, operationalised resilience in terms that map onto recovery: the macroeconomic cost of a shock depends heavily on the speed with which an economy can reallocate resources and restore activity. The collective implication is that any claim about what makes economies more resilient must specify *which margin* it is acting on. A theory that improves recovery is not the same as one that reduces the depth of the contraction.

2.2 Digital ecosystems and development: from "digital dividends" to public infrastructure

The literature linking digital technology to economic outcomes has shifted markedly in framing over the past decade. The World Bank's World Development Report 2016 (World Bank, 2016) set the early tone with its "digital dividends" thesis, arguing that connectivity raises growth, jobs, and service delivery, but warning that the dividends fail to materialise without complementary "analogue" foundations such as regulation, skills, and accountable institutions. That qualification matters here: it implies that connectivity alone is a weak predictor of outcomes, which is precisely what the present evidence shows. More recent work narrows the focus from connectivity to architecture. Alonso et al. (2023), analysing India's digital stack for the IMF, argue that the decisive ingredient is interoperable digital public infrastructure (a layered combination of digital identity, real-time payments, and consented data exchange) rather than digitisation in general. Studies of fast-payment systems make the same point empirically, documenting how state-sponsored, interoperable rails such as Brazil's Pix reshaped payment behaviour at population scale within a few years of launch (Duarte et al., 2022).

A distinct and older empirical literature on mobile money supplies the strongest causal evidence that digital rails build household-level resilience. Jack and Suri (2014) showed that M-Pesa improved risk-sharing in Kenya, allowing households hit by shocks to smooth consumption by drawing on remittances that moved faster and more cheaply than before; Suri and Jack (2016) found durable poverty-reduction effects. This work is rarely cited in the macro-resilience literature, yet it identifies the micro-mechanism (faster, cheaper transfer of value under stress) that scales up to the national patterns observed during COVID-19.

2.3 The delivery channel: shock-responsive social protection and digital G2P

A third literature, largely separate from both of the above, studies how states deliver assistance during crises. Research on shock-responsive social protection (O'Brien et al., 2018) argues that the capacity to scale relief quickly depends on systems built *before* the shock (social registries, payment mechanisms, and identification) that can be expanded or repurposed when a crisis hits. The COVID-19 period produced an unusually rich evidence base: Gentilini et al. (2022) documented a worldwide surge in social-assistance measures, a

large share delivered through digital payments, and noted that countries with pre-existing digital delivery systems mounted faster and broader responses. This is the literature that names the capability this paper calls "adaptive wiring": the integration that connects digital public infrastructure to crisis delivery. Its limitation is that it treats digital systems instrumentally, as plumbing for social protection, without locating them within a theory of economic resilience.

2.4 E-government and GovTech in transition economies

For the Eastern European cases, the relevant strand is the long-running study of e-government in developing and transition states. Heeks (2003) warned early that a large share of public-sector ICT projects fail because of "design–reality gaps" between imported systems and local institutional conditions. The caution applies directly to economies that have digitised services without integrating them. More recent benchmarking through the World Bank's GovTech Maturity Index (World Bank, 2022) and the United Nations E-Government Survey provides comparative measures of how far states have built core systems, service delivery, and enablers. These instruments are descriptive rather than explanatory: they rank maturity but do not test whether maturity translates into resilience, and as the present study shows, high maturity scores coexist with very different shock outcomes.

2.5 The gap

These four literatures rarely speak to one another, and the silence is where this paper sits. The resilience literature offers a multi-margin framework but seldom specifies the digital mechanism that would move any particular margin. The digital-development and DPI literature identifies interoperable public rails as decisive but connects them to growth and inclusion rather than to a resilience framework with distinct resistance and recovery margins. The shock-responsive-social-protection literature names the delivery capability but treats it as administrative plumbing. And the GovTech literature measures maturity without testing its consequences. No existing work, to our knowledge, brings these together to ask which margin of resilience digital ecosystems actually strengthen, tests the question across economies facing both a common and a region-specific shock, and translates the answer into a policy diagnosis for a specific emerging economy. That is the contribution this paper makes, with Moldova as the focal case.

3. Methodology

3.1 Research design

This study is a comparative policy analysis built on a three-tier case architecture rather than a flat cross-country sample. The design separates the cases by the analytical role they play. A first tier of *global frontier* economies (Brazil, India, and Kenya) establishes the mechanism: it shows how a mature digital ecosystem converts into adaptive capacity when a large shock arrives. A second tier consists of a single *regional frontier* case, Estonia, which serves as the aspiration point and demonstrates that the frontier is reachable by a small post-Soviet economy. A third tier of *diagnostic* cases (Ukraine and Moldova) is then read against the first two, not to be ranked but to locate where each Eastern European economy sits relative to the frontier and which policy choices would close the distance. Moldova is the focal case; the others are calibrated around it.

The logic is benchmark-and-backdrop. Frontier cases supply the standard of what interoperable digital infrastructure can do under stress; the diagnostic cases are interpreted on that backdrop. This converts the study from description ("how digital is Moldova?") into a policy argument ("the frontier shows that design choice X produces resilience outcome Y, which Moldova has not yet realised"). Methodologically it combines structured-focused comparison (George & Bennett, 2005) with descriptive cross-country indicator analysis. The two are complementary: indicators establish the broad association between digital maturity and macroeconomic outcomes, while the focused cases trace the mechanism through which a digital ecosystem actually transmits resilience, which correlation alone cannot reveal.

3.2 The shocks: a common disturbance and a sequential second test

The analysis uses the COVID-19 pandemic as the common shock across all cases. Its methodological value is that it arrived almost simultaneously in early 2020, was exogenous to any country's digital policy, and produced both a sharp contraction (2020) and a measurable recovery (2021–2022). That timing approximates a natural experiment, allowing differently-equipped economies to be compared against the same disturbance.

The Eastern European cases carry a second, regionally specific shock that the global frontier did not face in the same form: the disturbance associated with Russia's full-scale invasion of Ukraine in February 2022. For Ukraine this shock was direct and existential; for Moldova it arrived as spillover: an energy crisis, a refugee influx, and an inflation surge compounded by a severe drought. Treating the diagnostic cases as subject to two sequential shocks is deliberate. A digital ecosystem that demonstrably aids absorption of *both* a global health shock and a regional security-and-energy shock provides a far stronger test of adaptive capacity than a single episode. Estonia, by contrast, is used as a structural reference rather than a shock-tested case; the argument it carries is about architecture, not about its response to a particular disturbance.

3.3 Operationalising resilience and adaptive capacity

Economic resilience is operationalised, following Martin (2012), as a two-part construct rather than a single number. For economy *i*, resilience to a shock combines *resistance* (the depth of the output loss relative to the pre-shock trend) and *recovery* (the speed of return toward that trend):

$$R_i = \text{f}(\text{Resistance}_i, \text{Recovery}_i) \quad (1)$$

where Resistance is the gap between actual and counterfactual trend GDP at the trough, and Recovery is the time taken to regain the pre-shock output level. For the diagnostic cases the construct is observed across the two-shock window (2020 and 2022 troughs) rather than a single one. Defining resilience this way matters for the argument: a country can resist shallowly yet recover slowly, or contract deeply yet rebound fast, and digital ecosystems plausibly act on these two margins through different channels.

Adaptive capacity, the explanatory concept, is disaggregated into the three tiers established in the resilience literature (Béné et al., 2012): absorptive capacity (coping without structural change), adaptive capacity (incremental adjustment), and transformative capacity (systemic reconfiguration). Mapping digital-ecosystem functions onto these tiers is the analytical core of the paper: digital government-to-person payments serve absorption, e-commerce and digital service migration serve adaptation, and interoperable digital public infrastructure

(DPI) enables transformation. The comparison across cases is organised explicitly around how far up this ladder each economy's digital ecosystem carried it under shock.

3.4 Measuring the digital ecosystem

The digital ecosystem is decomposed into four layers, each measured with an established public indicator. Table 1 sets out the scheme.

Table 1. Analytical dimensions, indicators, and data sources

Ecosystem layer	Construct	Indicator	Source
Connectivity	Meaningful access	ICT Development Index (IDI)	ITU (2024)
Digital public infrastructure	ID, payments, data exchange	GovTech Maturity Index (GTMI)	World Bank (2022)
Market / platform	Digital commerce readiness	B2C E-commerce Index	UNCTAD (2021)
Skills & adoption	Firm and household uptake	Enterprise Surveys; Global Findex	World Bank (2021, 2022)

Source: *compiled by the author.*

Macroeconomic outcomes are drawn from the IMF World Economic Outlook database (real GDP growth and output paths, 2018–2024). Two caveats attach to the indicator data and are carried through the analysis. First, the ITU revived the IDI in 2023 under a methodology that is not comparable to editions published before 2017, so the index is used cross-sectionally rather than as a time series across the break. Second, the 2024 IDI edition reflects 2022 data because of reporting lags, which constrains how tightly connectivity can be aligned with the 2020 trough.

3.5 Case selection and analytical approach

Case selection is purposive and follows a maximum-variation logic across region, ecosystem maturity, and shock type, so that the argument does not rest on a single development model. The six cases span three continents and three institutional models of digital infrastructure: state-led interoperable DPI (India, Brazil), mobile-money-led inclusion (Kenya), and the post-Soviet digital-state pathway (Estonia, Ukraine, Moldova). One analytic thread is intentional: Ukraine's data-exchange layer, Trembita, is built on the X-Road architecture pioneered by Estonia, so the regional frontier and the diagnostic case are technologically linked, which lets the study trace how a frontier design choice travels to a neighbouring economy under the most extreme conditions.

Within each case the study uses process tracing on documentary evidence (central bank and regulator publications, World Bank, IMF, and UN country material, and transaction-volume statistics) to establish whether and how the digital ecosystem mediated the shock response, rather than inferring mechanism from outcomes. Analysis then proceeds by triangulation across three streams: the descriptive cross-country indicator patterns, the within-case process evidence, and the synthesis of existing empirical estimates from the literature reviewed in Section 2. A finding is treated as robust only where the streams converge; divergences are reported rather than smoothed over.

Three limitations follow directly from the design and bound the claims. First, this is associational policy analysis, not causal identification: economies with deeper digital

infrastructure also tend to have greater fiscal space and stronger institutions, and the study cannot fully separate these. Second, the diagnostic cases face confounds that complicate attribution: Moldova's 2020 and 2022 contractions were amplified by drought, and Ukraine's wartime outcomes reflect physical destruction that no digital system could offset. The digital ecosystem is therefore treated as one resilience factor among several, not the sole driver. Third, Estonia functions as a structural reference rather than a matched comparator, and conclusions drawn from it concern architecture rather than measured shock response.

4. Results and Discussion

The hypothesis under test is that digitalisation makes emerging economies more resilient to shocks. The evidence assembled here does not support that claim in the simple form in which it is usually stated. It supports a sharper, more defensible version: digital ecosystems strengthen one specific margin of resilience (the speed and reach of relief and recovery), while leaving another margin, the depth of the initial contraction, largely to factors that have little to do with digital maturity. The six cases are presented first as macroeconomic trajectories, then decomposed along the resistance and recovery margins, and finally read through the mechanism that links the two.

4.1 Two shocks, six trajectories

Figure 1 plots real GDP growth for the six economies across the period that contains both the common COVID-19 shock of 2020 and the regional energy-and-war shock of 2022. Two features stand out. First, every economy contracted in 2020, but by very different amounts, from a barely perceptible −0.3% in Kenya to −8.3% in Moldova (World Bank, 2024).

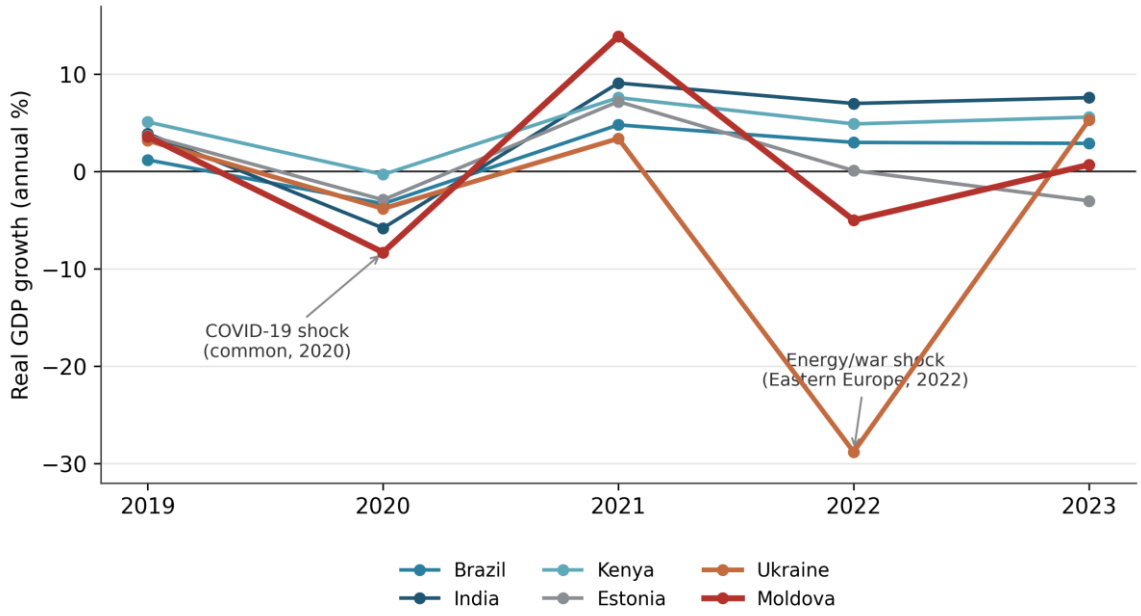

Figure 1. GDP growth paths across two shocks, 2019-2023

Source: *World Bank / IMF World Economic Outlook. India on fiscal-year basis; Moldova 2020 on the World Bank constant-LCU series.*

Second, the Eastern European cases face a second trough in 2022 that the frontier economies do not: Ukraine's output collapsed by roughly 28.8% under invasion, and Moldova contracted by about 5.0% as the energy crisis, a refugee influx, and a further drought converged (World Bank, 2024; United Nations, 2026). The trajectories already hint at the central result: the size of the contraction does not line up with how digitally advanced these economies are.

Table 2 makes the comparison explicit, setting each economy's resistance (2020 trough) and recovery (2021 rebound) against its GovTech maturity and the digital mechanism it actually used during the crisis.

Table 2. Resilience margins, digital maturity, and crisis-delivery mechanisms

Economy	Role	GTMI 2022 group	2020 resistance	2021 recovery	2022 second shock	Documented digital crisis response
Kenya	Frontier	B	−0.3%	+7.6%	+4.9%	CBK waived fees on M-Pesa transfers ≤ KES 1,000 (Mar 2020); +6.2 m active users by Oct 2022
Estonia	Regional frontier	A	−2.9%	+7.2%	+0.1%	X-Road interoperability; uninterrupted digital services
Brazil	Frontier	A	−3.3%	+4.8%	+3.0%	Auxílio Emergencial to ~68 m people via Caixa Tem; ~100 m newly banked in nine months
India	Frontier	A	−5.8%	+9.1%	+7.0%	PMGKY: ~340 m beneficiaries, ₹32,300 cr in weeks; AePS use doubled to ~11.3 m/day
Ukraine	Diagnostic	A	−3.8%	+3.4%	−28.8%	Diia/Trembita; 2.7 m aid applications in week 1; eDocument, IDP aid, eRecovery; ~19 m users
Moldova	Focal diagnostic	A	−8.3%†	+13.9%	−5.0%	"Ajutor la contor" (Oct 2022): digital energy-compensation system on compensatii.gov.md; Energy Vulnerability system auto-targeted ~895,000 households (~75%) using interoperable registry data; energy poverty cut 43%

Note: *India on fiscal-year basis; †World Bank constant-LCU series (the World Bank country brief reports −7%).*

Sources: *World Bank (2022, 2024, 2025); ITU (2024); Government of India (2020); Central Bank of Kenya (2020, 2022); CGAP (2024); Government of the Republic of Moldova (2023); UNDP Moldova (2025).*

4.2 What the data refute: maturity does not buy resistance

The first finding cuts against the naive hypothesis. Figure 2 arranges the six economies by GovTech maturity and shows, for each, the 2020 contraction alongside the 2021 rebound. Five of the six (Estonia, Brazil, India, Ukraine, and Moldova) sit in the top GovTech group (Group A) in the World Bank's 2022 index (World Bank, 2022). If digital maturity translated directly into the ability to withstand a shock, these five should have contracted least. They did not. Moldova, a Group A economy, suffered the deepest contraction in the sample (−8.3%); India, also Group A and home to the world's most-cited digital public infrastructure, contracted by −5.8%. Meanwhile Kenya, which sits a tier lower on GovTech, recorded the mildest contraction of all (−0.3%). The depth of the initial hit tracked the

stringency of lockdowns and the structure of each economy (the weight of agriculture and informality in Kenya, the severity of Moldova's simultaneous drought) far more than it tracked any digital indicator. On the resistance margin the hypothesis is not confirmed.

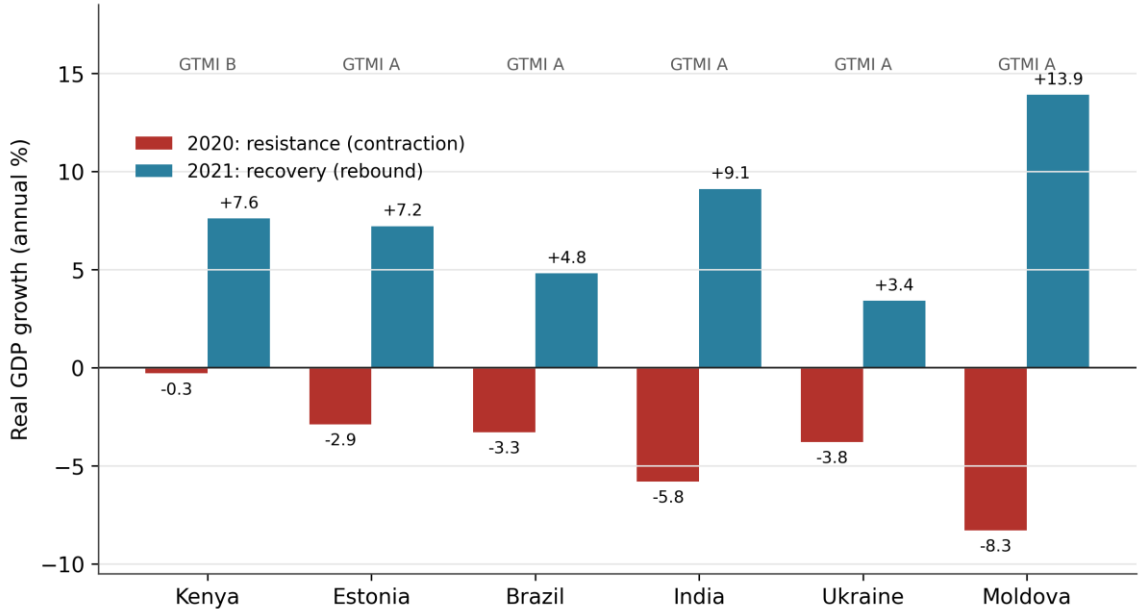

Figure 2. The COVID shock: contraction depth versus recovery, by GovTech maturity

Source: *World Bank / IMF WEO; GovTech group from World Bank GTMI 2022. Five of six cases are GovTech Group A, yet 2020 contraction depth ranges from −0.3% to −8.3%.*

4.3 What the data confirm: digital rails drive the reach and speed of response

The hypothesis recovers its force the moment attention shifts from the size of the contraction to the response. Here the evidence is strong and consistent across cases. Brazil's *Auxílio Emergencial* reached roughly 68 million people (over 40% of households) by routing payments through the *Cadastro Único* registry into *Caixa Tem* digital accounts, banking more than 100 million people in nine months (World Bank, 2021). India's *Pradhan Mantri Garib Kalyan* package put direct transfers into about 340 million Aadhaar-seeded accounts within weeks of the March 2020 lockdown, while daily use of the Aadhaar-enabled payment system doubled to roughly 11.3 million transactions (Government of India, 2020; Alonso et al., 2023). Kenya's central bank eliminated fees on small M-Pesa transfers from 16 March 2020 and watched 6.2 million additional citizens become active mobile-money users by October 2022 (Central Bank of Kenya, 2020, 2022). None of these states could prevent the shock; all of them could reach their populations through it, fast and at scale, because the rails were already laid.

That capacity is not only defensive. The same payment infrastructure that delivered relief also restructured these economies. India's Unified Payments Interface carried fewer than one billion transactions in FY2018 and more than 80 billion by FY2023; Brazil's Pix reached roughly 70% of the population within a few years of its 2020 launch (Duarte et al., 2022; ORF America, 2026). The digital ecosystem thus operates on the recovery margin on two fronts: it accelerates the rebound, and it changes the structure of the economy that rebounds. This is the confirmation the hypothesis deserves, and it is more specific than the original claim.

4.4 The extreme confirmation: Ukraine under war

Ukraine supplies the strongest single test. Diia, the government super-app launched in 2020, runs on the Trembita data-exchange layer built on the same X-Road architecture pioneered by Estonia (Ingram & Vora, 2024). When the full-scale invasion closed offices and displaced millions, the state delivered through this infrastructure: citizens filed over 2.7 million applications for war-related aid in the first week of March 2022 (CGAP, 2024), and new services (*eDocument* for those who fled without papers, internally-displaced-person payments, and *eRecovery* for war damage) were stacked onto the existing rails rather than built from scratch. With roughly 19 million users, Diia functioned as state-continuity infrastructure under the most extreme stress imaginable. No digital system could offset the −28.8% output collapse that physical destruction produced. But the ecosystem kept the state present and paying when its physical apparatus could not. This is the recovery-and-delivery margin operating at its limit.

4.5 The architectural lesson: Estonia and interoperability

Estonia clarifies why the frontier is reachable rather than reserved for large economies. With a population near 1.3 million it built X-Road so that registries and services communicate without a central database, and it made interoperability the organising principle of the digital state. The relevance is that the binding constraint on resilient digital ecosystems is architectural, not demographic: a small economy that invests in shared public rails can reach the frontier, while one that accumulates disconnected sectoral systems cannot, however many services it digitises. Estonia's own near-flat 2022 and contraction in 2023 also caution against overclaiming: a mature digital state is no shield against an energy-and-inflation shock transmitted through trade. The digital ecosystem shapes how a state responds, not whether the shock arrives.

4.6 The focal diagnosis: Moldova's reactive wiring

Moldova is where the comparison pays off, and the focal case requires more care than a first glance suggests. The country absorbed two large shocks in close succession (−8.3% in 2020 and −5.0% in 2022), and it is not a digital laggard; its e-Governance Agency had already built interoperable public rails and placed it in GovTech Group A (World Bank, 2022). When the 2022 energy crisis struck, Moldova did not improvise relief outside those rails. It built a genuinely digital shock-response system on top of them. The *Ajutor la contor* programme, launched in October 2022 and financed through the Energy Vulnerability Reduction Fund, delivered energy compensation through the compensatii.gov.md platform, where an "Energy Vulnerability" information system calculated each household's entitlement automatically and assigned it to one of seven vulnerability categories, drawing on data exchanged with the State Fiscal Service, the National Social Insurance House, and other state registries (Government of the Republic of Moldova, 2023; UNDP Moldova, 2025). The system reached roughly 895,000 households (about 75% of the country), and a UNDP impact evaluation found that it cut energy poverty by 43%, with the largest effect on the most vulnerable families. On the recovery-and-delivery margin, in other words, Moldova's digital ecosystem performed exactly as the frontier mechanism predicts: it let the state identify, target, and reach three-quarters of households at speed.

This finding strengthens the paper's thesis rather than complicating it, because *Ajutor la contor* is a Moldovan demonstration of the same recovery-margin capability that Brazil exercised through Caixa Tem and Ukraine through Diia. What distinguishes Moldova is not the absence

of adaptive wiring but its provisional form, and three features mark the distance from the frontier. First, the system was built reactively, during the shock, rather than pre-positioned before it; Brazil and India entered their crises with rails already in place, whereas Moldova assembled its delivery mechanism under duress in the autumn of 2022. Second, the system is sector-specific: an energy-compensation instrument rather than a general-purpose, reusable shock-response rail that the next, differently-shaped crisis could draw on. Third, its last mile depended heavily on human intermediation: more than half of beneficiary households registered with the assistance of registrars, and the programme leaned on social workers and librarians to enrol citizens who could not use the digital channel on their own, revealing a digital-divide constraint that the mobile-first frontier cases did not face in the same way.

Figure 3 locates this pattern. Moldova's ecosystem reached the adaptive tier and acted on the recovery margin through *Ajutor la contor*, but it did so as a single, improvised circuit rather than as permanent, general-purpose infrastructure. The diagnosis is therefore narrower and more encouraging than a maturity-deficit story would imply: Moldova has already proved, once and under pressure, that it can wire its digital public infrastructure into crisis delivery. The unfinished task is to institutionalise that capability: to convert a reactive, single-sector compensation system into a standing, multi-shock delivery rail that is ready before the next disturbance and reaches citizens with less dependence on assisted enrolment.

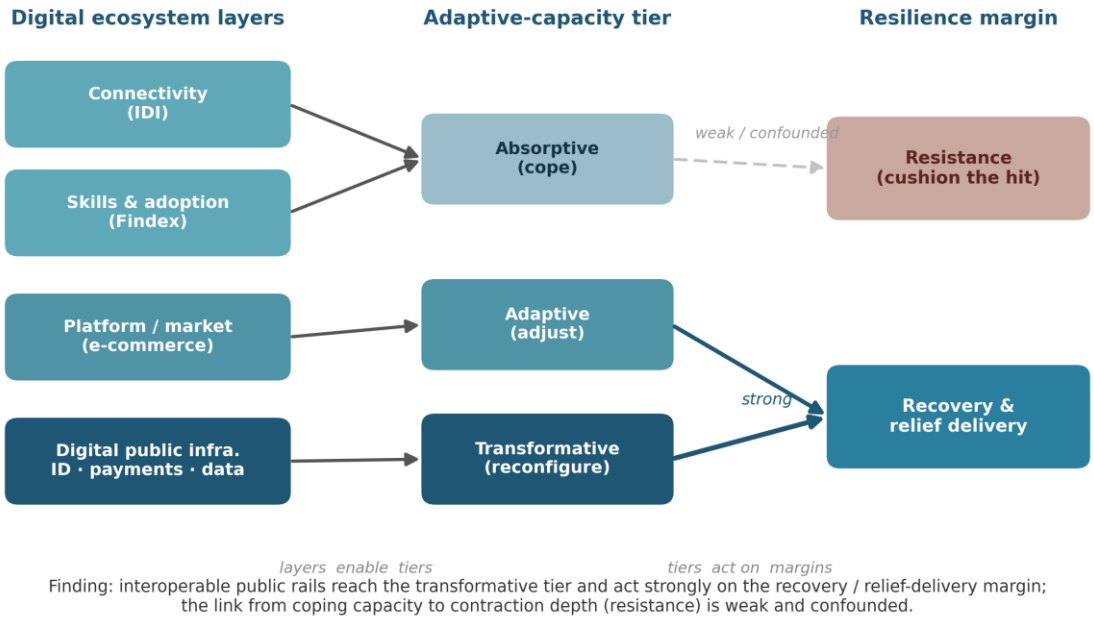

Figure 3. How digital ecosystems transmit resilience

Source: *author's elaboration based on Béné et al. (2012)*

4.7 Synthesis

Across the six cases the pattern is consistent. Digital maturity does not explain how deeply an emerging economy contracts when a shock lands; that resistance margin is governed by lockdown policy, economic structure, and, for Eastern Europe, by exposure to energy and conflict. What digital ecosystems demonstrably do is govern the recovery margin: the pace and the breadth with which a state can find and pay its population, and the structural transformation that interoperable payment rails set in motion. The hypothesis, then, is

confirmed in a revised and stronger form. The policy variable that carries the resilience dividend is not connectivity or a broad e-service portfolio but interoperable public rails wired into crisis delivery, and that is a design choice available to a small economy as much as to a continental one. Moldova has shown, through *Ajutor la contor*, that it can build the wiring even under pressure; the frontier shows the value of making that wiring permanent, general-purpose, and ready in advance.

5. Conclusions

This paper set out to test a claim that is asserted more often than it is examined: that digitalisation makes emerging economies more resilient to shocks. Examined across six economies and two very different disturbances, the claim does not survive in its general form, but it re-emerges in a sharper and more useful one. Digital maturity, measured by the indicators most commonly used to rank it, did not determine how deeply any of these economies contracted. The resistance margin, that is, the depth of the initial fall in output, tracked the stringency of lockdowns, the structure of each economy, and, for the Eastern European cases, exposure to energy and conflict. Five of the six economies studied sit in the top GovTech maturity group, yet their 2020 contractions ranged from negligible to among the deepest in the sample. On this margin, digital infrastructure is not the decisive variable, and policy framed as though it were will disappoint.

What digital ecosystems did govern, consistently and visibly, was the recovery margin. The capacity to identify, reach, and pay citizens through interoperable public rails determined how quickly and how inclusively states could respond once a shock had landed. Brazil reached more than two-fifths of its households within weeks through a registry-and-payment combination it had built in advance; India moved direct transfers into hundreds of millions of accounts through its identity-and-payments stack; Kenya kept money circulating by removing friction from a mobile-money network already woven into daily life; and Ukraine sustained the basic functions of the state under invasion through a digital ecosystem layered on Estonian-style interoperability. The same rails that delivered relief also restructured these economies, pulling activity into traceable digital channels and deepening financial inclusion. The resilience dividend of digitalisation is real, but it is earned on the recovery and delivery margin, not the resistance margin, and it is earned only where infrastructure has been wired into crisis-response functions before the crisis arrives.

For Moldova the diagnosis is specific and, on balance, encouraging. The country is not a digital laggard, and, contrary to what a maturity-deficit reading would suggest, it did not deliver its 2022 energy relief outside its digital infrastructure. Through *Ajutor la contor* it built a digital compensation system that auto-targeted some 895,000 households, about three-quarters of the country, and cut energy poverty by 43%. Moldova has therefore already demonstrated the recovery-margin capability that this paper identifies as the true resilience dividend of digitalisation. Its shortfall is not maturity, and no longer even the absence of wiring, but the provisional form that wiring took: reactive rather than pre-positioned, single-sector rather than general-purpose, and dependent on assisted enrolment at the last mile. The policy implications follow directly and are achievable rather than sweeping. First, generalise the Energy Vulnerability registry into a standing, multi-shock social registry, so that the next crisis, whatever its shape, can be met with a delivery system that already exists. Second, pre-authorise and maintain that system between shocks rather than rebuilding it under pressure each time. Third, invest in interoperable self-service access so that reaching vulnerable

households depends less on the extraordinary mobilisation of social workers that the 2022 season required. None of these steps asks Moldova to climb to a higher rung of digital maturity; each asks it to make permanent what it has already shown it can do.

These conclusions are bounded by the design that produced them. This is associational policy analysis across a small, purposive set of cases, not causal estimation: economies with deeper digital infrastructure also tend to have greater fiscal space and stronger institutions, and the analysis cannot fully separate these influences. The diagnostic cases carry confounds that no digital system could offset: Moldova's contractions were amplified by drought, and Ukraine's wartime collapse reflects physical destruction. The digital ecosystem is therefore best understood as one resilience factor among several rather than the decisive one. Estonia functions as a structural reference rather than a matched comparator. Future research could strengthen the argument in three directions: by constructing a panel that measures the integration between digital public infrastructure and social-protection delivery directly, rather than inferring it; by extending the comparison to a larger set of small open economies exposed to energy and trade shocks; and by evaluating, after the fact, whether reforms that wire infrastructure into crisis delivery measurably shorten recovery. For policymakers in Moldova and economies like it, the practical message is already clear enough to act on. The resilience payoff of the coming decade will come less from building more digital infrastructure than from connecting the infrastructure that already exists to the moments when citizens most need the state to find them.

References

Alonso, C., Bhojwani, T., Hanedar, E., Prihardini, D., Uña, G., & Zhabska, K. (2023). *Stacking up the benefits: Lessons from India's digital journey* (IMF Working Paper No. WP/23/78). International Monetary Fund.

Béné, C., Wood, R. G., Newsham, A., & Davies, M. (2012). Resilience: New utopia or new tyranny? Reflection about the potentials and limits of the concept of resilience in relation to vulnerability reduction programmes. *IDS Working Paper, 2012*(405), 1–61.

Briguglio, L., Cordina, G., Farrugia, N., & Vella, S. (2009). Economic vulnerability and resilience: Concepts and measurements. *Oxford Development Studies, 37*(3), 229–247. https://doi.org/10.1080/13600810903089893

Central Bank of Kenya. (2020, March 16). *Emergency measures to facilitate mobile money transactions* [Press release]. https://www.centralbank.go.ke

Central Bank of Kenya. (2022, December 6). *Reintroduction of charges for mobile money wallet and bank account transactions* [Press release]. https://www.centralbank.go.ke

Consultative Group to Assist the Poor. (2024, October 24). *Ukraine's Diia: A digital lifeline in times of crisis* [Blog post]. CGAP. https://www.cgap.org/blog/ukraines-diia-digital-lifeline-in-times-of-crisis

Duarte, A., Frost, J., Gambacorta, L., Koo Wilkens, P., & Shin, H. S. (2022). *Central banks, the monetary system and public payment infrastructures: Lessons from Brazil's Pix* (BIS Bulletin No. 52). Bank for International Settlements. https://www.bis.org/publ/bisbull52.pdf

Gentilini, U., Almenfi, M., Iyengar, H., Okamura, Y., Downes, J. A., Dale, P., … Aziz, S. (2022). *Social protection and jobs responses to COVID-19: A real-time review of country measures* (Living paper). World Bank.

George, A. L., & Bennett, A. (2005). *Case studies and theory development in the social sciences*. MIT Press.

Government of India, Ministry of Finance. (2020). *Pradhan Mantri Garib Kalyan Package: Progress so far* [Press release]. Press Information Bureau.

Government of the Republic of Moldova, Ministry of Labour and Social Protection. (2023). *The "Help at the meter" compensation programme: Results and prospects for improvement for the coming cold season* [Press release]. https://social.gov.md

Hallegatte, S. (2014). *Economic resilience: Definition and measurement* (Policy Research Working Paper No. 6852). World Bank.

Heeks, R. (2003). *Most eGovernment-for-Development projects fail: How can risks be reduced?* (iGovernment Working Paper No. 14). Institute for Development Policy and Management, University of Manchester.

Ingram, G., & Vora, P. (2024). *Ukraine: Digital resilience in a time of war*. Brookings Institution. https://www.brookings.edu/articles/ukraine-digital-resilience-in-a-time-of-war/

International Monetary Fund. (2024). *World Economic Outlook database, October 2024 edition* [Data set]. IMF.

International Telecommunication Union. (2024). *Measuring digital development: The ICT Development Index 2024*. ITU.

Jack, W., & Suri, T. (2014). Risk sharing and transactions costs: Evidence from Kenya's mobile money revolution. *American Economic Review, 104*(1), 183–223. https://doi.org/10.1257/aer.104.1.183

Martin, R. (2012). Regional economic resilience, hysteresis and recessionary shocks. *Journal of Economic Geography, 12*(1), 1–32.

Martin, R., & Sunley, P. (2015). On the notion of regional economic resilience: Conceptualization and explanation. *Journal of Economic Geography, 15*(1), 1–42. https://doi.org/10.1093/jeg/lbu015

O'Brien, C., Scott, Z., Smith, G., Barca, V., Kardan, A., Holmes, R., … Congrave, J. (2018). *Shock-responsive social protection systems research: Synthesis report*. Oxford Policy Management.

ORF America. (2026). *Digital public infrastructure and the future of digital payments: Lessons from Pix and UPI*. Observer Research Foundation America. https://orfamerica.org/newresearch/digital-public-infrastructure-and-the-future-of-digital-payments-lessons-from-pix-and-upi

Rose, A. (2007). Economic resilience to natural and man-made disasters: Multidisciplinary origins and contextual dimensions. *Environmental Hazards, 7*(4), 383–398. https://doi.org/10.1016/j.envhaz.2007.10.001

Suri, T., & Jack, W. (2016). The long-run poverty and gender impacts of mobile money. *Science, 354*(6317), 1288–1292. https://doi.org/10.1126/science.aah5309

UNCTAD. (2021). *The UNCTAD B2C E-commerce Index 2020: Spotlight on Latin America and the Caribbean*. United Nations Conference on Trade and Development.

UNDP Moldova. (2025). *Report on the welfare impact of energy compensations in Moldova 2021–2025*. United Nations Development Programme. https://www.undp.org/moldova/publications/report-welfare-impact-energy-compensations-moldova-2021-2025

United Nations. (2026). *World economic situation and prospects 2026*. United Nations.

World Bank. (2016). *World Development Report 2016: Digital dividends*. World Bank.

World Bank. (2021). *Moldova economic update, Spring 2021*. World Bank.

World Bank. (2022). *GovTech Maturity Index, 2022 update: Trends in public sector digital transformation*. World Bank.

World Bank. (2024). *World development indicators* [Data set]. World Bank.

World Bank. (2025, December 2). *From queues to clicks: Digitalization transforms Moldova's public services* [Feature story]. World Bank. https://www.worldbank.org/en/news/feature/2025/12/02/from-queues-to-clicks-digitalization-transforms-moldova-s-public-services