DIGITAL INFRASTRUCTURES AS THE NEW PIPES OF GLOBAL CAPITAL

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EXTENDED ABSTRACT

Purpose Global capital increasingly flows not only through traditional financial markets and institutions, but through digital infrastructures—payment platforms, mobile banking systems, and online transaction networks that have become the new pipes of the global economy. These infrastructures shape how quickly capital enters, how securely it is intermediated, and how abruptly it can reverse. In this sense, digitalization is now part of the architecture of the global economy, conditioning the volatility that defines openness. Traditional analyses of the drivers of capital flows and their volatility, built around push factors (global shocks) and pull factors (domestic fundamentals), cannot fully explain why countries with similar fundamentals often face very different volatility profiles (Koepke, 2015; Cerutti *et al*., 2015; Fratzscher, 2011). As Carney (2019) noted, the pipes through which capital flows are transmitted matter as much as the drivers themselves. This study builds directly on that insight and provides a systematic empirical evidence that digital infrastructures act as pipes that shape the stability of global capital.

Design/methodology/approach We extend the classical push–pull framework into a push–pull–pipes model (Pagliari *et al.*, 2017; Wang, 2019). Push factors include a Global Financial Conditions Index (data sourced from Capital Economics), U.S. real GDP growth volatility (estimated volatility based on data sourced from FRED), and Global Economic Conditions volatility (estimated volatility based on data sourced from KOF Swiss Economic Institute). Pull factors comprise a Domestic Financial Conditions Index (data sourced from Capital Economics, Boraccia *et al.*, 2023), a Financial Development Index (data sourced from the IMF), Capital Account Openness (Chinn–Ito index; Chinn *et al.*, 2008), and Real Effective Exchange Rate volatility (estimated volatility based on data sourced from Bruegel). Pipes are measured by Relative Sovereign Credit Ratings (score versus the global median; De *et al.*, 2020) and a Relative Digital Infrastructure Index (mobile and internet banking penetration per 1,000 adults, benchmarked globally).

$$\sigma_{kt}^{ij} = \alpha_k^{ij} + \beta^{ij} PUSH_t + \gamma^{ij} PULL_{k,t-1} + \delta^{ij} PIPES_{k,t-1} + \varepsilon_{kt}^{ij}$$

In this study, we explicitly embed digital infrastructures within the pipes dimension, thereby expanding the volatility debate beyond incentives to the channels through which capital is transmitted. Regarding the methodology, the analysis uses an unbalanced quarterly panel of advanced and emerging, and developing economies over 2000Q1–2023Q1. The dependent variable σ_{kt}^{ij} is the volatility of gross capital inflows, which is estimated as follows. For each economy and instrument (direct, portfolio, and other investment), we first estimate residuals from an ARIMA (1,1,0) model on the quarterly series; second, the standard deviation of these

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residuals is calculated as our volatility measure. The econometric specification employs panel fixed effects to control for unobserved country heterogeneity, with Driscoll–Kraay standard errors to address heteroskedasticity and autocorrelation. We estimate separate regressions for the drivers of volatility in FDI, portfolio, and other-investment inflows. We also run the specifications on the EMDE subsample to examine this group more closely.

Findings Across the full sample, push factors dominate: global financial conditions and U.S. cycle volatility account for most of the variation in capital-flow volatility. Pull factors are uneven: stronger financial development and greater openness tend to attract flows but often raise volatility, while REER volatility remains a persistent destabilizer. Within this structure, pipe condition outcomes. Relative sovereign ratings are procyclical—upgrades attract inflows that are often more volatile—and digital infrastructures display a negative and statistically significant association with the volatility of total, portfolio, and especially banking-related inflows, suggesting that countries with deeper digital systems experience smoother financial intermediation and lower exposure to sudden stops.

In EMDEs, however, the estimated coefficients on the Digital Infrastructure Index remain negative but largely insignificant, indicating that the stabilizing potential of digital pipes does not systematically materialize in weaker institutional environments.

This pattern implies that while digitalization may facilitate access and speed of intermediation, it cannot by itself anchor stability without complementary institutional quality and regulatory depth. In such contexts, digital infrastructures operate more as accelerators of integration than as absorbers of volatility—enhancing financial connectivity but offering limited insulation from global shocks.

Originality/value For EMDEs, investing in digital infrastructures should be viewed both as a development priority and as a conditional macro-financial resilience strategy. While digital systems can expand access and efficiency, their stabilizing potential remains largely unrealized in the absence of strong institutional and regulatory frameworks. Without these complements, digital infrastructures enhance financial connectivity but offer limited insulation from external shocks, operating more as channels of speed than of stability. Strengthening institutional quality and financial supervision is therefore essential for digital pipes to function as genuine macro-stabilizers.

At the global level, integrating the "pipes" dimension—particularly digital infrastructures—into the IMF's Integrated Policy Framework would acknowledge their role as structural complements to monetary, fiscal, and macroprudential instruments (Basu et al., 2023; IMF, 2023; IMF, 2022). Doing so would allow global surveillance and policy design to better capture how technological architectures condition the transmission and volatility of capital in an increasingly digitalized financial system (IMF, 2023).

This study reconceptualizes the analysis of capital flow volatility for the digital era by extending the classical push–pull framework into a structural push–pull–pipes perspective. The evidence confirms that while global and domestic macro-financial conditions remain the primary determinants of volatility, the channels through which capital circulates increasingly matter (Reuter *et al.*, 2025). Among these, digital infrastructures emerge as a new driver of capital flow volatility. Across all economies, deeper digital infrastructures are associated with lower volatility in total, portfolio, and banking inflows, reflecting smoother intermediation and improved informational efficiency. In EMDEs, however, the effect remains statistically weak,

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implying that digital systems alone cannot substitute for institutional strength. Their stabilizing potential is contingent on regulatory quality, supervisory depth, and the credibility of financial governance. Digital pipes are reshaping the speed, reach, and resilience of capital mobility. Recognizing their dual role—facilitating integration while conditioning volatility—should become central to future macro-financial frameworks.

Keywords: *Capital flows volatility, Drivers, Push, Pull, Pipes, Digital infrastructure*

JEL classification: *F32, G15, O33*

Table 1: Baseline Regression

	All countries					Emerging and Developing countries				
	Total Gross Inflows	Direct Inv Inflows	Portfolio Inv Inflows	Other Inv Inflows	Other Inv Inflows Banks	Total Gross Inflows	Direct Inv Inflows	Portfolio Inv Inflows	Other Inv Inflows	Other Inv Inflows Banks
Country Fin. Conditions Index (t-1)	0.167	-0.035	0.052	-0.166	0.030	0.408	0.136	-0.124	-0.297	0.220
	(0.413)	*(0.085)*	*(0.228)*	*(0.201)*	*(0.169)*	*(0.355)*	*(0.092)*	*(0.194)*	*(0.302)*	*(0.154)*
Fin. Development Index (t-1)	4.584***	-0.238	1.275**	2.706***	3.237***	3.387**	0.312	-0.233	2.806*	2.927***
	(0.939)	*(0.226)*	*(0.539)*	*(0.562)*	*(0.500)*	*(1.472)*	*(0.576)*	*(0.637)*	*(1.560)*	*(1.073)*
REER Volatility (t-1)	0.163*	-0.049**	0.081	0.178**	0.036	0.024	-0.108***	0.027	0.193*	0.019
	(0.097)	*(0.020)*	*(0.051)*	*(0.077)*	*(0.049)*	*(0.089)*	*(0.029)*	*(0.063)*	*(0.112)*	*(0.044)*
US rGDP Growth (t-1)	0.097*	0.023	-0.011	0.122	0.069	0.053	-0.020	-0.028	0.111	0.077
	(0.053)	*(0.016)*	*(0.062)*	*(0.075)*	*(0.062)*	*(0.073)*	*(0.025)*	*(0.097)*	*(0.093)*	*(0.076)*
Chinn - Ito (t-1)	-1.201	0.905	-2.436*	-2.147	-1.650*	0.544	2.018*	0.073	-0.160	1.153
	(2.006)	*(0.582)*	*(1.444)*	*(1.656)*	*(0.969)*	*(2.216)*	*(1.069)*	*(1.441)*	*(2.077)*	*(1.350)*
World Economic Conditions Volatility (t-1)	0.156***	0.017	0.124***	-0.046	-0.035*	0.141***	0.011	0.139***	-0.060	-0.039
	(0.027)	*(0.011)*	*(0.026)*	*(0.033)*	*(0.019)*	*(0.039)*	*(0.010)*	*(0.040)*	*(0.040)*	*(0.025)*
World Fin. Conditions Index (t-1)	-0.053	-0.151***	-0.774***	0.483***	0.582**	-0.111	-0.272***	-0.417**	0.668**	0.648***
	(0.325)	*(0.056)*	*(0.243)*	*(0.163)*	*(0.230)*	*(0.395)*	*(0.093)*	*(0.203)*	*(0.282)*	*(0.135)*
Country Relative Rating (t-1)	0.063*	-0.015	0.001	0.014*	-0.057***	0.015*	-0.021***	0.032**	0.015	0.011
	(0.037)	*(0.018)*	*(0.034)*	*(0.022)*	*(0.017)*	*(0.036)*	*(0.007)*	*(0.020)*	*(0.016)*	*(0.012)*
Relative Digital Infrastructure Index (t-1)	-0.056**	-0.131	-0.563*	-0.059*	-1.401***	-0.675*	-0.260	0.217	0.162	0.092
	(0.541)	*(0.248)*	*(0.326)*	*(0.373)*	*(0.286)*	*(0.535)*	*(0.159)*	*(0.286)*	*(0.384)*	*(0.430)*
Constant	-10.919***	3.270***	0.764	-3.582	-8.343***	-5.921	0.525	4.099	-5.719	-8.931*
	(3.798)	*(0.947)*	*(2.449)*	*(2.529)*	*(2.130)*	*(5.930)*	*(2.322)*	*(3.017)*	*(6.249)*	*(5.021)*
Observations	991	991	990	990	990	675	675	674	674	674
Groups	22	22	22	22	22	15	15	15	15	15
Country fixed effects	yes	yes	yes	yes	yes	Yes	yes	yes	yes	yes

Source: Authors' calculations.

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