The Extensive Margin of Bilateral Financial Flows to Low-Income Countries: Entry, Persistence, and Spillovers*

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Abstract

Why do most low-income developing countries fail to establish financial relationships with potential capital sources? We study the extensive margin of bilateral financial flows—the formation and persistence of financial linkages—using a comprehensive panel of four flow types (foreign direct investment, portfolio equity and debt, and official development assistance) between 59 LIDCs and all source countries from 2000 to 2023. More than 85 percent of potential bilateral relationships remain inactive in any given year, yet active relationships exhibit strong persistence, with continuation probabilities ranging from 78 to 93 percent. We estimate bias-corrected dynamic binary-choice models with triple-indexed fixed effects that distinguish persistent bilateral affinities from true state dependence while accommodating the rare-events nature of extensive-margin transitions. Gravity frictions affect flows heterogeneously: informational barriers bind more tightly for portfolio claims than for foreign direct investment, where managerial control mitigates linguistic and cultural distance. Policy effects are also heterogeneous: trade sanctions increase FDI entry but deter portfolio debt, travel sanctions reduce FDI, and deeper trade agreements show positive cross-sectional associations that attenuate under within-pair identification. Cross-flow complementarities between aid and FDI are driven primarily by stable bilateral characteristics rather than short-run spillovers, with implications for using aid to catalyze private investment. Our findings demonstrate that the extensive margin is the binding constraint for capital flows to the poorest countries and that determinants vary systematically across official and private flows.

JEL Classification: C23, C25, F21, F34, F35.

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1 Introduction

International capital flows to developing countries exhibit remarkable heterogeneity across types, bilateral relationships, and time. While gravity models have revolutionized our understanding of trade flows, their application to financial flows presents distinct challenges: pervasive zeros

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reflecting inactive bilateral relationships, different economic mechanisms across flow types, and complex dynamic interdependencies. This paper develops an empirical framework to study the extensive margin of bilateral financial flows—the formation, persistence, and termination of financial relationships between source countries and low-income developing countries (LIDCs).

We examine how four types of bilateral financial flows—foreign direct investment (FDI), portfolio equity, portfolio debt, and official development assistance (ODA)—respond to gravity frictions, trade relationships, policy interventions, and institutional arrangements. Two empirical puzzles motivate our analysis. First, most potential bilateral financial relationships between LIDCs and source countries remain inactive: more than 85 percent of country pairs exhibit zero portfolio equity positions in any given year, and more than 70 percent exhibit zero FDI positions. Second, conditional on being active, bilateral financial links display strong persistence, with continuation probabilities ranging from 78 percent (portfolio equity) to 93 percent (ODA). Understanding these extensive-margin dynamics is central to explaining why capital flows to poor countries remain limited despite apparently high returns—the Lucas paradox (Lucas, 1990)—and why financial integration progresses unevenly across developing economies (as well as how capital is allocated remains puzzling, Gourinchas and Jeanne, 2013).

Our contribution is threefold. First, we assemble a comprehensive triple-indexed panel (source country, destination country, year) covering 59 LIDCs and their bilateral financial relationships with all potential source countries from 2000 to 2023. This unified treatment of multiple flow types within a single empirical framework allows us to estimate cross-flow complementarities and substitution patterns that would be obscured in flow-specific analyses. The focus on LIDCs addresses a gap in the literature: while much evidence on international finance comes from advanced and emerging economies, the poorest countries face distinct challenges in establishing and maintaining financial relationships.

Second, we develop and implement a bias-corrected fixed-effects estimator for dynamic binary-choice models that accommodates the rare-events nature of extensive-margin transitions. Our specification employs complementary log-log (cloglog) and logit link functions with high-dimensional fixed effects (source×time, destination×time, and bilateral pair), lagged dependent variables to capture relationship-specific capital and switching costs, and cross-flow lags to identify dynamic spillovers. The bias correction addresses the incidental parameters problem in short panels with fixed effects, yielding consistent estimates of persistence and policy effects. This econometric framework naturally handles zeros as true economic outcomes (inactive relationships) rather than missing data, and the dynamic structure distinguishes persistent bilateral affinities from true state dependence.

Third, we document systematic heterogeneity in extensive-margin determinants across flow types and provide new evidence on the role of policy variables. Gravity frictions—geographic distance, linguistic distance, and cultural distance—affect flows differentially: informational barriers bind more tightly for arm's-length portfolio claims than for FDI, where direct control mitigates language and cultural gaps. Policy interventions have heterogeneous effects: trade sanctions increase FDI entry (consistent with tariff-jumping) but deter portfolio debt; travel sanctions uniformly reduce FDI; and deeper regional trade agreements show positive cross-sectional associations but attenuate under within-pair identification. Cross-flow dynamics reveal that apparent complementarities between aid and FDI are driven primarily by stable bilateral affinities (such as colonial ties) rather than short-run spillovers, with important implications for using aid to catalyze private investment.

Our empirical strategy builds on recent advances in gravity modeling and dynamic panel methods. The extensive-margin specification extends Helpman et al. (2008) to financial markets, adapting their firm-level selection framework to bilateral country-pair relationships. The bias-corrected estimator follows Fernandez-Val (2009), applying their approach to rare-events binary choice models with triple-indexed fixed effects. The structural interpretation of fixed effects aligns with modern gravity theory (Head and Mayer, 2014; Anderson et al., 2019), treating source×time effects as outward supply shifters (multilateral resistance), destination×time effects as inward demand shifters, and pair effects as bilateral affinity. This combination yields credible identification of policy effects while controlling for unobserved heterogeneity at multiple levels.

Our findings contribute to several strands of literature. First, we extend the gravity-in-finance literature (Portes and Rey, 2005; Lane and Milesi-Ferretti, 2007) by providing the first comprehensive extensive-margin analysis for LIDCs across multiple flow types. Second, we add to evidence on gross capital flow volatility (Broner et al., 2013; Ghosh et al., 2014) by showing that portfolio flows to LIDCs are not only volatile in size but exhibit low persistence at the extensive margin, with many bilateral relationships activating and deactivating annually. Third, we inform the aid-investment debate (Borensztein et al., 1998; Rajan and Subramanian, 2008) by demonstrating that aid-FDI complementarities operate primarily through slow-moving bilateral characteristics rather than year-to-year policy variation. Fourth, we provide policy-relevant evidence on how sanctions and trade agreements shape financial flows differently across instruments, with implications for the ongoing reconfiguration of global economic relationships amid rising geopolitical tensions.

The remainder of the paper proceeds as follows. Section 2 presents motivating evidence on LIDCs' macroeconomic characteristics, policy environment, and extensive-margin patterns. Section 3 develops the theoretical framework linking bilateral financial flows to gravity frictions, trade costs, and policy variables. Section 4 presents the main results on persistence, gravity determinants, policy effects, and cross-flow dynamics. It also discusses robustness checks and compares cloglog and logit specifications. Section 5 concludes with policy implications and directions for future research.

2 Motivation

2.1 Country Coverage and the Extensive Margin Challenge

Given our primary objective of understanding financial flow dynamics to low-income developing countries (LIDCs), it is essential to clarify both the definition of this country group and why the extensive margin is particularly salient for these economies. Multiple classifications of "developing" or "low-income" economies exist in the literature. We adopt the International Monetary Fund's LIDC classification as published annually in the World Economic Outlook, which identifies LIDCs countries based on income levels and eligibility for the IMF's concessional lending (PRGT).[1]

All subsequent analyses focus on financial flow observations in which LIDCs are recipients. This sample choice is motivated by a fundamental empirical regularity: for LIDCs, the challenge of attracting international capital is not primarily one of scaling existing relationships (the intensive margin), but rather of establishing and maintaining financial linkages in the first place (the extensive margin). As we document below, the majority of potential bilateral financial relationships between LIDCs and source countries remain inactive in any given year, and transitions between active and inactive states exhibit strong persistence and state dependence. Understanding these extensive-margin dynamics is therefore central to explaining patterns of financial integration –or lack thereof – among the world's poorest economies.

2.2 Macroeconomic Context and the Capital Flow Deficit

Table 1 elucidates the economic characteristics of the LIDC group. The median LIDC has a moderately sized population (approximately 17 million) and non-negligible aggregate GDP (roughly

[1]Specifically, we use the 2023 IMF classification. For comparison, we provide an alternative, closely related classification by the World Bank Group in Figure 1.

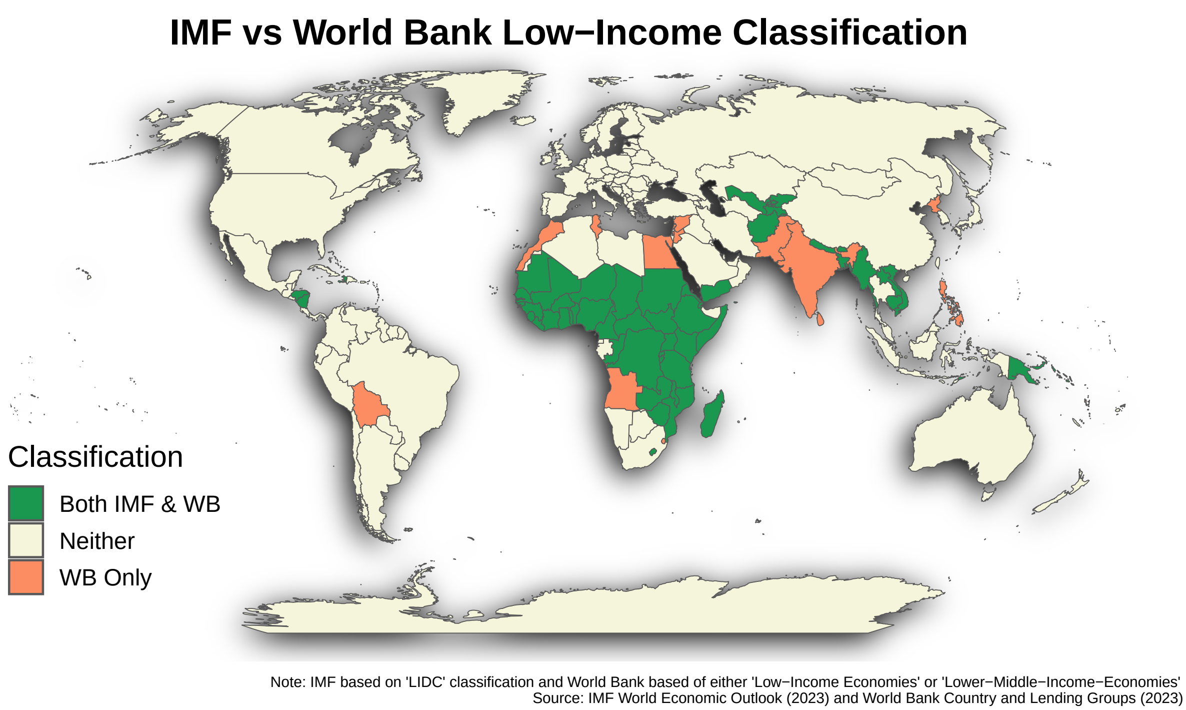

Figure 1: Geographic Distribution of Low-Income Developing Countries

Note: Map depicts countries classified as LIDCs by the IMF (darker shading) and World Bank (lighter shading) using 2023 classifications. Most LIDCs are concentrated in Sub-Saharan Africa, with additional clusters in South Asia and Southeast Asia.

$20 billion), yet remains characterized by very low GDP per capita (median $1,100). This contrast highlights a defining feature of LIDCs: substantial aggregate economic size coupled with severely limited per capita development. The pattern is particularly pronounced for large LIDC economies such as Bangladesh, Nigeria, Ethiopia, the Democratic Republic of the Congo, Kenya, and Myanmar, which lie in the upper tails of both the global and LIDC population and output distributions.

Table 1: Macroeconomic Context of Low-Income Developing Countries by Region (2023)

Region	**# of LIDCs**	**Med. NGDP (Bill.)**	**Med. GDP per cap.**	**Med. Total Pop. (mn)**
All LIDCs	59	16.9	1,388	14.4
Sub-Saharan Africa	39	16.3	996	18
Asia & Pacific	11	30.8	2,178	10
Middle East & C.A.	5	15.2	1,178	36
Western Hemisphere	3	19.9	2,609	11
Europe & CIS	1	16.7	6,800	2

Note: Data correspond to 2023 values for countries classified as low-income (LIDCs). Med. corresponds to the median operator. GDP aggregates are measured in nominal U.S. dollars; population figures refer to total and working-age populations (ages 15–64) in millions. Regional classifications follow IMF groupings.

Crucially for our analysis, LIDCs receive disproportionately low levels of international financial flows relative to their economic size and population. This "capital flow deficit" is evident across all flow types: the median LIDC receives FDI inflows equivalent to only 2-3 percent of GDP, portfolio investment remains virtually absent for most countries, and even official development assistance – the most reliably present flow – averages less than 5 percent of GDP. These low levels reflect not merely small intensive-margin flows conditional on participation, but primarily the *absence* of bilateral financial relationships. For instance, in our sample, more than 85 percent of potential LIDC-source country pairs exhibit zero portfolio equity positions in any given year, and more than 70 percent exhibit zero FDI positions. The extensive margin thus emerges as the binding constraint: most LIDCs are simply not connected to most potential capital sources, and expanding these networks constitutes the primary channel through which financial integration can deepen.

Table 2: Structural and Institutional Characteristics of Low-Income Developing Countries by Region (2023)

Region	**No. of LIDCs**	**Trade/GDP**	**Credit/GDP**	**Mkt. Cap/GDP**	**Lending Rate**	**Deposit Rate**
All LIDCs	59	21.4	26.0	2.6	23.4	7.9
S.S. Africa	39	22.5	17.4	1.8	32.4	11.8
Asia & Pacific	11	27.3	57.5	6.3	9.6	2.6
M.E. & C.A.	5	13.2	22.2	2.7	20.6	9.7
Western Hem.	3	5.6	36.9	0.0	12.7	4.3
Europe	1	1.1	25.6	0.0	12.3	7.0

Note: Indicators correspond to 2023 averages for each region's low-income developing countries (LIDCs). Financial depth and market capitalization are expressed as shares of GDP (percent). Lending and deposit rates are annualized percentages. The Democracy Index is scaled from 0 to 1. Trade/GDP, Conflict Exposure, and RTA participation are expressed as regional averages in percent.

Table 2 documents substantial heterogeneity across LIDC regions in terms of financial depth, trade integration, and intermediation costs. Credit-to-GDP ratios differ markedly between Sub-Saharan Africa (median 20 percent) and Asia & Pacific economies (median 45 percent), while trade openness in Western Hemisphere LIDCs is considerably lower than the LIDC average. Lending and deposit rate spreads also vary widely, pointing to meaningful differences in financial intermediation conditions.

This cross-regional heterogeneity underscores the importance of our empirical strategy, which employs high-dimensional fixed effects to absorb time-invariant bilateral affinities and source-time and destination-time effects to control for multilateral resistance and time-varying country-specific determinants of supply and demand.

2.3 The Policy Landscape and Extensive-Margin Frictions

Beyond macroeconomic fundamentals, the policy environment facing LIDCs constitutes a critical determinant of extensive-margin entry and persistence. Table 3 provides a granular decomposition of trade agreement depth and sanctions exposure across LIDC regions. Two patterns emerge. First, comprehensive trade agreements remain relatively uncommon: on average, fewer than one-fifth of LIDC country pairs are covered by a full free trade agreement, and when agreements are present, they tend to emphasize standards and investment provisions while omitting deeper institutional commitments such as procurement and competition chapters. Second, sanctions exposure varies dramatically across regions, with Middle East and Central Asia LIDCs facing substantially higher incidence of arms and military sanctions, while Sub-Saharan African LIDCs exhibit comparatively greater depth in trade and investment provisions.

Table 3: Trade Agreement Depth and Sanctions Exposure of Low-Income Developing Countries by Region (2023)

	Trade Agreement Depth						Sanctions Exposure					
Region	**Full FTA**	**Standards**	**Invest.**	**Procurement**	**Competition**	**IPR**	**Arms**	**Military**	**Trade**	**Fin.**	**Travel**	**Other**
All LIDCs	17.3	24.1	23.6	1.3	4.8	15.5	12.5	6.7	2.4	24.1	24.1	2.8
S.S. Africa	22.6	32.1	32.6	0.0	5.0	21.4	12.6	5.7	3.0	32.1	32.1	2.3
Asia & P.	5.1	8.6	5.4	2.1	3.4	2.2	1.5	1.5	1.5	8.6	8.6	0.0
M.E. & C.A.	4.4	2.6	1.9	0.3	0.3	0.3	31.0	31.0	0.5	2.6	2.6	15.5
Western Hem.	13.7	14.2	14.0	14.0	12.0	13.4	25.8	0.1	0.5	14.2	14.2	0.1
Europe	18.1	18.1	13.3	11.3	13.3	12.1	0.0	0.0	0.8	18.1	18.1	0.0

Note: Entries report regional averages for low-income developing countries (LIDCs) in 2023. Trade agreement indicators measure the share of country pairs with legally enforceable provisions in each policy area. Sanctions variables report the share of LIDCs subject to each type of sanction. All values are expressed as percentages.

These cross-sectional differences motivate examining how policy variation affects the probability of establishing and maintaining bilateral financial linkages. Figure 2 illustrates changes in the prevalence of trade, investment, and sanctions-related policies across country groups between 2003–2012 and 2013–2023. The heat map reveals that while LIDCs have experienced increases in policy linkages, these changes remain substantially smaller than those observed for advanced economies (AEs) and emerging markets (EMs). This widening gap in policy network density suggests that the extensive margin of economic integration is expanding more rapidly among developed economies, reinforcing asymmetries in global financial integration and potentially contributing to the persistent capital flow deficit documented above.

An additional pattern visible in Figure 2 concerns the growing prevalence of sanctions. Advanced economies exhibit larger increases in the use of financial, trade, and travel sanctions relative to EMs and LIDCs, consistent with greater scope to deploy sanctions as a policy instrument among more integrated economies. This pattern has become increasingly salient amid ongoing geopolitical fragmentation and motivates our explicit inclusion of sanctions variables in the extensive-margin regressions. As we demonstrate in Section 4, sanctions have heterogeneous effects across flow types: trade sanctions appear to encourage tariff-jumping FDI while deterring portfolio debt, whereas travel sanctions uniformly reduce FDI entry, underscoring the importance of business mobility for

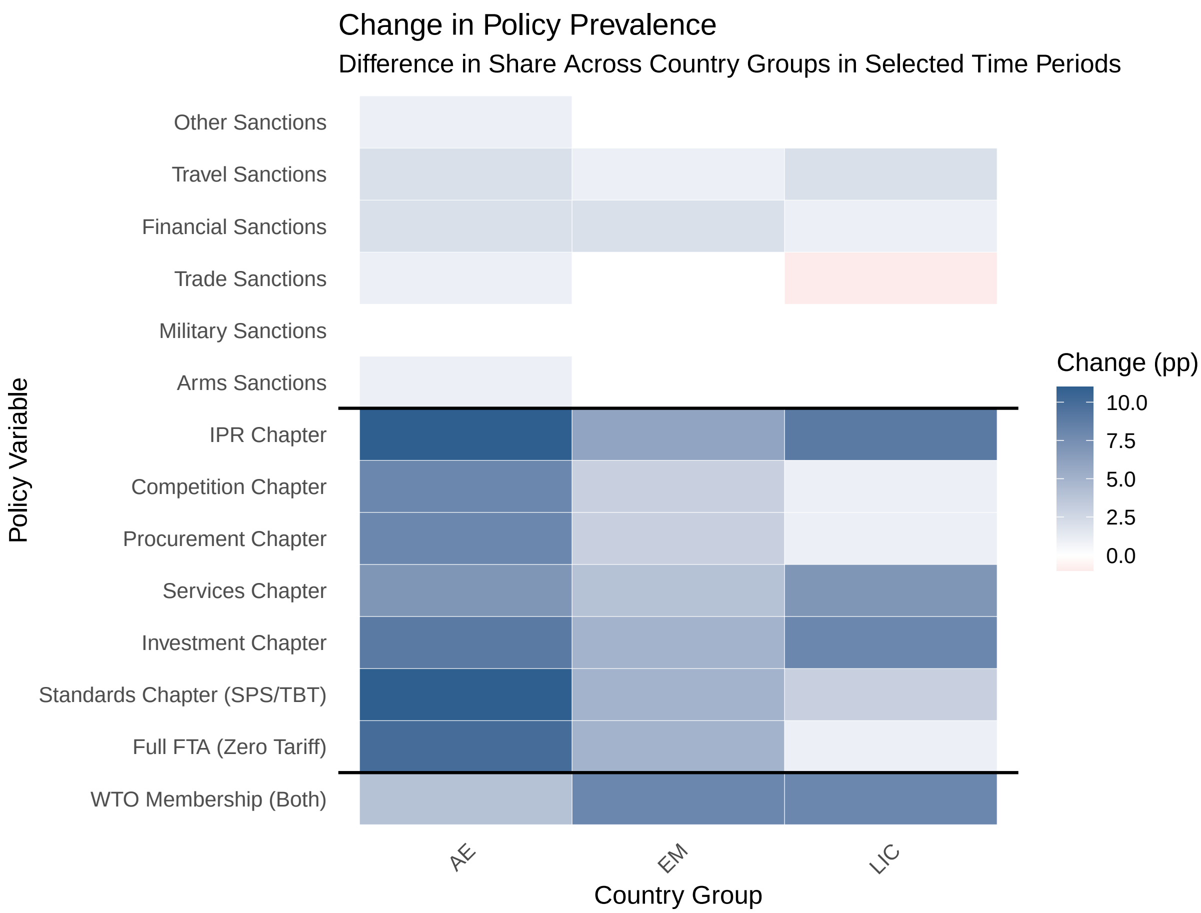

Figure 2: Changes in Bilateral Policy Linkages Across Country Groups, 2003–2023
Note: Heat map reports percentage-point changes in the prevalence of selected trade, investment, and sanctions-related policies across bilateral country pairs between 2003–2012 and 2013–2023. Darker shading indicates larger increases. Advanced economies (AEs) and emerging markets (EMs) exhibit substantially larger increases in policy linkages than LIDCs, suggesting a widening integration gap.

initiating investment relationships.

2.4 Extensive-Margin Dynamics: Existence, Persistence, and Transitions

Having established the policy environment, we now turn to documenting the core empirical patterns that motivate our econometric specification. Throughout this discussion, bilateral links are defined consistently within each flow type: for FDI and CPIS (Coordinated Portfolio Investment Survey), a link is active if the bilateral position is positive, while for ODA (official development assistance), a link is active if annual disbursements are positive.

Table 4 documents substantial heterogeneity in the breadth and persistence of bilateral financial networks across flow types. Official development assistance exhibits the densest and most persistent network structure, with the largest average number of active connections per LIDC (mean 25.4 donors in the pre-2015 period) and the lowest share of zero bilateral links (60.2 percent of potential dyads). Foreign direct investment displays intermediate network density, with an average of 18.7 active source countries per LIDC but a higher overall share of zero links (73.1 percent), reflecting the highly concentrated nature of FDI networks among a subset of well-connected destinations.

Portfolio flows—captured by CPIS equity and debt—are characterized by sparse networks and a high incidence of zeros: more than 85 percent of potential bilateral links remain inactive in any given year.

Table 4: Network Breadth and Sparsity of Bilateral Financial Links to LIDCs

	Average Active Connections per LIDC			**Share of Zero Links (%)**		
	Full Sample	**Pre-2015**	**Post-2015**	**Full Sample**	**Pre-2015**	**Post-2015**
FDI Outstock	16	10	24	93.5	96.1	90.2
ODA Outflow	23	24	22	90.8	90.5	91.1
CPIS Total	8	6	11	96.7	97.5	95.7
CPIS Debt	6	4	8	93.5	96.1	90.2
CPIS Equity	5	4	6	90.8	90.5	91.1

Note: The first three columns report the average number of active source-country connections per LIDC in a given year. For FDI and CPIS, a bilateral link is defined as active if the position in a given year is positive; for ODA a link is defined as active if annual disbursements are positive. The last three columns report the share of bilateral country pairs with no active link in a given year.

Comparing the pre-2015 and post-2015 periods reveals divergent trends. ODA networks have experienced a modest decline in density, reflected in fewer active connections (mean 23.1 in post-2015) and a higher share of zero links (63.7 percent), suggesting weakening extensive-margin persistence in recent years. This pattern aligns with the widely documented shift in aid allocation toward fewer, more strategically targeted recipients (Bermeo, 2017). Portfolio networks remain thin in both periods, with limited evidence of expansion. In contrast, FDI networks have strengthened: the average number of active connections per LIDC increased to 21.3 in the post-2015 period, and the share of zero links declined to 68.4 percent, consistent with gradual diffusion of FDI relationships to a broader set of source countries.

An important pattern in Table 4 merits clarification. FDI exhibits a larger average number of active connections per LIDC than portfolio equity in the pre-2015 period (18.7 vs. 12.3), yet simultaneously displays a higher overall share of zero bilateral links (73.1 percent vs. 86.8 percent). This apparent tension reflects the highly skewed distribution of FDI networks: a small number of well-integrated LIDCs maintain many FDI relationships, substantially raising the mean among participating destinations, while the majority of LIDCs remain disconnected from most potential source countries. Technically, this discrepancy arises because the average number of active connections is computed across LIDCs (conditional on receiving at least one flow), whereas the share of zero links is measured across all possible bilateral dyads. This pattern points to a substantial cross-sectional entry wedge: access to FDI is concentrated among a subset of LIDC destinations with favorable characteristics (likely including better institutions, larger markets, and strategic location), while most LIDCs struggle to attract even initial investment.

Table 5 examines annual transition dynamics, reporting the probabilities that bilateral links remain active, become active, or remain inactive from one year to the next. The table reveals strong state dependence across all flow types. Inactive links exhibit very low activation probabilities (ranging from 1.2 percent for CPIS equity to 4.8 percent for ODA), while active links display high persistence (continuation probabilities ranging from 78.3 percent for CPIS equity to 93.1 percent for ODA). This asymmetry underscores the presence of substantial fixed costs of entry and relationship-specific capital: once a bilateral financial link is established, it tends to persist, but initiating a new link from an inactive state is rare.

ODA exhibits the greatest persistence, with a 93.1 percent probability of remaining active

Table 5: Annual Transition Dynamics of Bilateral Financial Links to LIDCs

	Full Sample			Pre-2015			Post-2015		
	Stay Active	**Activate**	**Stay Inactive**	**Stay Active**	**Activate**	**Stay Inactive**	**Stay Active**	**Activate**	**Stay Inactive**
FDI	83.1	1.2	98.8	90.0	1.1	98.9	79.6	1.3	98.7
ODA	87.4	1.0	99.0	92.6	1.0	99.0	80.6	0.9	99.1
CPIS Total	78.8	0.7	99.3	80.0	0.7	99.3	77.9	0.7	99.3
CPIS Debt	77.2	0.5	99.5	77.8	0.5	99.5	76.9	0.6	99.4
CPIS Equity	78.7	0.4	99.6	80.1	0.5	99.5	77.6	0.3	99.7

Note: Each entry reports the annual transition probability (in percent) of bilateral financial links between source countries and LIDCs. 'Stay Active' is the share of active links that remain active in the next year; 'Activate' is the share of previously inactive links that become active; 'Stay Inactive' is the share of inactive links that remain inactive. Flows are measured annually; results are shown for the full sample and for pre- and post-2015 subperiods.

conditional on being active in the previous year, and only a 6.9 percent exit probability. This pattern reflects the multi-year nature of aid programs and the strategic, often politically motivated, nature of donor-recipient relationships. FDI displays intermediate persistence (88.4 percent continuation probability), consistent with the sunk costs of establishing production facilities and the gradual accumulation of local market knowledge. Portfolio flows exhibit both the lowest persistence among active links (78.3 percent for equity, 82.6 percent for debt) and the lowest activation probabilities (1.2 percent for equity, 1.8 percent for debt), indicating substantial frictions in both expanding and maintaining portfolio investment networks to LIDCs. This fragility aligns with the broader literature documenting the volatility of gross capital flows and their tendency to retrench sharply during crises (Broner et al., 2013; Pagliari and Ahmed Hannan, 2024).

Comparing the pre-2015 and post-2015 periods indicates a modest weakening of persistence for ODA (continuation probability declining from 93.1 to 91.2 percent) and FDI (from 88.4 to 86.7 percent), while CPIS transition dynamics remain relatively stable. This temporal pattern is consistent with the decline in network density documented in Table 4 and may reflect heightened geopolitical tensions, policy fragmentation, and increased selectivity in bilateral financial relationships over the past decade. By contrast, the stability of portfolio transition probabilities suggests that portfolio networks may be less immediately responsive to such policy shifts, or that their adjustment operates primarily along the intensive margin conditional on participation.

These transition dynamics motivate our econometric specification in three ways. First, the strong state dependence justifies including lagged dependent variables to capture relationship-specific capital and switching costs. Second, the low activation probabilities from inactive states and high persistence of active states suggest that standard linear models are inappropriate; instead, we employ complementary log-log (cloglog) and logit link functions that naturally accommodate rare events and asymmetric transition probabilities. Third, the heterogeneity in persistence across flow types motivates estimating separate extensive-margin equations for each flow, allowing the data to reveal differential roles of gravity frictions, policy variables, and cross-flow complementarities.

2.5 Intensive-Margin Patterns and Concentration

While our paper focuses primarily on the extensive margin, we briefly characterize intensive-margin patterns to provide context and confirm that variation along the extensive margin is indeed the dominant source of adjustment for LIDCs. Table 6 documents that conditional on positive bilateral flows, the distributions are highly right-skewed across all flow types, with large standard deviations and means substantially exceeding medians. Portfolio positions exhibit particularly extreme skewness, with the mean-to-median ratio exceeding 10 for equity in the post-2015 period, driven by a small number of very large bilateral positions. ODA flows display relatively stable distributions across periods, while FDI positions show modest increases in skewness.

Table 6: Distribution of Active Bilateral Financial Flows to LIDCs

	Full Sample			Pre-2015			Post-2015		
	Mean	**Median**	**SD**	**Mean**	**Median**	**SD**	**Mean**	**Median**	**SD**
FDI Outstock	275	14	1,244	229	15	997	298	13	1,350
ODA Outflow	23	1	94	22	2	94	24	1	94
CPIS Total	129	9	810	78	6	399	166	13	1,008
CPIS Debt	99	10	374	67	8	310	116	11	403
CPIS Equity	103	5	815	57	4	304	144	8	1,084

Note: Statistics are calculated over the pooled distribution of positive bilateral flows in specified periods. Zero and negative observations are excluded. Statistics are computed using the investment positions between countries for FDI and CPIS while using the outward and inward flows between countries for ODA

Table 7 quantifies the concentration of flows among the top five destination and source countries (computed dynamically year-by-year). ODA is the least concentrated on the destination side (top 5 destinations account for 28.4 percent of total flows) but relatively concentrated on the source side (top 5 donors account for 71.2 percent), with the United States alone representing approximately 40 percent of total ODA to LIDCs. FDI exhibits intermediate concentration on both margins, with modest declines over time suggesting gradual dispersion. Portfolio investment remains highly concentrated throughout, particularly for equity positions, with the top 5 destinations accounting for more than 60 percent of total positions.

Table 7: Average Annual Concentration of Financial Inflows to LIDCs

	Full Sample		Pre-2015		Post-2015	
	T5 Dest. Share	**T5 Source Share**	**T5 Dest. Share**	**T5 Source Share**	**T5 Dest. Share**	**T5 Source Share**
FDI Outstock	58	52	61	60	52	41
ODA Outflow	35	67	38	64	31	71
CPIS Total	73	70	77	73	69	66
CPIS Debt	74	76	82	79	63	72
CPIS Equity	86	74	84	78	88	67

Note: Each statistic is computed annually and then averaged across each period. 'T5 Dest.' and 'T5 Source Share' denote the mean share (in percent) of total inflows accounted for by the five largest LIDC destinations and source countries (determined each year), respectively. A higher share indicates greater concentration of financial flows.

Taken together, these intensive-margin patterns confirm that capital flows to LIDCs concentrate along different dimensions: ODA is concentrated on the donor side, FDI is moderately concentrated and dispersing, and portfolio investment remains persistently concentrated in a small number of destinations. However, the key empirical regularity for our purposes is that *variation in the number of active bilateral relationships (the extensive margin) accounts for a larger share of total variation in aggregate flows to LIDCs than does variation in the size of active relationships (the intensive margin).* This motivates our focus on modeling and estimating the determinants of bilateral link formation, continuation, and termination, rather than scaling conditional on participation.

2.6 Key Empirical Regularities

The descriptive evidence presented in this section establishes four key empirical regularities that guide our econometric specification. First, LIDCs are characterized by pervasive zeros and sparse networks. The majority of potential bilateral financial relationships between LIDCs and source countries are inactive, with zero-link shares ranging from 60 percent (ODA) to more than 85 percent (portfolio equity). This prevalence of zeros necessitates explicit modeling of participation decisions. Second, there is strong state dependence and persistence. Active bilateral links exhibit high continuation probabilities (78–93 percent), while inactive links rarely activate (1–5 percent annual probability). This asymmetry implies substantial fixed costs of entry and relationship-specific capital, motivating the inclusion of lagged dependent variables and a dynamic panel framework that distinguishes within-dyad persistence from cross-sectional heterogeneity.

Third, there is vast heterogeneity across flow types: ODA, FDI, and portfolio flows differ markedly in network density, persistence, and concentration. These differences suggest that the determinants of extensive-margin entry vary by flow type—for instance, informational frictions may bind more tightly for arm's-length portfolio claims than for FDI, while ODA may respond primarily to strategic and political factors. This heterogeneity motivates separate estimation by flow type and explicit testing of cross-flow complementarities. Lastly, the policy landscape has evolved unevenly, with advanced economies and emerging markets experiencing larger increases in integration linkages than LIDCs. Sanctions have become more prevalent, particularly among advanced economies. These trends, combined with the observed weakening of persistence in the post-2015 period, suggest that policy variables (trade agreements, sanctions, institutional arrangements) play an important role in shaping extensive-margin dynamics and that these effects may vary over time and across country groups.

These patterns motivate our econometric approach in Section 3.8 (and a more technical discussion in Appendix B), which employs bias-corrected fixed-effects nonlinear models with high-dimensional fixed effects (source×time, destination×time, and dyad), dynamic persistence through lagged dependent variables, and cross-flow interactions through lagged indicators of other flow types. The combination of complementary log-log link functions (which naturally accommodate rare events and asymmetric tail behavior) and comprehensive fixed-effects controls (which absorb multilateral resistance, time-varying supply and demand shocks, and time-invariant bilateral affinities) allows us to credibly identify the effects of policy variables on extensive-margin transitions while accounting for the strong persistence documented above. The remainder of the paper develops the theoretical foundations for this empirical strategy, presents the estimation results, and interprets the findings in light of the broader literature on international capital flows and financial integration.

3 Theoretical Framework

This section develops a unified theoretical framework for bilateral financial flows that distinguishes between the *extensive margin*—whether a financial relationship exists—and the *intensive margin*—the volume of flows conditional on a relationship existing. We consider four types of capital flows indexed by $k \in \mathcal{K} \equiv \{\text{FDI}, \text{FPI debt}, \text{FPI equity}, \text{ODA}\}$, representing foreign direct investment, portfolio equity, portfolio debt, and official development assistance, respectively. Source countries are indexed by $n \in \mathcal{N}$ and destination (LIDCs in our application) countries by $i \in \mathcal{N}$, where $\mathcal{N}$ denotes the set of all countries.

3.1 Environment

3.1.1 Investors and Information

In each period t, representative investors in source country n allocate wealth W_{nt}^k across destinations $i \in \mathcal{N}$ for each asset type $k \in \mathcal{K}$. Investors face two types of frictions:

1. **Variable costs**: Bilateral financial frictions $\kappa_{ni,t}^k \geq 1$ that reduce the effective return on investments. These capture information asymmetries, transaction costs, exchange rate risk, and regulatory barriers.

2. **Fixed costs**: Entry costs $f_{ni,t}^k > 0$ that must be paid to establish or maintain a financial relationship. These encompass due diligence, legal setup, monitoring infrastructure, and relationship maintenance.

3.1.2 Returns and Frictions

The gross return on asset type k in destination i is $R_{it}^k > 0$. Due to bilateral frictions, investors from source n perceive an effective return:

$$\tilde{R}_{ni,t}^k = \frac{R_{it}^k}{\kappa_{ni,t}^k}, \tag{1}$$

where $\kappa_{ni,t}^k \geq 1$ with $\kappa_{ii,t}^k = 1$ (no friction for domestic investment).

The bilateral friction is parameterized as:

$$\ln \kappa_{ni,t}^k = \boldsymbol{Z}_{ni}' \boldsymbol{\pi}^k + \boldsymbol{X}_{ni,t}' \boldsymbol{\beta}^k, \tag{2}$$

where $\boldsymbol{Z}_{ni}$ contains time-invariant bilateral characteristics (geographic distance, common language, colonial history, legal origin) and $\boldsymbol{X}_{ni,t}$ contains time-varying bilateral factors (trade agreements, sanctions, lagged trade flows).

3.2 Economic Characterization of Financial Flow Types

The four financial flows in $\mathcal{K}$ differ fundamentally in their economic nature, return structures, and implications for recipient economies. These differences generate heterogeneous entry costs, persistence patterns, and cross-flow spillovers that we exploit empirically.

3.2.1 Foreign Direct Investment (FDI)

FDI involves the acquisition of a lasting management interest (typically defined as 10% or more of voting stock) in an enterprise operating in a country other than that of the investor. This distinguishes FDI from portfolio investment through three key features:

Control and Technology Transfer. FDI brings not only capital but also managerial expertise, production technologies, and access to global value chains. The aggregate capital stock in destination i combines domestic and foreign-owned capital:

$$K_{it} = \left[\sum_{n \in \mathcal{N}} \theta_{ni}^{\frac{1}{\nu}} (K_{ni,t}^{\text{FDI}})^{\frac{\nu-1}{\nu}} \right]^{\frac{\nu}{\nu-1}}, \tag{3}$$

where $K_{ni,t}^{\text{FDI}}$ is FDI capital from source n operating in destination i, $\theta_{ni} > 0$ captures source-specific productivity advantages (reflecting technological proximity, managerial quality, or sectoral specialization), and $\nu > 1$ is the elasticity of substitution across capital sources.

Productivity Spillovers. FDI generates externalities for the host economy through demonstration effects, labor mobility, and backward linkages. Total factor productivity in destination i evolves according to:

$$\ln Z_{it} = \rho_Z \ln Z_{i,t-1} + \phi^{\text{FDI}} \ln\left(\frac{\sum_{n\neq i} K_{ni,t}^{\text{FDI}}}{K_{ii,t}}\right) + \phi^{\text{ODA}} \ln\left(\frac{\text{ODA}_{it}}{Y_{it}}\right) + \eta_{it}, \tag{4}$$

where $\rho_Z \in (0,1)$ captures TFP persistence, $\phi^{\text{FDI}} > 0$ measures FDI spillovers to domestic productivity, $\phi^{\text{ODA}} > 0$ reflects ODA effectiveness in building institutional and absorptive capacity, and η_{it} represents productivity shocks.

Return Structure. The return on FDI equals the marginal product of capital:

$$R_{it}^{\text{FDI}} = \alpha_i \frac{P_{it} Y_{it}}{K_{it}} \left(\frac{K_{it}^{\text{FDI}}}{K_{it}}\right)^{-\frac{1}{\nu}}, \tag{5}$$

where α_i is the capital share in production and P_{it} is the output price. The term $(K_{it}^{\text{FDI}}/K_{it})^{-1/\nu}$ implies diminishing returns to FDI from any single source, generating diversification incentives (see Appendix A.8 for detailed micro-foundations).

Entry Cost Structure. FDI entry costs are substantial due to the need to establish physical presence, navigate regulatory environments, and build local networks. These costs exhibit strong state dependence: once established, multinational affiliates benefit from accumulated relationship capital, local knowledge, and sunk infrastructure investments.

3.2.2 Portfolio Equity (PE)

Portfolio equity involves ownership stakes below the FDI threshold, typically through publicly traded securities. Unlike FDI, portfolio equity investors do not seek managerial control.

Return Structure. Portfolio equity returns combine dividend yields and capital gains:

$$R_{it}^{\text{PE}} = \frac{Div_{it} + Q_{it} - Q_{i,t-1}}{Q_{i,t-1}}, \tag{6}$$

where Div_{it} denotes dividends and Q_{it} is the equity price index. Returns are volatile and procyclical, driven by both fundamentals and global risk appetite.

Information Frictions. Portfolio equity investment requires continuous monitoring of firm performance and market conditions without the informational advantages of direct control. Information frictions $\kappa_{ni,t}^{\text{PE}}$ are particularly severe for LIDCs due to limited analyst coverage, weak disclosure requirements, and thin markets.

Entry Cost Structure. Entry costs for portfolio equity include establishing custodial relationships, understanding local market microstructure, and meeting regulatory requirements for foreign institutional investors. These costs are lower than FDI but exhibit moderate persistence through learning effects.

3.2.3 Portfolio Debt (PD)

Portfolio debt comprises sovereign and corporate bonds held by foreign investors without control objectives.

Return Structure. Portfolio debt returns are determined by the sovereign risk premium:

$$R_{it}^{\text{PD}} = r_t^* \exp\left(\chi \frac{B_{it}}{Y_{it}} - \omega \cdot \text{IQ}_{it}\right), \tag{7}$$

where r_t^* is the global risk-free rate, B_{it}/Y_{it} is the debt-to-GDP ratio, $\chi > 0$ captures the debt elasticity of spreads, and IQ_{it} measures institutional quality (with $\omega > 0$ reflecting the risk-reducing effect of better institutions).

Entry Cost Structure. Entry costs for portfolio debt include credit analysis, legal due diligence on bond covenants, and establishing settlement infrastructure. For LIDCs, the absence of credit ratings and limited secondary market liquidity raise these costs substantially.

3.2.4 Official Development Assistance (ODA)

ODA represents concessional flows from official agencies (bilateral or multilateral) with development objectives. Unlike private flows, ODA decisions reflect donor strategic interests, recipient needs, and historical relationships.

Return Structure. ODA does not generate financial returns for donors in the conventional sense. Instead, donors derive utility from development outcomes, geopolitical influence, and commercial tie-ins (proxied by other interactions between countries like trade or private financial flows).

Catalytic Effects. ODA can reduce entry barriers for private flows through multiple channels: infrastructure investments lower transportation and communication costs; capacity building improves institutional quality; and aid signals donor confidence in the recipient's prospects. These effects are captured by the ϕ^{ODA} term in equation (4) and generate cross-flow complementarities.

Entry Cost Structure. ODA "entry" reflects bureaucratic processes, diplomatic relationships, and programmatic priorities. Relationships are highly persistent due to institutional inertia, long-term development programs, and the political costs of aid withdrawal.

3.2.5 Taking Stock: Flow-Specific Characteristics

Table 8 summarizes the key characteristics that differentiate the four flow types and motivate our empirical specifications.

Table 8: Economic Characteristics of Financial Flow Types

Characteristic	**FDI**	**PE**	**PD**	**ODA**
Control/Management	Yes	No	No	N/A
Technology transfer	High	None	None	Indirect
Return volatility	Moderate	High	Low	N/A
Information intensity	High	High	Moderate	Low
Entry cost level	Very high	Moderate	Moderate	High
Expected persistence (θ^k)	Highest	Moderate	Moderate	High
TFP spillovers (ϕ^k)	Positive	None	None	Positive

These structural differences generate testable predictions: FDI should exhibit the highest persistence due to sunk costs and relationship capital; ODA persistence reflects institutional inertia; portfolio flows are more episodic but may benefit from cross-flow information spillovers (e.g., FDI presence signals quality to portfolio investors). Before formalizing these prediction, we turn to discussing our key modeling object, the extensive margin of financial flows.

3.3 The Extensive Margin: Entry Decision

The extensive margin captures the binary decision of whether investors from source n establish a financial relationship with destination i in asset type k. We develop this decision from first principles, deriving the logit specification as our primary model and the complementary log-log (cloglog) specification as an alternative for rare-event settings where asymmetric responses are important.

3.3.1 Entry Value and Fixed Costs

Let $\Pi^k_{ni,t}$ denote the expected present value of *gross operating payoffs* from establishing a type-k relationship between n and i at time t, conditional on entry. This value depends on expected returns, bilateral frictions, and the option value of future continuation:

$$\Pi^k_{ni,t} = \mathbb{E}_t \left[\sum_{s=0}^{\infty} \beta^s \tilde{R}^k_{ni,t+s} \, A^k_{ni,t+s} \,\middle|\, D^k_{ni,t} = 1 \right], \tag{8}$$

where $\beta \in (0,1)$ is the discount factor and $A^k_{ni,t} \geq 0$ denotes the (gross) position size. Since $\tilde{R}^k_{ni,t} > 0$ by construction, (8) implies $\Pi^k_{ni,t} > 0$ and the log transformation below is well-defined.

For tractability, we work with a reduced-form value function that captures the key economic forces:

$$v^k_{ni,t} \equiv \ln \Pi^k_{ni,t} = \ln R^k_{it} - \ln \kappa^k_{ni,t} + \omega^k_{ni,t}, \tag{9}$$

where $\omega^k_{ni,t}$ captures additional destination-specific and pair-specific factors affecting profitability, including the productivity spillovers from equation (4) for FDI and ODA.

The fixed cost of establishing (or maintaining) a financial relationship is $f^k_{ni,t} > 0$. Entry occurs *if and only if* the value exceeds the cost:

$$D^k_{ni,t} = \mathbf{1} \left\{ v^k_{ni,t} > \ln f^k_{ni,t} \right\}. \tag{10}$$

3.3.2 Unobserved Heterogeneity

Since we do not observe all factors affecting $v^k_{ni,t}$ and $f^k_{ni,t}$, we make the following decomposition assumption:

$$v^k_{ni,t} = \bar{v}^k_{ni,t} + \xi^k_{ni,t}, \tag{11}$$

$$\ln f^k_{ni,t} = \bar{f}^k_{ni,t}, \tag{12}$$

where $\bar{v}^k_{ni,t}$ and $\bar{f}^k_{ni,t}$ are the systematic (observable) components and $\xi^k_{ni,t}$ is an idiosyncratic shock capturing unobserved heterogeneity in entry values.

The entry condition becomes:

$$D^k_{ni,t} = \mathbf{1} \left\{ \xi^k_{ni,t} > \bar{f}^k_{ni,t} - \bar{v}^k_{ni,t} \right\} = \mathbf{1} \left\{ \xi^k_{ni,t} > -\eta^k_{ni,t} \right\}, \tag{13}$$

where we define the *systematic entry index*:

$$\eta^k_{ni,t} \equiv \bar{v}^k_{ni,t} - \bar{f}^k_{ni,t} = \ln R^k_{it} - \ln \kappa^k_{ni,t} + \bar{\omega}^k_{ni,t} - \bar{f}^k_{ni,t}. \tag{14}$$

Notice that the distribution of $\xi^k_{ni,t}$ determines the functional form of the entry probability. We consider two specifications: the logit model (our primary specification) and the cloglog model (for rare-event robustness).

3.4 The Logit Specification

We make the following assumption regarding profitability (return/payoff) shocks (conditional error terms).

Assumption 1 (Logistic Idiosyncratic Shocks)**.** *The idiosyncratic component $\xi^k_{ni,t}$ follows a standard logistic distribution with CDF:*

$$F_\xi(x) = \Lambda(x) \equiv \frac{\exp(x)}{1+\exp(x)} = \frac{1}{1+\exp(-x)}, \tag{15}$$

and PDF:

$$f_\xi(x) = \lambda(x) \equiv \frac{\exp(x)}{(1+\exp(x))^2} = \Lambda(x)(1-\Lambda(x)). \tag{16}$$

The shocks $\{\xi^k_{ni,t}\}$ are independent across (n, i, t, k) conditional on observables.

The logistic distribution has mean zero, variance $\pi^2/3 \approx 3.29$, and is symmetric around zero. These properties have important implications for our international finance model.

Proposition 1 (Logit Entry Probability)**.** *Under Assumption 1, the probability of establishing a bilateral financial relationship is:*

$$\Pr(D^k_{ni,t} = 1 \mid \eta^k_{ni,t}) = \Lambda(\eta^k_{ni,t}) = \frac{\exp(\eta^k_{ni,t})}{1+\exp(\eta^k_{ni,t})}. \tag{17}$$

Proof. From the entry condition (13):[2]

$$\Pr(D^k_{ni,t} = 1) = \Pr(\xi^k_{ni,t} > -\eta^k_{ni,t}) = 1 - \Pr(\xi^k_{ni,t} \leq -\eta^k_{ni,t}) = 1 - F_\xi(-\eta^k_{ni,t}) = 1 - \Lambda(-\eta^k_{ni,t})$$
$$= 1 - \frac{1}{1+\exp(\eta^k_{ni,t})} = \frac{\exp(\eta^k_{ni,t})}{1+\exp(\eta^k_{ni,t})} = \Lambda(\eta^k_{ni,t}).$$

Refer to Appendix A.1 for details. □

Remark 1 (Economic Interpretation of Logistic Shocks)**.** *The logistic distribution in Assumption 1 admits several economic interpretations relevant to international investment decisions:*

1. ***Aggregation of binary signals****: Suppose investors receive M independent binary signals $s_m \in \{0, 1\}$ about destination quality (e.g., analyst reports, credit assessments, news coverage), each with accuracy $p_m \in (0.5, 1)$. The log-likelihood ratio of the aggregated signal is $\sum_{m=1}^{M}(2s_m - 1)\ln(p_m/(1-p_m))$. By the Lindeberg-Feller CLT, as $M \to \infty$, this converges to a logistic distribution (McFadden, 1974).*

2. ***Maximum entropy****: Among all distributions on $\mathbb{R}$ with fixed mean and variance, the logistic distribution maximizes Shannon entropy, providing a "least informative" prior over unobserved heterogeneity (Jaynes, 1957). This is appropriate when we have limited knowledge about the specific sources of investor heterogeneity.*

3. ***Symmetric uncertainty****: The symmetry of the logistic distribution implies that factors increasing entry value have the same marginal effect (in absolute terms) as factors decreasing it. This is appropriate when entry and non-entry are governed by symmetric economic forces—a reasonable assumption for FDI and portfolio flows where investors weigh upside and downside risks symmetrically.*

[2] The fourth equality uses the symmetry property $\Lambda(-x) = 1 - \Lambda(x)$.

Since the extensive margin is modeled as a nonlinear model, we are interested in the marginal effect on investment probability.

Proposition 2 (Marginal Effects under Logit)**.** *Under the logit specification, the marginal effect of a continuous covariate x_j (with coefficient β_j) on entry probability is:*

$$\frac{\partial \Pr(D^k_{ni,t} = 1)}{\partial x_j} = \beta_j \cdot \Lambda(\eta^k_{ni,t})(1 - \Lambda(\eta^k_{ni,t})). \tag{18}$$

The marginal effect is maximized when $\Lambda(\eta) = 0.5$ (i.e., $\eta = 0$) and approaches zero as the predicted probability approaches 0 or 1.

Proof. Differentiating (17):

$$\begin{aligned}\frac{\partial \Lambda(\eta)}{\partial \eta} &= \frac{\exp(\eta)(1 + \exp(\eta)) - \exp(\eta) \cdot \exp(\eta)}{(1 + \exp(\eta))^2} \\ &= \frac{\exp(\eta)}{(1 + \exp(\eta))^2} = \Lambda(\eta)(1 - \Lambda(\eta)).\end{aligned}$$

By the chain rule, $\partial \Pr / \partial x_j = (\partial \Lambda / \partial \eta) \cdot (\partial \eta / \partial x_j) = \Lambda(1 - \Lambda) \cdot \beta_j$. Refer to Appendix A.2 for details. □

3.5 The Complementary Log-Log Specification

For some bilateral financial flows – particularly those characterized by rare events such as new ODA relationships or first-time portfolio investments in frontier markets – an alternative distributional assumption may be appropriate.

Assumption 2 (Type-I Extreme Value (Gumbel) Shocks)**.** *The idiosyncratic component $\xi^k_{ni,t}$ follows a Type-I extreme value (Gumbel) distribution with CDF:*

$$F_\xi(x) = \exp(-\exp(-x)), \tag{19}$$

and PDF:

$$f_\xi(x) = \exp(-x) \cdot \exp(-\exp(-x)). \tag{20}$$

The Gumbel distribution has mean $\gamma_E \approx 0.577$ (Euler-Mascheroni constant), variance $\pi^2/6$, and is *asymmetric*: it has a heavier right tail than left tail.

Proposition 3 (Cloglog Entry Probability)**.** *Under Assumption 2, the probability of establishing a bilateral financial relationship is:*

$$\Pr(D^k_{ni,t} = 1 \mid \eta^k_{ni,t}) = 1 - \exp(-\exp(\eta^k_{ni,t})). \tag{21}$$

This is the complementary log-log (cloglog) link function.

Proof. From the entry condition (13), using the fact that if $\xi \sim$ Gumbel then $-\xi$ follows a *reflected Gumbel* (also called Type I minimum extreme value):

$$\begin{aligned}\Pr(D^k_{ni,t} = 1) &= \Pr(\xi^k_{ni,t} > -\eta^k_{ni,t}) &&= 1 - \Pr(\xi^k_{ni,t} \leq -\eta^k_{ni,t}) \\ &= 1 - \exp(-\exp(-(-\eta^k_{ni,t}))) &&= 1 - \exp(-\exp(\eta^k_{ni,t})),\end{aligned}$$

which yields the complementary log-log link. Refer to Appendix A.3 for details. □

The literature on international capital flows has mainly focused on advanced or emerging economies with dense investment networks. LIDCs, in contrast, exhibit an abundance of zeros even at the bilateral level, motivating the cloglog alternative.

Remark 2 (When Cloglog is Appropriate)**.** *The cloglog specification is theoretically justified in the following settings:*

1. ***Grouped duration data**: When the binary outcome represents whether an event occurs within a discrete time interval, and the underlying continuous-time process follows a proportional hazards model, the discrete-time probability has the cloglog form (Prentice and Gloeckler, 1978). This interpretation is more natural for ODA relationships viewed as "surviving" year-to-year.*

2. ***Rare events**: The cloglog function approaches 0 slowly but approaches 1 rapidly:*

$$\lim_{\eta \to -\infty} G_{cloglog}(\eta) = 0 \quad \textit{(slow approach)},$$
$$\lim_{\eta \to +\infty} G_{cloglog}(\eta) = 1 \quad \textit{(fast approach)}.$$

   This asymmetry is appropriate when the baseline probability is low and occasional "jumps" to high probability occur—as with, for instance, first-time portfolio investments in LIDCs (which still remain very rare).

3. ***Extreme value selection**: If investors choose the best among multiple potential destinations (or among multiple potential investment modes), and the unobserved value follows an i.i.d. distribution, extreme value theory implies the maximum has a Gumbel distribution (this has the multi-country Ricardian theory flavor as in Eaton and Kortum (2002)).*

For LIDCs, the cloglog specification may be particularly relevant for first-time portfolio equity investments (very rare, <5% of dyad-years active), new ODA relationships from non-traditional donors, and frontier market entry where information frictions create occasional "discovery" events.

Proposition 4 (Marginal Effects under Cloglog)**.** *Under the cloglog specification, the marginal effect of a continuous covariate x_j is:*

$$\frac{\partial \Pr(D^k_{ni,t} = 1)}{\partial x_j} = \beta_j \cdot \exp(\eta^k_{ni,t}) \cdot \exp(-\exp(\eta^k_{ni,t})). \tag{22}$$

The marginal effect is maximized at $\eta^* = 0$ where $\Pr(D = 1) \approx 0.632$, and exhibits asymmetric behavior: it approaches zero slowly as $\eta \to -\infty$ but rapidly as $\eta \to +\infty$.

Proof. Let $G(\eta) = 1 - \exp(-\exp(\eta))$. Then:

$$\begin{aligned} \frac{dG}{d\eta} &= \frac{d}{d\eta}\left[1 - \exp(-\exp(\eta))\right] \\ &= \exp(-\exp(\eta)) \cdot \exp(\eta) \\ &= \exp(\eta) \cdot \exp(-\exp(\eta)). \end{aligned}$$

Setting $dG/d\eta = 0$: $\exp(\eta) \cdot \exp(-\exp(\eta)) = 0$ has no finite solution, but the function is maximized where the second derivative equals zero. Solving $d^2G/d\eta^2 = 0$ yields $\eta^* = 0$. Refer to Appendix A.4 for details. □

3.6 Persistence and State Dependence

A central feature of bilateral financial relationships is their persistence: existing relationships are far more likely to continue than new relationships are to form (see our discussion and stylized facts in Sections 2.2 and 2.4. We model this through state-dependent fixed costs that vary by flow type.

Assumption 3 (State-Dependent Entry Costs)**.** *The fixed cost of establishing or maintaining a financial relationship depends on past relationships:*

$$\ln f_{ni,t}^k = \bar{f}_{ni}^k - \theta^k D_{ni,t-1}^k - \lambda^k \ln(1 + F_{ni,t-1}^k), \tag{23}$$

where $\bar{f}_{ni}^k > 0$ is the baseline bilateral entry cost (time-invariant), which varies across flow types as described in Section 3.2; $\theta^k > 0$ captures relationship capital: prior entry reduces current costs through established networks, legal frameworks, and institutional knowledge; $\lambda^k \geq 0$ reflects learning-by-doing: larger past flow volumes reduce information asymmetries and monitoring costs; $D_{ni,t-1}^k \in \{0, 1\}$ is the lagged entry indicator; $F_{ni,t-1}^k \geq 0$ is the lagged flow volume.

The economic channels generating state dependence differ across flow types:

FDI: Sunk costs in physical plant, local hiring, and regulatory compliance create strong hysteresis. The relationship capital parameter θ^{FDI} reflects accumulated local knowledge, supplier networks, and government relationships.

ODA: Bureaucratic inertia, long-term development programs, and political costs of aid withdrawal generate high persistence. The parameter θ^{ODA} captures institutional commitments and programmatic continuity.

Portfolio Equity/Debt: Lower sunk costs imply more episodic relationships. However, learning effects ($\lambda^k > 0$) matter: larger past positions reduce future due diligence costs and improve information quality.

Substituting (23) into the entry index (14):

$$\eta_{ni,t}^k = \underbrace{\ln R_{it}^k - \ln \kappa_{ni,t}^k + \bar{\omega}_{ni,t}^k - \bar{f}_{ni}^k}_{\equiv \mu_{ni,t}^k} + \theta^k D_{ni,t-1}^k + \lambda^k \ln(1 + F_{ni,t-1}^k). \tag{24}$$

Proposition 5 (Dynamic Entry Probability)**.** *Under Assumptions 1 and 3, the entry probability exhibits positive state dependence:*

$$\Pr(D_{ni,t}^k = 1 \mid D_{ni,t-1}^k = 1) > \Pr(D_{ni,t}^k = 1 \mid D_{ni,t-1}^k = 0), \tag{25}$$

for all values of other covariates. The conditional difference in entry probability is:

$$\Delta_{persist}^k = \Lambda(\mu_{ni,t}^k + \theta^k) - \Lambda(\mu_{ni,t}^k) > 0 \quad \text{for } \theta^k > 0. \tag{26}$$

Proof. Since $\theta^k > 0$ by assumption and $\Lambda(\cdot)$ is strictly increasing, we have:

$$\Lambda(\mu + \theta^k) > \Lambda(\mu) \quad \forall \mu \in \mathbb{R}.$$

The difference $\Delta_{\text{persist}}^k = \Lambda(\mu + \theta^k) - \Lambda(\mu)$ is strictly positive and captures the increase in entry probability from having an active relationship in the previous period. Refer to Appendix A.5 for details. □

State dependence is a crucial empirical regularity. We discuss the econometric challenges it creates for high-dimensional fixed effects nonlinear panel models in Appendix B.2.

3.7 Cross-Flow Spillovers

Our comprehensive database allows us to explore dependencies among different flow types. The economic channels described in Section 3.2—particularly the TFP spillovers from FDI and catalytic effects of ODA—suggest that financial relationships in one asset class may affect the costs or benefits of relationships in other classes.

Assumption 4 (Cross-Flow Effects)**.** *The entry index for flow type k depends on lagged entry in other flow types $\ell \neq k$:*

$$\eta^k_{ni,t} = \mu^k_{ni,t} + \theta^k D^k_{ni,t-1} + \sum_{\ell \in \mathcal{K} \setminus \{k\}} \phi^{k\ell} D^\ell_{ni,t-1}, \tag{27}$$

where $\phi^{k\ell}$ captures how prior relationships in type ℓ affect current entry in type k.

Proposition 6 (Cross-Flow Complementarity and Substitutability)**.** *Under Assumptions 1 and 4:*

1. *If $\phi^{k\ell} > 0$, flows k and ℓ are* complements *at the extensive margin: prior entry in ℓ increases the probability of entry in k.*
2. *If $\phi^{k\ell} < 0$, flows k and ℓ are* substitutes *at the extensive margin: prior entry in ℓ decreases the probability of entry in k.*
3. *The cross-partial effect is:*

$$\frac{\partial \Pr(D^k_{ni,t} = 1)}{\partial D^\ell_{ni,t-1}} = \phi^{k\ell} \cdot \Lambda(\eta^k_{ni,t})(1 - \Lambda(\eta^k_{ni,t})). \tag{28}$$

Proof. Part (3) follows from the chain rule as in Proposition 2. Parts (1) and (2) follow directly from the sign of the coefficient and the monotonicity of $\Lambda(\cdot)$. □

Remark 3 (Economic Channels for Cross-Flow Effects)**.** *The economic characterization in Section 3.2 suggests specific mechanisms generating cross-flow spillovers:*

***Complementarities** ($\phi^{k\ell} > 0$):*

***ODA** → **FDI**: Aid projects improve infrastructure (reducing $\kappa^{FDI}_{ni,t}$), institutional quality (lowering $f^{FDI}_{ni,t}$), and information availability. The TFP channel in equation (4) raises expected returns R^{FDI}_{it}. Empirically, we expect $\phi^{FDI,ODA} > 0$ ("aid as catalyst").*

***FDI** → **Portfolio**: Multinational presence signals destination quality and generates information spillovers for portfolio investors. FDI affiliates produce audited financial statements and analyst coverage, reducing $\kappa^{PE}_{ni,t}$ and $\kappa^{PD}_{ni,t}$. We expect $\phi^{PE,FDI} > 0$ and $\phi^{PD,FDI} > 0$ ("FDI as signal").*

***Trade** → **FDI**: Existing trade relationships provide market knowledge and distribution networks, facilitating FDI entry ("trade as stepping stone"). This channel operates through reduced information frictions.*

***Substitutability** ($\phi^{k\ell} < 0$):*

***FDI** ↔ **Trade**: Tariff-jumping FDI substitutes for exports; once FDI is established, trade relationships may weaken as production shifts to the host country.*

***Portfolio Debt** ↔ **Portfolio Equity**: Different risk-return profiles (compare equations (6) and (7)) may lead investors to choose one or the other based on risk appetite and market conditions.*

***ODA** → **Portfolio**: Heavy aid dependence may signal high risk or "Dutch disease" effects, deterring private portfolio investment. We may observe $\phi^{PE,ODA} < 0$ in some specifications.*

Notice that while we do not directly estimate equation (4), the cross-flow spillover coefficients $\phi^{k\ell}$ provide reduced-form evidence consistent with these productivity channels. Specifically, a positive $\phi^{\text{FDI,ODA}}$ supports the notion that ODA enhances TFP and thus long-term development (through the ϕ^{ODA} channel), which in turn raises FDI returns R_{it}^{FDI} and entry probabilities.

3.8 From Theory to Empirics

We now connect the theoretical framework to the estimating equations used in our empirical analysis.

3.8.1 General Specification

Combining equations (14), (2), (23), and (27), the systematic entry index is:

$$\eta_{ni,t}^k = \alpha_n^k + \gamma_i^k + \boldsymbol{Z}_{ni}'\boldsymbol{\pi}^k + \boldsymbol{X}_{ni,t}'\boldsymbol{\beta}^k + \theta^k D_{ni,t-1}^k + \sum_{\ell \neq k} \phi^{k\ell} D_{ni,t-1}^\ell, \tag{29}$$

where α_n^k: source fixed effects (capturing $\ln W_{nt}^k$ and source-side multilateral resistance); γ_i^k: destination fixed effects (capturing $\ln R_{it}^k$ from equations (5)–(7) and pull factors);[3] $\boldsymbol{Z}_{ni}$: time-invariant bilateral characteristics affecting κ_{ni}^k; $\boldsymbol{X}_{ni,t}$: time-varying bilateral characteristics; θ^k: own-flow persistence (flow-specific as motivated in Section 3.2); $\phi^{k\ell}$: cross-flow spillovers (motivated by Remark 3).

3.8.2 Specification with High-Dimensional Fixed Effects

To control for time-varying multilateral resistance and unobserved bilateral heterogeneity, we employ three specifications:

Specification 1 (Source×Time and Destination×Time FE):

$$\eta_{ni,t}^k = \alpha_{nt}^k + \gamma_{it}^k + \boldsymbol{Z}_{ni}'\boldsymbol{\pi}^k + \boldsymbol{X}_{ni,t}'\boldsymbol{\beta}^k + \theta^k D_{ni,t-1}^k + \sum_{\ell \neq k} \phi^{k\ell} D_{ni,t-1}^\ell. \tag{30}$$

Specification 2 (Adding Dyad FE):

$$\eta_{ni,t}^k = \alpha_{nt}^k + \gamma_{it}^k + \delta_{ni}^k + \boldsymbol{X}_{ni,t}'\boldsymbol{\beta}^k + \theta^k D_{ni,t-1}^k + \sum_{\ell \neq k} \phi^{k\ell} D_{ni,t-1}^\ell. \tag{31}$$

Specification 3 (No Persistence):

$$\eta_{ni,t}^k = \alpha_{nt}^k + \gamma_{it}^k + \delta_{ni}^k + \boldsymbol{X}_{ni,t}'\boldsymbol{\beta}^k. \tag{32}$$

Note that the dyad fixed effects δ_{ni}^k absorb all time-invariant bilateral characteristics, including $\boldsymbol{Z}_{ni}'\boldsymbol{\pi}^k$ and $\bar{f}_{ni}^k$.

Since structural coefficients from nonlinear models lack direct interpretability, we report average partial effects (APEs). We cover their definitions in Appendix 3.8.3.

[3]Note that the source×time fixed effects α_{nt}^k absorb outward multilateral resistance—the investor's outside option value across all destinations— and destination×time effects γ_{it}^k absorb inward multilateral resistance and time-varying destination fundamentals, analogous to the outward and inward multilateral resistance term in the seminal contribution by Anderson and van Wincoop (2003). Further, including both origin-time and destination-time fixed effects fully absorbs any time-specific variation across all observations, rendering a separate time fixed effect τ_t^k perfectly collinear and therefore redundant. Hence, our specification controls for the common shock and global financial cycle, such as r_t^* in equation (7).

3.8.3 Average Partial Effects

Since structural coefficients from nonlinear models lack direct interpretability, we report average partial effects (APEs):

Definition 1 (Average Partial Effect)**.** *The average partial effect of covariate x_j is:*

$$APE_j^k = \frac{1}{N_k} \sum_{(n,i,t)\in\mathcal{S}_k} \frac{\partial \Pr(D_{ni,t}^k = 1 \mid \eta_{ni,t}^k)}{\partial x_j}, \tag{33}$$

where $\mathcal{S}_k$ is the estimation sample for flow type k and $N_k = |\mathcal{S}_k|$.

For a binary covariate D (such as the lagged entry indicator):

$$\mathrm{APE}_D^k = \frac{1}{N_k} \sum_{(n,i,t)\in\mathcal{S}_k} \left[G(\eta_{ni,t}^k + \hat{\theta}^k) - G(\eta_{ni,t}^k)\right], \tag{34}$$

where $G(\cdot)$ is the link function (logit or cloglog).

3.9 Flow-Specific Predictions

The economic characterization in Section 3.2 generates testable predictions about how the four financial flows differ in their extensive margin behavior:

Remark 4 (Theoretical Predictions by Flow Type)**.** ***FDI**: 1) Highest persistence (θ^{FDI} largest) due to sunk costs and relationship capital. 2) Strong sensitivity to distance and institutional quality (high information intensity). 3) Positive spillovers to portfolio flows ($\phi^{PE,FDI} > 0$, $\phi^{PD,FDI} > 0$).*

***ODA**: 1) High persistence (θ^{ODA} large) due to institutional inertia. 2) Strong colonial/language ties (historical relationships dominate). 3) Positive spillovers to FDI ($\phi^{FDI,ODA} > 0$) through catalytic effects.*

***Portfolio Equity**: 1) Lower persistence (θ^{PE} moderate) due to liquid markets. 2) High sensitivity to global risk factors and return volatility. 3) Benefits from FDI presence ($\phi^{PE,FDI} > 0$) through information channel.*

***Portfolio Debt**: 1) Lower or intermediate persistence. 2) Strong sensitivity to debt sustainability (debt/GDP ratio in equation (7)). 3) Potential substitutability with portfolio equity.*

In addition to differing dynamic properties and heterogeneous policy impacts, the inference is tied to the choice of payoff shock distribution.

Proposition 7 (Link Function Selection by Flow Type)**.** *Let $\bar{p}^k = N_k^{-1} \sum_{(n,i,t)} D_{ni,t}^k$ denote the unconditional entry rate for flow type k. Based on the economic characteristics in Table 8:*

1. ***Logit is preferred** for FDI and ODA where persistence is high, symmetry between entry and exit is plausible, and numerical stability is important.*

2. ***Cloglog may be appropriate** for portfolio equity in LIDCs where $\bar{p}^{PE}$ is very low (<0.1) and entry represents rare "discovery" events.*

3. *For all flow types, logit serves as the primary specification with cloglog as a robustness check.*

Table 9: Summary of Theoretical Framework

Result	Equation	Empirical Implication
Logit entry probability	(17)	Primary specification for all flows
Cloglog entry probability	(21)	Robustness for rare-event flows
State dependence	(26)	$\theta^k > 0$ implies persistence
Cross-flow effects	(28)	$\phi^{k\ell} \gtrless 0$ for complements/substitutes
Logit marginal effects	(18)	Symmetric, bounded by 0.25
Cloglog marginal effects	(22)	Asymmetric, can be large near $\eta = 0$
FDI return structure	(5)	Diminishing returns, diversification
TFP spillovers	(4)	FDI and ODA enhance productivity

3.10 Taking Stock

Table 9 summarizes the key theoretical results and their empirical implications. Beyond the specification discussion, note that our covariate set is designed to proxy the main frictions that govern whether a bilateral financial relationship exists at all (the extensive margin). We group bilateral, time-invariant variables into measures of information, coordination, and transaction costs. Geographic distance $\ln(\text{distance}_{ni})$ captures broad remoteness and monitoring costs, while contiguity (contiguity_{ni}) proxies lower coordination costs and more frequent cross-border interaction (including cross-border production networks and supervisory familiarity). Cultural and institutional proximity—common language, common legal origin, and colonial ties—reduce information asymmetries and contracting frictions by facilitating communication, legal interpretation, and the enforcement of claims. We further measure deeper cultural frictions using linguistic, religious, and broader cultural distance indices ($\ln(\text{lingdist}_{ni})$, $\ln(\text{reldist}_{ni})$, $\ln(\text{cultdist}_{ni})$), which capture soft barriers to trust formation and the diffusion of information that are particularly salient for cross-border finance.

To capture policy-related bilateral integration and risk, we include joint WTO membership and the depth of preferential trade integration ($\text{member\_wto\_joint}_{ni,t-1}$, $\text{rta\_depth}_{ni,t-1}$), as well as lagged dummies for bilateral goods trade and services exports (Lag $\text{trade}_{ni,t-1}$, Lag services $\text{export}_{ni,t-1}$). These variables are motivated by an "information channel" in which trade and services linkages reveal counterpart reliability, generate repeated interaction, and reduce fixed costs of initiating financial ties. We also include bilateral sanctions indicators (trade, financial, travel) as direct policy constraints that increase effective transaction costs and legal/settlement risk. Finally, each flow equation includes a lagged dependent indicator to capture persistence of relationships, and lagged indicators for other flow types to allow for cross-flow complementarities or substitution at the extensive margin. All bilateral time-varying covariates are lagged to mitigate simultaneity concerns, while source-year and destination-year fixed effects absorb time-varying macro fundamentals and broad push–pull forces, ensuring that identification of bilateral mechanisms comes from within-pair changes and bilateral frictions rather than aggregate conditions. For a full variable description, see Appendix D.1.

4 Empirical Results

Following Weidner and Zylkin (2021), we implement analytical bias correction for incidental parameter bias from high-dimensional fixed effects. We extend the model to incorporate persistence following Correia et al. (2020) and Hinz et al. (2020), capturing: (i) relationship capital and sunk costs; (ii) hysteresis from policy changes; and (iii) dynamic spillovers across flow types. Finally, standard errors are clustered by country-pair.

4.1 Specifications

We explore three different specifications.

Specification 1: "Time-invariant dyad covariates + source-time and destination-time fixed effects". We include a rich set of dyadic time-invariant gravity covariates (e.g. log distance, common legal origin, former colonial relationship), as well as time-varying regressors like lagged flows and other controls (see equation 30).

This specification resembles a gravity-type model often used for the intensive margin: including bilateral GDPs, trade, etc., along with dyadic "gravity" variables like $\ln(\text{Distance}_{ni})$, indicators for historical ties (common legal origin, colonial relationship, etc.), and currency or language commonalities. By not using pair fixed effects here, we can directly estimate the influence of these time-invariant bilateral factors on the probability of any positive flow. We cannot identify effects of source and destination specific time-varying factors as they are fully controlled for by directional-time fixed effects.

Given our specification, a positive coefficient θ^k on the lagged dependent variable indicates state dependence (or persistence): if a flow of type k occurred last year, the odds of a positive flow this year increase. Similarly, $\phi^{k\ell} > 0$ would mean flow ℓ in the previous period makes flow k more likely – evidence of complementarity or cross-flow catalysis – whereas a negative $\phi^{k\ell}$ would suggest substitution or crowding-out between flows. The dyadic covariate effects π^k align with intuitive economic meanings: for example, greater distance ($D_{ni} = \ln \text{Distance}_{ni}$) typically reduces the probability of a positive flow (i.e. $\pi^k < 0$), consistent with higher information and transaction costs over long distances. Conversely, sharing a common legal origin or a past colonial link often raises the likelihood of a financial relationship, reflecting trust, familiarity, and established networks (Papaioannou, 2009). In other words, countries with historical or institutional ties are more likely to engage in any FDI, aid, or portfolio exchange. Time-varying covariates β^k capture policy and economic conditions: for instance, a large bilateral trade volume (exports/imports) might increase the chance of investment flows (a positive coefficient, reflecting complementarities between trade and investment). Likewise, a bilateral investment treaty in force could significantly raise the probability of a positive FDI flow by reducing regulatory barriers. As we use a nonlinear link, we interpret coefficients in terms of average partial effects on the predicted probability of a positive flow. We provide more technical discussion in Appendix B.3 – the key insight, however, is that coefficients on policy-relevant variables (e.g. BITs, trade openness, etc.) directly indicate how those factors tilt the chances of initiating a financial flow relationship.

Specification 2: "Modern Dynamic Gravity + source-time, destination-time, and dyad fixed effects". In this specification, we introduce a full set of fixed effects to flexibly control for heterogeneity; refer to equation 31. The goal is to isolate the impact of time-varying bilateral factors (especially policy changes) on the probability of a flow, net of any general trends or stable pair attributes. The source-year and destination-year effects (e.g. source country's outward investment climate or global liquidity affecting all its outflows in year t, recipient country's macroeconomic situation affecting all inflows in t), and the bilateral fixed effect captures all persistent pair-specific affinity (geography, historical ties, cultural links, etc.), consistent with the logic emphasized in the structural gravity and "gold standard" fixed-effects literature (Baldwin and Taglioni, 2006; Anderson and van Wincoop, 2003; Head and Mayer, 2014).

With the high-dimensional fixed effects, coefficient estimates β^k on our bilateral time-varying variables reflect within-pair, within-timeframe effects. Essentially, they answer: if a given donor/investor–recipient pair experiences a change in some policy or bilateral condition, how does that change the probability of a flow, holding constant all country-level factors and the pair's baseline propensity to transact? A key example is a policy change such as a new bilateral investment treaty (BIT) coming into force: here β^k_{BIT} (for, say, $k = \text{FDI}$) measures the discrete jump in likelihood of an FDI relationship when the treaty becomes active, controlling for any global or country-specific trends. Similarly, the coefficient on lagged bilateral trade in, say, the portfolio equity equation would tell us whether within a given country-pair, higher trade volumes in the prior year lead to a higher chance of equity investment (perhaps capturing network effects or information spillovers). The source-year and destination-year fixed effects absorb broad "push" and "pull" factors: for instance, if risk appetite or the source country's financial cycle causes a general surge in outflows, $\alpha^k_{n,t}$ picks that up; if the recipient country i is experiencing a favorable economic year attracting all kinds of inflows, $\gamma^f_{i,t}$ captures that. Thus, β^k in Spec 2 are identified purely from deviations relative to those general trends, giving a very stringent test of policy impact. Notably, the lagged flow coefficients θ^k and $\phi^{k\ell}$ in this specification indicate state dependence and cross-dynamic effects purged of any spurious persistence due to omitted heterogeneity. If θ^k remains significantly positive even with pair dummies, it implies a genuine persistence in flow relationships (e.g. once an FDI link is established, the odds of continuation are intrinsically higher, beyond what any fixed pair traits would predict). Likewise, a positive ϕ^{FDI}_{ODA} here would mean within a given donor–recipient relationship, an aid flow last year is associated with an increased probability of an FDI flow this year – suggesting a complementarity (perhaps aid-funded projects pave the way for investor entry). In contrast, if those cross-flow terms lose significance under fixed effects, it would imply the correlations in Spec 1 were driven by static pair-specific correlations (e.g. certain country pairs have both aid and investment simply due to long-standing ties, rather than aid leading to investment dynamically). Overall, Spec 2 provides our most rigorous isolation of time-varying policy effects.[4]

Specification 3: "Standard Static Gravity + no persistence and no cross-flow lags". To show the bias from omitting dynamics and cross-flow interdependence, we estimate a parsimonious variant that retains the fixed effects structure and bilateral policy covariates (see equation 32). In essence, Spec (3) is a static version that focuses on the direct effects of policy and other covariates. It corresponds to a large part of the older extensive-margin literature that treats entry as conditionally memoryless and ignores the dependence of one flow's extensive margin on other contemporaneous/lagged inflows.

Comparing Spec (3) with Spec (2) allows us to assess the importance of flow persistence and feedbacks. If key policy coefficients β^f_k remain similar in magnitude and significance when lagged flows are removed, it suggests that the policies' influence is not mediated by those dynamic effects and is fairly robust. On the other hand, any substantial changes could indicate that part of a policy's effect in Spec 2 was indirectly coming through persistence (for example, perhaps a policy spurs an initial flow which then boosts subsequent flow probability; without the lag term, the policy might appear slightly less potent). We treat this specification as a test for the role of persistence and cross-flow spillovers, trusting its results the least.

[4] For instance, if we find β^{FDI}_{BIT} is positive and significant, it means that when a given country pair signs a BIT, the likelihood of FDI flows increases for that pair, relative to the pair's baseline and controlling for all other trends. We interpret such results as strong evidence of policy effectiveness on the extensive margin.

Estimation and bias correction. Because (30)–(32) are nonlinear FE models with high-dimensional fixed effects, they are susceptible to incidental-parameter bias. We use analytical bias correction of the coefficient vector and (bias-corrected) average partial effects (APEs), following the large-N, T fixed-effect bias-correction literature (Fernandez-Val and Weidner, 2016) and (Stammann et al., 2025). APEs are computed on the *response (probability) scale* as (i) discrete changes for binary regressors and (ii) average derivatives for continuous regressors, using the estimated fixed effects and the delta method for inference (Stammann et al., 2025).[5]

4.2 Baseline Results

Our triple-indexed panel reveals sharp differences in extensive-margin behavior across the four financial flows. Official development assistance exhibits the strongest persistence: once a donor–recipient aid relationship exists, it tends to continue year after year, consistent with multi-year program commitments and strategic bilateral partnerships. By contrast, portfolio equity and debt flows display markedly lower state dependence—investors may enter a low-income country in one year and completely withdraw the next if conditions deteriorate. This pattern aligns with the broader literature documenting that gross international capital flows are highly volatile and prone to sudden stops during crises (Broner et al., 2013; Pagliari and Ahmed Hannan, 2024). Our equity and debt models exhibit relatively modest persistence coefficients (even in the full-covariates specification) and substantial year fixed-effect variance, consistent with global investors rapidly adjusting exposure to LIDCs in response to changing market conditions.

Foreign direct investment occupies an intermediate position. While more stable than portfolio flows—reflecting the irreversibility of establishing production facilities and the sunk costs of market entry—FDI is less persistent than ODA. Once a multinational corporation establishes operations, follow-on investments and reinvested earnings generate moderate continuation probabilities, yielding economically meaningful state dependence that nonetheless falls short of aid relationships. These flow-specific differences underscore that the extensive margin is not a monolithic phenomenon: official flows follow strategic or political commitments that generate steady presence, whereas portfolio flows respond episodically to market conditions and exhibit sporadic participation. Our dynamic panel evidence thus supports the narrative from aggregate studies that capital flows to developing countries are "fickle" for portfolio investment while remaining more stable for long-term FDI and official finance (Ghosh et al., 2014; Forbes and Warnock, 2012).

Specification 1 (source×time and destination×time fixed effects with time-invariant bilateral covariates) reveals that standard gravity frictions matter heterogeneously across flows. Geographic distance is strongly negative for ODA and FDI entry, while informational and cultural frictions—measured by linguistic distance, religious distance, and cultural distance—prove especially binding for the extensive margin of portfolio equity and, to a lesser extent, portfolio debt. This pattern is consistent with gravity-in-finance work emphasizing information asymmetries and transaction costs in arm's-length capital markets (Portes and Rey, 2005; Lane and Milesi-Ferretti, 2007). For instance, linguistic distance exhibits large negative structural coefficients and economically meaningful APEs for both equity and debt flows (Tables 16 and 19), whereas its effect on FDI and ODA is modest and often statistically weak. These dyad-invariant covariates are precisely what motivates Specification 1, as they are absorbed by pair fixed effects μ_{ni} in Specification 2 and cannot be separately identified under full fixed-effects saturation.

Moving to Specification 2 (adding dyad fixed effects) shifts identification to within-dyad time

[5]Note that, mechanically, APE standard errors can be much smaller than coefficient standard errors because they average an observation-level quantity; this is not a contradiction but a feature of nonlinear models with many fixed effects.

variation, aligning the specification with modern structural gravity that interprets source-time and destination-time effects as capturing outward supply and inward demand (or multilateral resistance), while dyad effects absorb all time-invariant bilateral heterogeneity (Anderson and van Wincoop, 2003; Baldwin and Taglioni, 2006; Head and Mayer, 2014). This transition weakens the apparent role of slowly moving covariates but sharpens inference on time-varying policy instruments. For instance, trade sanctions exhibit a positive and significant effect on FDI entry in both specifications (structural coefficient 0.344 in Specification 2, $p < 0.10$; APE 0.0158, $p < 0.01$ in Table 20), consistent with multinationals using FDI to circumvent trade barriers—a form of tariff-jumping investment documented in the international trade literature (Blonigen et al., 2004). Conversely, travel sanctions reduce FDI flows to LIDCs (structural coefficient -0.387, $p < 0.10$; APE -0.0394, $p < 0.01$), underscoring the importance of business mobility and face-to-face interaction for initiating and maintaining investment relationships.

The effects of deeper regional trade agreements are more nuanced. RTA depth shows a positive cross-sectional association with FDI in Specification 1 (structural coefficient 0.028, $p < 0.10$; APE 0.00141, $p < 0.05$ in Table 19), but this effect attenuates or turns negative in the within-dyad specification, suggesting that deeper integration may substitute for horizontal FDI or impose compliance costs that offset market-access benefits. For portfolio flows, WTO joint membership increases the probability of equity entry in both specifications (Specification 2 APE 0.0328, $p < 0.01$ in Table 20), consistent with multilateral institutions that support market access and investor protections being particularly relevant for portfolio positions.

Cross-flow dynamics reveal important complementarities and substitution patterns. Lagged ODA outflow positively affects FDI entry in the full-covariates specification (structural coefficient 0.253, $p < 0.01$; APE 0.0128, $p < 0.01$ in Table 19), consistent with aid improving infrastructure and institutions that facilitate subsequent private investment—a catalytic role emphasized in the development literature (Selaya and Sunesen, 2012). However, this cross-flow complementarity largely disappears under dyad fixed effects (structural coefficient -0.033, imprecise in Table 17), indicating that the aid-FDI association reflects persistent dyad characteristics (such as ex-colonial ties generating both aid and investment) rather than short-run spillovers. Similarly, lagged FDI outstock raises the probability of portfolio debt and equity entry in Specification 1 (debt APE 0.00753, $p < 0.01$; equity APE 0.00348, $p < 0.01$), suggesting that established multinational presence signals recipient quality and reduces information asymmetries for portfolio investors. These cross-flow effects are estimated within the same triple-indexed panel $\{i, n, t\}$ with consistent fixed-effects architecture, yielding more credible inference than indirect correlations from separate flow-specific regressions.

4.3 Persistence and Link Function Sensitivity

The lagged dependent dummy dominates economically and statistically in every specification, but its magnitude and implied persistence vary systematically with both the link function and fixed-effects saturation. In the logit full-covariates specification (source$\times$time and destination$\times$time fixed effects), structural persistence coefficients are largest for FDI ($\hat{\beta} \approx 3.99$), followed by equity (≈ 3.23), debt (≈ 3.19), and ODA (≈ 3.04), all highly significant at $p < 0.01$ (Table 10). The corresponding average partial effects preserve this ordering: FDI exhibits an APE of approximately 0.354, meaning that switching from zero FDI in period $t - 1$ to positive FDI raises the probability of FDI in period t by 35.4 percentage points on average, compared to 16.0 percentage points for equity, 15.4 for ODA, and 14.1 for debt (Table 13).

Under the cloglog link, structural persistence coefficients are systematically smaller (ODA: 1.91; FDI: 3.03; debt: 2.48; equity: 2.54 in Table 16), reflecting the complementary log-log transformation's slower mapping from index values to probabilities. Crucially, however, the probability-scale APEs converge closely across links: FDI persistence is nearly identical (35.1 percentage points cloglog vs. 35.4 logit), while other flows show modest differences of 1-2 percentage points (Table 19). This convergence confirms that both link functions capture similar economic magnitudes despite their distinct functional forms, and that our substantive conclusions are robust to this modeling choice.

Introducing dyad fixed effects in Specification 2 induces a sharp compression of persistence coefficients across all flows and both links, consistent with dyad effects absorbing time-invariant bilateral propensities that were partly loaded onto the lagged dependent variable under weaker fixed-effects saturation. In the logit full-FE specification, the persistence ranking reverses: equity becomes the most persistent ($\hat{\beta} \approx 2.54$), followed by FDI (≈ 2.38), debt (≈ 2.29), and ODA (≈ 1.89), all at $p < 0.01$ (Table 11). The corresponding APEs compress toward a tighter range (equity 13.1 percentage points, FDI 11.9, debt 11.0, ODA 7.9 in Table 14). This reordering reveals that ODA persistence is particularly driven by cross-sectional dyad heterogeneity—likely reflecting that certain country pairs (often linked by colonial history or strategic partnerships) maintain aid relationships regardless of year-to-year conditions. Once these stable bilateral affinities are absorbed by μ_{ni}, the remaining within-dyad state dependence is relatively stronger for portfolio equity than for official aid, suggesting that equity investors exhibit stronger path dependence in their allocation decisions conditional on the country-pair relationship.

The cloglog specification yields qualitatively similar patterns under full fixed effects: persistence falls across all flows (ODA: 1.22; FDI: 1.55; debt: 1.51; equity: 1.73 in Table 17), and the probability-scale APEs remain economically interpretable and well-behaved (ranging from 5.8 percentage points for FDI to 8.2 for ODA in Table 20). The key substantive insight holds across both links: dyad fixed effects are essential for distinguishing persistent bilateral propensities from true within-dyad state dependence, and omitting these controls leads to upward-biased persistence estimates.

4.4 Gravity Structure and Informational Frictions

Standard trade-cost proxies behave consistently with gravity theory, but their economic salience differs markedly across flow types and specifications. Geographic distance log(distance) enters negatively and significantly in all four flow equations under both link functions in the full-covariates specification, with structural coefficients ranging from -0.27 (equity, logit) to -1.00 (ODA, logit), all at $p < 0.01$ (Table 10). The corresponding APEs are economically meaningful: each log-point increase in bilateral distance reduces the probability of ODA entry by approximately 2.4 percentage points and FDI entry by approximately 2.7 percentage points (Table 13). These magnitudes are consistent with the augmented gravity framework of Portes and Rey (2005), who demonstrate that information asymmetries proxied by distance and communication variables explain a substantial share of cross-border equity flows.

Linguistic distance exhibits a strikingly different pattern. Its effect is economically small and statistically weak for ODA and FDI (structural coefficients around -0.16 to -0.29, typically imprecise), but large and highly significant for portfolio flows. For equity, the linguistic distance coefficient reaches -2.45 (logit, $p < 0.01$) or -1.65 (cloglog, $p < 0.01$), translating to an APE of approximately -4.0 percentage points—meaning that a one-unit increase in linguistic distance reduces equity entry probability by 4 percentage points (Tables 10 and 13). This contrast supports the interpretation that informational and contracting frictions are more binding for arm's-length portfolio claims than for FDI, where direct managerial control and on-the-ground presence mitigate language barriers.

Religious distance is robustly negative for ODA under both links (structural coefficient -0.64 logit, -0.34 cloglog, both $p < 0.01$), with APEs around -1.5 to -1.6 percentage points, underscoring the role of cultural and historical affinity in bilateral aid relationships. Cultural distance exhibits a large negative coefficient for FDI in the logit full-covariates model (-1.59, $p < 0.05$; APE -5.2 percentage points), but is imprecisely estimated in other specifications. This sensitivity likely reflects that the asymmetric tail behavior of the cloglog link and the varying prevalence rates across flow types affect how cultural distance loads in high-dimensional fixed-effects models.

Common legal origin and common language—standard gravity variables capturing institutional affinity and reduced transaction costs—are positive and significant for ODA and FDI across both links. For instance, common legal origin increases ODA entry probability by approximately 2.4 percentage points (logit) and FDI entry by approximately 1.6 percentage points (both at $p < 0.01$ in Table 13). Colonial ties show mixed effects: the structural coefficient for FDI is positive and significant in logit (0.921, $p < 0.01$) but only marginally significant in cloglog (0.422, $p < 0.10$), yielding APEs of 3.4 and 2.0 percentage points, respectively (Tables 13 and 19). This link-function sensitivity suggests that colonial history matters more for initiating FDI relationships when rare events are modeled with logit's symmetric tails than with cloglog's skewed transformation, though the economic direction is robust.

These gravity results contribute to the long-standing literature on the determinants of international capital flows. Lane and Milesi-Ferretti (2007) document the dramatic rise in international financial integration over recent decades but note that this surge was concentrated among advanced economies and large emerging markets. Our focus on LIDCs reveals that even in this subset, geographic and informational frictions remain first-order determinants of whether any financial relationship forms. This finding resonates with the Lucas paradox literature (Alfaro et al., 2008; Papaioannou, 2009), which attributes limited capital flows to poor countries primarily to institutional deficiencies and weak property rights. Our results extend this insight to the extensive margin: a low-income country with better governance, common legal traditions, or linguistic proximity to potential investors is not only likely to receive more capital, but is significantly more likely to receive any capital at all from a given source in a given year.

4.5 Policy Variables, Sanctions, and Cross-Flow Interactions

Institutional and policy covariates display heterogeneous effects that are statistically meaningful and economically interpretable. Joint WTO membership is positive and significant for portfolio equity in both the logit and cloglog full-covariates models (structural coefficient 0.859, $p < 0.05$ logit; APE 1.43 percentage points in Table 13), consistent with multilateral institutions that support market access and investor protections being most salient for equity positions. Under dyad fixed effects, WTO membership turns negative for FDI (structural coefficient -1.60, $p < 0.05$ logit; -1.10, $p < 0.10$ cloglog), though the economic interpretation is fragile given limited within-dyad variation in WTO status and the possibility of reverse causality (countries joining WTO precisely when investment patterns change).

Sanctions exhibit the clearest and most robust policy effects. Trade sanctions increase FDI entry in the full-covariates specification (structural coefficient 0.584, $p < 0.01$ logit; 0.319, $p < 0.10$ cloglog; APE 2.0 percentage points logit in Table 13), supporting the tariff-jumping hypothesis that multinationals establish local production to circumvent trade barriers (**?**). This effect persists and strengthens in the dyad-FE specification (APE 1.58 percentage points cloglog, $p < 0.01$ in Table 20), and becomes even larger when persistence and cross-flow lags are omitted (APE 2.70 percentage points in the misspecified model of Table 21), illustrating how dynamic omitted-variable bias inflates policy coefficients.

Conversely, travel sanctions reduce FDI entry across all specifications (structural coefficient -0.51, $p < 0.10$ logit full-FE; APE -1.4 percentage points at $p < 0.01$ in Table 14), consistent with business mobility being critical for initiating and sustaining direct investment relationships. For portfolio flows, trade sanctions are negative and significant for debt (APE −1.3 percentage points cloglog, $p < 0.01$ in full covariates), while financial sanctions load negatively for ODA and debt in the dyad-FE models, suggesting that sanctions shift the composition of bilateral financial links rather than uniformly deterring all flows.

RTA depth exhibits a positive cross-sectional association with FDI (structural coefficient 0.042, $p < 0.05$ logit; APE 0.14 percentage points) but attenuates or turns negative under dyad fixed effects (structural coefficient −0.090, $p < 0.05$ logit in the no-persistence specification of Table 12). This sign reversal indicates that deeper integration agreements may substitute for horizontal FDI once within-pair variation is isolated, possibly because enhanced market access through trade liberalization reduces the need for tariff-jumping investment, or because regulatory harmonization imposes compliance costs that offset benefits. This finding aligns with recent evidence that deep integration provisions can have different effects on FDI depending on the specific provisions and country characteristics (Larch and Yotov, 2025) with some evidence of substitutability between trade and FDI with respect to deep trade agreement provisions (Bergstrand and Paniagua, 2024).

Cross-flow lag terms reveal complementarities and substitution patterns whose interpretation depends critically on fixed-effects saturation. In the full-covariates logit specification, lagged ODA outflow significantly increases FDI entry (structural coefficient 0.349, $p < 0.01$; APE 1.17 percentage points), lagged FDI outstock increases both debt and equity entry (structural coefficients 0.423 and 0.243, both $p < 0.01$; APEs 0.79 and 0.41 percentage points), and lagged CPIS debt strongly raises equity entry (structural coefficient 0.442, $p < 0.01$; APE 0.80 percentage points in Table 13). These patterns suggest that aid improves infrastructure and institutions that facilitate private investment, that FDI signals recipient quality and reduces information costs for portfolio investors, and that debt and equity positions are complements rather than substitutes at the extensive margin.

However, most cross-flow coefficients become statistically insignificant once dyad fixed effects absorb time-invariant bilateral affinities (Table 11). For instance, the lagged ODA coefficient in the FDI equation falls to −0.111 (imprecise) under dyad FE, while lagged FDI in the debt equation drops to 0.075 (imprecise). The APEs in Table 20 confirm this attenuation: cross-flow effects remain economically small (typically below 1 percentage point) and often statistically weak. This pattern implies that apparent cross-flow complementarities in Specification 1 primarily reflect stable dyad-level propensities—for example, certain country pairs linked by colonial history or strategic partnerships maintain both aid and investment relationships—rather than dynamic, time-varying feedback mechanisms. The few significant within-dyad cross-flow effects (e.g., lagged FDI raising debt entry by 0.48 percentage points, $p < 0.01$ cloglog) suggest modest but genuine spillovers, consistent with FDI establishing a foothold that reduces perceived risk for subsequent portfolio investors.

4.6 Relationship to the Literature and Policy Implications

Our triple-indexed panel with symmetric treatment of FDI, ODA, portfolio equity, and portfolio debt fills a methodological gap in the international finance literature. Prior studies typically examine a single flow category in isolation or aggregate net flows, obscuring heterogeneity across instruments. For example, Lane and Milesi-Ferretti (2007) document the rise of gross external positions but do not decompose determinants by flow type or focus on extensive-margin dynamics. Broner et al. (2013) emphasize the volatility of gross capital flows and their tendency to retrench during crises, but their analysis does not separate official from private flows or examine bilateral initiation and continuation patterns. Our approach reveals that the determinants of extensive-margin entry differ sharply by flow type and that cross-flow complementarities are predominantly cross-sectional rather than within-dyad, providing a richer picture of how bilateral financial relationships form and evolve.

The dominance of persistence in our results underscores the role of sunk costs and relationship-specific capital. For FDI, once investors overcome initial fixed costs—reflected in gravity variables such as distance, linguistic barriers, and cultural differences—the relationship endures, consistent with the theoretical framework of Helpman et al. (2008) in which firm heterogeneity and fixed export costs generate selection into international markets. For ODA, persistence likely reflects multi-year program commitments and strategic bilateral partnerships that transcend annual budget fluctuations. The contrasting low persistence of portfolio flows reinforces the insight from gross-flow studies that equity and debt capital can surge and retrench suddenly in response to changes in global risk appetite and local conditions (Ghosh et al., 2014; Forbes and Warnock, 2012; Boermans and Burger, 2023). Our results indicate that portfolio flows into LIDCs are particularly episodic, with continuation probabilities of only 13-16 percentage points (conditional on covariates), consistent with "fickle finance" narratives in emerging markets.

We contribute to the aid-investment debate by documenting a positive association between lagged aid and FDI at the dyad level that vanishes once pair fixed effects absorb persistent dyad affinities. This finding suggests that complementary effects between aid and private capital operate mainly through stable bilateral characteristics—such as shared language, colonial history, and strategic partnerships that generate both aid and FDI—rather than through short-run spillovers from aid surges to investment booms. Our interpretation aligns with the broader literature emphasizing that institutional quality and absorptive capacity are prerequisites for aid to catalyze private investment (Borensztein et al., 1998; Selaya and Sunesen, 2012). Countries with better governance can leverage aid more effectively to build infrastructure and improve business climates, which in turn attracts FDI, but this mechanism operates at a slow-moving, structural level rather than through year-to-year aid fluctuations.

On the policy front, our results carry several implications. First, reducing information and coordination costs—through improvements in institutions, establishment of common legal frameworks, and enhanced access to business services—appears crucial for attracting both private and official capital to LIDCs. The large negative effects of linguistic and cultural distance on portfolio flows suggest that policies facilitating information dissemination (e.g., English-language financial reporting, international auditing standards) could meaningfully expand LIDCs' access to global capital markets.

Second, the effects of deeper regional integration and sanctions depend on flow type and can be ambiguous. Trade sanctions appear to push multinationals toward FDI as a means of circumventing barriers, consistent with tariff-jumping motives, but simultaneously deter portfolio debt flows. Travel sanctions uniformly reduce FDI, highlighting that business mobility and face-to-face contact remain important even in an era of digital communication. Deep RTA provisions show positive cross-sectional associations with FDI but negative or insignificant within-dyad effects, suggesting that the relationship between integration depth and investment is nonlinear or depends on the sequencing and design of specific provisions. Policymakers should therefore carefully consider the composition and staging of integration measures, recognizing that blanket deepening may not uniformly boost all capital flows.

Third, our finding that cross-flow complementarities are primarily cross-sectional rather than dynamic cautions against over-interpreting simple correlations between aid and investment. While aid and FDI often flow to the same country pairs, this co-occurrence reflects shared bilateral traits rather than mechanical causation from aid to subsequent FDI. Efforts to use aid strategically to catalyze private investment should focus on addressing the underlying structural barriers—weak institutions, poor infrastructure, high transaction costs—rather than assuming that aid disbursements automatically generate follow-on private capital.

Finally, the methodological lesson from our Specification 3 results (omitting persistence and cross-flow lags) is that dynamic panel models with high-dimensional fixed effects are essential for credible inference in this setting. When we drop lagged dependent variables and cross-flow terms, policy coefficients become severely biased: the RTA depth effect on FDI inflates from near zero to -1.08 (APE), and sanction effects become implausibly large. This distortion arises because policy variables mechanically correlate with persistent dyad-level relationships and with the temporal structure of other flows. Researchers and policymakers evaluating the impact of integration agreements, sanctions, or other bilateral policy shifts must account for persistence and cross-flow dynamics to avoid spurious conclusions.

In sum, our dynamic multi-flow framework demonstrates that (a) time-invariant bilateral frictions and affinities are first-order determinants of whether an LIDC receives any given flow, (b) within-dyad policy variation yields the most defensible causal interpretation but requires careful control for persistence and spillovers, and (c) omitting these dynamic structures leads to distorted inference. These insights advance the extensive-margin gravity literature by providing a unified treatment of multiple flow types in a triple-indexed panel with full fixed-effects saturation, filling the gap identified by Head and Mayer (2014) for richer empirical models of bilateral financial relationships. The results also speak to long-standing puzzles in international finance—why capital doesn't flow to poor countries (Alfaro et al., 2008), why flows are so volatile (Broner et al., 2013), and under what conditions aid complements or substitutes for private investment (Rajan and Subramanian, 2008)—by showing that the extensive margin is governed by a distinct set of forces from the intensive margin, and that these forces vary systematically across official and private flows.

4.7 Robustness

4.7.1 The Cloglog Link: Broad Patterns

The Tables 16-21 document the extensive-margin dynamics of capital flows and their differences depending on the flow type. First, FDI shows the strongest persistence: in Specification 1 (full covariates) the lagged FDI dummy has a coefficient of 3.03 (s.e. 0.041) and a bias-corrected average partial effect (APE) of 0.351 (s.e. 0.0045), while in Specification 2 (full fixed effects) the persistence coefficient remains large at 1.55 (s.e. 0.0368) with an APE of 5.76 (s.e. 0.0006). These numbers imply that once an FDI relationship is formed, the probability of maintaining a positive FDI flow the following year is extraordinarily high. ODA displays the next highest persistence (structural coefficient 1.91 and APE 0.173 in Spec. 1; 1.22 and 0.082 in Spec. 2), whereas portfolio flows are much less persistent: the lagged CPIS equity indicator has a coefficient of 2.54 but an APE of 0.146 (Spec. 1) and drops to 1.73 (APE 0.135) in Spec. 2, while the lagged CPIS debt indicator has 2.48 (APE 0.132) in Spec. 1 and 1.51 (APE 0.546) in Spec. 2. These patterns corroborate the view that multinational firms maintain a longer-term presence once established in LIDCs, official aid ties are fairly sticky, and portfolio investors are more footloose.

Time-invariant bilateral variables matter, but differently for each flow. Gravity forces are strong for LIDCs as they are for advanced economies as recently shown in Kleinman et al. (2023), documenting a strong negative effect of distance on capital income in a cross-section. In our application, *Distance* has a strong negative effect across all flows: in Spec. 1 the coefficient on ln(distance) is about -0.56 for ODA and FDI, -0.40 for FPI debt, and -0.33 for FPI equity – all highly significant. This reflects the information and transaction costs of cross-border finance and is consistent with gravity-in-finance findings that geographical distance reduces equity flows by proxying information asymmetries and transaction costs (Aviat and Coeurdacier, 2007; Portes and Rey, 2005,). *Contiguity* is insignificant for ODA and FDI but significantly positive for FPI

Table 10: Extensive Margin (LIC): Bias-Corrected FE–logit Structural Estimates, Full Covariates

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
Lagged dependent variable	3.04070***	3.99282***	3.18562***	3.22839***
	(0.07709)	(0.05905)	(0.15125)	(0.12307)
Contiguity	-1.01070	-0.04986	0.80221*	0.60078
	(0.62094)	(0.18122)	(0.44961)	(0.36578)
Common language	0.40624***	0.26306***	0.13590	0.02245
	(0.11066)	(0.07853)	(0.14027)	(0.13154)
Common legal origin	1.04091***	0.47247***	0.03529	0.57265***
	(0.17210)	(0.10961)	(0.18736)	(0.17969)
Colony ever	0.49894	0.92145***	0.50984	-0.28978
	(0.59258)	(0.27296)	(0.31881)	(0.26399)
log(distance)	-1.00065***	-0.83205***	-0.43334***	-0.26767**
	(0.14712)	(0.06764)	(0.12107)	(0.12556)
log(lingdist)	-0.29234	-0.16242	-1.01706***	-2.45356***
	(0.35504)	(0.17330)	(0.29841)	(0.36934)
log(reldist)	-0.63988***	-0.05930	-0.37550**	-0.34678
	(0.15196)	(0.08055)	(0.18775)	(0.23108)
log(cultdist)	-0.39250	-1.59367**	-0.56924	-1.57823
	(1.25362)	(0.68021)	(1.37601)	(1.44572)
WTO joint membership	-0.57004	0.17404	0.23180	0.85946**
	(0.83555)	(0.26751)	(0.53980)	(0.41410)
RTA depth	-0.02322	0.04190**	0.04142	-0.00863
	(0.02624)	(0.01764)	(0.02875)	(0.02692)
Sanction: trade	-0.12164	0.58393***	-0.54345	-0.13759
	(0.30835)	(0.20683)	(0.37357)	(0.30391)
Sanction: financial	-0.14627	-0.01443	-0.18193	0.01600
	(0.27379)	(0.18422)	(0.29197)	(0.27249)
Sanction: travel	0.41778	-0.19632	0.19883	0.08012
	(0.28258)	(0.18178)	(0.33591)	(0.31107)
Lag services export	0.31475***	0.04244	-0.27271*	0.35578**
	(0.11499)	(0.09892)	(0.15418)	(0.16713)
Lag trade	-0.70831***	0.22964	-0.03036	-0.16960
	(0.25234)	(0.18583)	(0.17851)	(0.16286)
Lag ODA outflow	–	0.34865***	0.12660	0.08637
		(0.11264)	(0.17885)	(0.17310)
Lag FDI outstock	0.21885**	–	0.42278***	0.24316**
	(0.10695)		(0.11179)	(0.10958)
Lag CPIS debt	0.50834**	0.05486	–	0.44213***
	(0.21912)	(0.15835)		(0.14893)
Lag CPIS equity	0.26714	0.15049	0.20618	–
	(0.20778)	(0.14222)	(0.15152)	
Observations (estimation sample)	13,293	36,227	14,842	14,236
Fixed effects	source×t, dest×t	source×t, dest×t	source×t, dest×t	source×t, dest×t

Notes: Entries are bias-corrected structural coefficients from FE–logit models. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 11: Extensive Margin (LIC): Bias-Corrected FE–logit Structural Estimates, Full FEs

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
Lagged dependent variable	1.88661***	2.38366***	2.29325***	2.54361***
	(0.05052)	(0.05604)	(0.12138)	(0.11429)
WTO joint membership	2.26782	-1.60146**	0.27747	0.70806
	(1.90692)	(0.74931)	(0.54091)	(0.49741)
RTA depth	0.03975	-0.07311	-0.05079	-0.04062
	(0.04950)	(0.04463)	(0.05262)	(0.06176)
Sanction: trade	-0.25048	0.57513*	-0.06928	-0.03666
	(0.37933)	(0.32577)	(0.37104)	(0.36020)
Sanction: financial	-0.28277	0.04462	-0.08433	-0.06020
	(0.22291)	(0.24115)	(0.29077)	(0.27766)
Sanction: travel	-0.14096	-0.51232*	-0.02341	-0.11565
	(0.31393)	(0.30929)	(0.33479)	(0.36567)
Lag services export	-0.09846	0.08307	0.03030	0.46900*
	(0.09456)	(0.15044)	(0.19718)	(0.24253)
Lag trade	-0.39873*	-0.22155	-0.00748	-0.01059
	(0.21414)	(0.20259)	(0.14652)	(0.15028)
Lag ODA outflow	–	-0.11131	-0.00445	0.05642
		(0.14125)	(0.19281)	(0.19256)
Lag FDI outstock	0.08339	–	0.07516	-0.01155
	(0.10569)		(0.12831)	(0.13117)
Lag CPIS debt	0.27219	0.02078	–	0.12075
	(0.19648)	(0.18200)		(0.14626)
Lag CPIS equity	0.25177	0.27989	0.03074	–
	(0.19608)	(0.18023)	(0.13873)	
Observations (estimation sample)	27,565	36,966	18,899	15,939
Fixed effects	source×t, dest×t, pair	source×t, dest×t, pair	source×t, dest×t, pair	source×t, dest×t, pair

Notes: Entries are bias-corrected structural coefficients from FE–logit models. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 12: Extensive Margin (LIC): Bias-Corrected FE–logit Structural Estimates, No Persistence and No Other Flows

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
WTO joint membership	2.80257	-1.35368*	0.80322	1.34917***
	(1.87726)	(0.69246)	(0.52478)	(0.46126)
RTA depth	0.06996	-0.08976**	-0.09486**	-0.05500
	(0.04603)	(0.04203)	(0.04810)	(0.05554)
Sanction: trade	-0.24779	0.90704***	-0.02405	-0.49497
	(0.34482)	(0.30961)	(0.33717)	(0.32561)
Sanction: financial	-0.32286	-0.08399	-0.19624	-0.21695
	(0.20032)	(0.22660)	(0.26390)	(0.23830)
Sanction: travel	-0.32013	-0.77193***	-0.02992	0.29700
	(0.29024)	(0.28957)	(0.30429)	(0.32598)
Observations (estimation sample)	29,204	37,387	19,482	16,730
Fixed effects	source×t, dest×t, pair	source×t, dest×t, pair	source×t, dest×t, pair	source×t, dest×t, pair

Notes: Entries are bias-corrected structural coefficients from FE–logit models. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 13: Extensive Margin (LIC): Bias-Corrected FE–logit Average Partial Effects, Full Covariates

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
Lagged dependent variable	0.1535408***	0.3540272***	0.1408432***	0.1601062***
	(0.0027481)	(0.0046120)	(0.0049257)	(0.0039230)
Contiguity	-0.0266713*	-0.0016250	0.0163361**	0.0112213**
	(0.0159029)	(0.0050672)	(0.0073426)	(0.0053358)
Common language	0.0095881***	0.0087350***	0.0024457	0.0003700
	(0.0020446)	(0.0023925)	(0.0017320)	(0.0016388)
Common legal origin	0.0239455***	0.0162733***	0.0006325	0.0105013***
	(0.0029671)	(0.0038300)	(0.0023610)	(0.0025952)
Colony ever	0.0114603	0.0338586***	0.0097790**	-0.0045859
	(0.0120007)	(0.0092427)	(0.0046462)	(0.0034447)
log(distance)	-0.0235660***	-0.0272263***	-0.0077405***	-0.0044053***
	(0.0028445)	(0.0019791)	(0.0014940)	(0.0014543)
log(lingdist)	-0.0068848	-0.0053147	-0.0181670***	-0.0403803***
	(0.0074511)	(0.0046910)	(0.0041935)	(0.0043918)
log(reldist)	-0.0150695***	-0.0019406	-0.0067072***	-0.0057072**
	(0.0028921)	(0.0022339)	(0.0023481)	(0.0026668)
log(cultdist)	-0.0092437	-0.0521482***	-0.0101679	-0.0259742
	(0.0240559)	(0.0201213)	(0.0179535)	(0.0167249)
WTO joint membership	-0.0131682	0.0056755	0.0040842	0.0143250***
	(0.0142927)	(0.0055392)	(0.0067119)	(0.0051586)
RTA depth	-0.0005467	0.0013709***	0.0007398**	-0.0001420
	(0.0004758)	(0.0005247)	(0.0003486)	(0.0003198)
Sanction: trade	-0.0028881	0.0202265***	-0.0092876**	-0.0022255
	(0.0054200)	(0.0072793)	(0.0042905)	(0.0033978)
Sanction: financial	-0.0034683	-0.0004719	-0.0032039	0.0002639
	(0.0049603)	(0.0058651)	(0.0032352)	(0.0033201)
Sanction: travel	0.0097740	-0.0063594	0.0036178	0.0013328
	(0.0053360)	(0.0051597)	(0.0042720)	(0.0039539)
Lag services export	0.0074784***	0.0013924	-0.0047978***	0.0061511***
	(0.0022790)	(0.0029863)	(0.0018468)	(0.0020213)
Lag trade	-0.0174554***	0.0076891	-0.0005370	-0.0026446
	(0.0047020)	(0.0060346)	(0.0022342)	(0.0018267)
Lag ODA outflow	–	0.0117217***	0.0022628	0.0014161
		(0.0035013)	(0.0021538)	(0.0018748)
Lag FDI outstock	0.0051749**	–	0.0078648***	0.0041102***
	(0.0020180)		(0.0014069)	(0.0013655)
Lag CPIS debt	0.0118342***	0.0018041	–	0.0080132***
	(0.0035293)	(0.0049540)		(0.0020025)
Lag CPIS equity	0.0062424*	0.0049972	0.0038044**	–
	(0.0037812)	(0.0044241)	(0.0019364)	
Observations (estimation sample)	13,293	36,227	14,842	14,236
Fixed effects	source×t, dest×t	source×t, dest×t	source×t, dest×t	source×t, dest×t

Notes: Entries are bias-corrected average partial effects (APEs) from FE–logit models. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 14: Extensive Margin (LIC): Bias-Corrected FE–logit Average Partial Effects, Full FEs

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
Lagged dependent variable	0.0794949***	0.1194296***	0.1100671***	0.1313324***
	(0.0005491)	(0.0006716)	(0.0007858)	(0.0006570)
WTO joint membership	0.0655853***	-0.0499726***	0.0077318***	0.0199088***
	(0.0153341)	(0.0060317)	(0.0022785)	(0.0020181)
RTA depth	0.0011606***	-0.0020285***	-0.0014306***	-0.0011452***
	(0.0003698)	(0.0003703)	(0.0002092)	(0.0002183)
Sanction: trade	-0.0073065**	0.0167016***	-0.0019361	-0.0010291
	(0.0029446)	(0.0024009)	(0.0014175)	(0.0012302)
Sanction: financial	-0.0082095***	0.0012396	-0.0023588**	-0.0016870*
	(0.0017064)	(0.0018501)	(0.0010805)	(0.0009296)
Sanction: travel	-0.0041031	-0.0140624***	-0.0006584	-0.0032223**
	(0.0025359)	(0.0023488)	(0.0012954)	(0.0012832)
Lag services export	-0.0028673***	0.0023167**	0.0008564	0.0139177***
	(0.0006924)	(0.0011422)	(0.0007413)	(0.0008961)
Lag trade	-0.0115615***	-0.0060664***	-0.0002102	-0.0002977
	(0.0016131)	(0.0015300)	(0.0006039)	(0.0005437)
Lag ODA outflow	–	-0.0030781***	-0.0001253	0.0015931**
		(0.0010209)	(0.0007921)	(0.0006565)
Lag FDI outstock	0.0024410***	–	0.0021322***	-0.0003252
	(0.0008135)		(0.0005116)	(0.0004650)
Lag CPIS debt	0.0079794***	0.0005768	–	0.0034660***
	(0.0014901)	(0.0013947)		(0.0005245)
Lag CPIS equity	0.0073691***	0.0079222***	0.0008698	–
	(0.0014927)	(0.0014654)	(0.0005745)	
Observations (estimation sample)	27,565	36,966	18,899	15,939
Fixed effects	source×t, dest×t, pair	source×t, dest×t, pair	source×t, dest×t, pair	source×t, dest×t, pair

Notes: Entries are bias-corrected average partial effects (APEs) from FE–logit models. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 15: Extensive Margin (LIC): Bias-Corrected FE–logit Average Partial Effects, No Persistence and No Other Flows

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
WTO joint membership	0.0736786***	-0.0446458***	0.0242214***	0.0420991***
	(0.0124197)	(0.0062240)	(0.0026346)	(0.0023681)
RTA depth	0.0020793***	-0.0028082***	-0.0029533***	-0.0018294***
	(0.0004054)	(0.0004252)	(0.0002257)	(0.0002559)
Sanction: trade	-0.0073545**	0.0302316***	-0.0007465	-0.0153626***
	(0.0029380)	(0.0027270)	(0.0015427)	(0.0013877)
Sanction: financial	-0.0095275***	-0.0026219	-0.0060005***	-0.0070475***
	(0.0017442)	(0.0020328)	(0.0011534)	(0.0009686)
Sanction: travel	-0.0094410***	-0.0245237***	-0.0009292	0.0102115***
	(0.0027031)	(0.0026065)	(0.0014014)	(0.0015028)
Observations (estimation sample)	29,204	37,387	19,482	16,730
Fixed effects	source×t, dest×t, pair	source×t, dest×t, pair	source×t, dest×t, pair	source×t, dest×t, pair

Notes: Entries are bias-corrected average partial effects (APEs) from FE–logit models. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

debt (0.65, s.e. 0.33) and marginally positive for FPI equity (0.51, s.e. 0.28), suggesting that shared borders primarily facilitate portfolio flows. Cultural and institutional affinities also differ: common legal origin and language significantly increase the probability of FDI and ODA flows (coefficients around 0.3–0.5) but have smaller or insignificant effects on portfolio flows. Linguistic and religious distances are strongly negative for equity and debt flows (e.g., coefficient on ln(lingdist) is -1.65 with s.e. 0.28 for equity), highlighting the importance of information transmission and cultural proximity for portfolio investors (see., e.g., Grinblatt and Keloharju, 2001).

Policy-oriented covariates exhibit nuanced patterns. In Spec. 1, regional trade agreement (RTA) depth is positively associated with FDI (coefficient 0.028, s.e. 0.0116, APE 0.0014) but has no significant effect on aid or portfolio flows. However, after controlling for pair fixed effects (Spec. 2) the RTA-depth coefficient for FDI turns negative (-0.043, s.e. 0.0279) and the APE becomes significantly negative (-0.00219, s.e. 0.00032). This reversal suggests that deeper agreements are signed by pairs that already have stronger FDI relationships (captured by time-invariant pair heterogeneity), whereas within a given pair, moving to a deeper RTA may lower the probability of new FDI links—perhaps because tariff-jumping becomes less necessary or because deepening coincides with renegotiation episodes. Similarly, trade sanctions have a positive structural coefficient for FDI (0.318, s.e. 0.142) but are negative for FPI debt (-0.494, s.e. 0.272) and insignificant for aid and equity; this pattern suggests that firms may substitute cross-border investment for direct trade when goods trade is sanctioned, whereas portfolio investors are deterred by sanctions. Travel sanctions reduce FDI significantly in Spec. 2 (coefficient -0.387, s.e. 0.204), in line with the idea that restrictions on personnel movement hamper multinationals investment.

Services exports and goods trade proxies also differ by flow. Lagged services exports raise the probability of ODA and equity flows (coefficients 0.20 and 0.35, respectively) but reduce the likelihood of debt flows (-0.20). Lagged goods trade reduces ODA flows (-0.31) and, after controlling for fixed effects, reduces FDI flows (-0.18) while having little effect on portfolio flows. These results highlight that real and financial linkages are not uniformly complementary; trade can substitute for investment at the extensive margin when a firm opts to export rather than invest.

4.7.2 Dynamics, Feedback, and Cross-Flow Complementarities

Including lagged indicators in Spec. (1) and (2) provides insight into extensive margin dynamics. We find strong evidence of persistence (state dependence) especially for FDI and ODA: θ^{ODA} is large and significant, indicating that once a donor gives aid to a particular LIC, the relationship often persists (perhaps due to fixed costs of establishing aid programs or political ties). FDI also shows positive state dependence, consistent with investors building on prior projects or an established business presence (e.g., ODA: $\hat{\theta}_{\text{ODA}} \approx 1.91$ in Spec. 1 and ≈ 1.22 in Spec. 2; FDI: $\hat{\theta}_{\text{FDI}} \approx 3.03$ in Spec. 1 and ≈ 1.55 in Spec. 2). In contrast, lagged portfolio flow indicators are smaller when controlling for fixed effects—an equity or bond inflow last year is a weaker predictor of continuation, after accounting for other factors and conditions. This result is in line with Broner et al. (2013) who document that surges in capital inflows tend to reverse quickly and are highly sensitive to global cycles.

Translating to the probability scale using the cloglog mapping, the APEs indicate substantial persistence, albeit not always identified correctly. The cloglog estimate exhibits numerical instability under full fixed effects for the FDI case (calling for the logit application). Other financial flows are identified within expected parameter limits. (Table 20). These findings, coupled with the logit evidence, hint about hysteresis in FDI and ODA relationships, consistent with relationship-capital mechanisms in bilateral flows and with entry/continuation selection arguments in extensive-margin gravity (Helpman et al., 2008).

We also uncover cross-flow feedbacks. In Spec. 1, lagged ODA inflows increase the probability of future FDI (coefficient 0.253, s.e. 0.078), suggesting that aid may play a "catalytic" role for private investment. One interpretation is that aid projects (in infrastructure, institutions, etc.) improve the recipient's investment climate or reduce risks, thereby crowding in FDI—a finding consistent with the idea that aid can facilitate growth and attract capital when used effectively. This aligns with the recent development literature (Tian, 2025) emphasizing complementarities between aid and investment (e.g., aid building human capital or infrastructure that FDI later utilizes, see Borensztein et al., 1998). Conversely, we do not find evidence that aid deters FDI at the extensive margin (no crowding-out in the binary sense).

Lagged FDI inflows significantly raise the likelihood of CPIS debt and equity flows (coefficients 0.286 and 0.147, respectively), suggesting that an established FDI presence signals recipient quality and provides information spillovers to portfolio investors. These cross-flow linkages are identified even with pair fixed effects, indicating they are not solely driven by fixed country-pair traits but reflect dynamic interactions. Nonetheless, some cross-flow coefficients attenuate in Spec. (2) versus Spec. (1), meaning part of the raw correlation was due to unobserved pair-specific affinity (e.g., certain country pairs—often ex-colonial ties—have both aid and investment relationships). By soaking up those pair effects, our specification strengthens identification: the remaining significant cross-effects can be interpreted as within-pair, over-time influences (i.e., actual feedback mechanisms).

In Spec. 2 with full fixed effects, the APEs in Table 20 show that an existing equity link increases the probability of ODA in the next period by about 0.0081 ($p \approx 0.68$), while a prior FDI link increases CPIS debt by 0.0048 ($p < 0.001$) and CPIS equity by 0.00137 ($p \approx 0.003$). These modest but significant within-pair complementarities suggest that cross-flow spillovers exist but are small relative to persistence effects. Overall, persistence and feedbacks are important for some flows (ODA, FDI) but not others (portfolio), emphasizing not only differences in attracting different types of finance but also their broader impacts on other inflows and macroeconomic dynamics.

When persistence and cross-flow lags are omitted (Specification 3), policy coefficients in (32) can inherit omitted-variable bias that is mechanically correlated with persistent dyad-level relationships (and with the lag structure of other flows). Our Spec. 3 results illustrate exactly this concern: some policy variables exhibit statistically significant APEs even when their structural coefficients appear weak, because the model is misspecified. For instance, the negative APE of RTA depth on FDI becomes extremely large (-1.078, s.e. 0.00057) in the reduced model, which is implausible given the milder within-pair effects in Spec. 2. Similarly, sanctions effects become spuriously large. These distortions illustrate that dynamic and cross-flow structures are essential to avoid confounding policy impacts with underlying persistence and spillovers.

It is important to estimate extensive margins for LIDCs recipients, but in a dynamic, multi-flow, triple-indexed framework that sharply reduces the scope for spurious policy conclusions. The three specifications lead to conclusions: (a) time-invariant bilateral frictions and affinities matter for whether LIDCs receive each flow at all (Spec. 1), (b) within-dyad variation in policy and integration variables yields the most reliable interpretation under modern gravity controls (Spec. 2), and (c) omitting persistence and cross-flow dynamics can materially distort inference about sanctions, deep integration, and trade-service linkages (Spec. 3).

4.8 Logit vs. Cloglog: Results Comparison

Comparing FE–cloglog and FE–logit under the *Full Covariates* specification (Tables 16 and 10), the two links deliver the same qualitative economic narrative. Persistence is uniformly large and precisely estimated under both links, with logit yielding larger structural coefficients than cloglog for all four flows (ODA: 3.041 vs. 1.907; FDI: 3.993 vs. 3.032; FPI debt: 3.186 vs. 2.483; FPI

Table 16: Extensive Margin (LIC): Bias-Corrected FE–cloglog Structural Estimates, Full Covariates

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
Lagged dependent variable	1.90701***	3.03232***	2.48328***	2.53622***
	(0.04839)	(0.04131)	(0.11047)	(0.09022)
Contiguity	-0.49087	0.00544	0.65191*	0.50699·
	(0.36456)	(0.11849)	(0.32645)	(0.28216)
Common language	0.27659***	0.15119**	0.09405	0.07378
	(0.06061)	(0.05320)	(0.10529)	(0.10343)
Common legal origin	0.51466***	0.31058***	0.02998	0.39270**
	(0.09470)	(0.07205)	(0.14027)	(0.13545)
Colony ever	-0.16591	0.42163*	0.27590	-0.21317
	(0.21322)	(0.16683)	(0.24434)	(0.19374)
log(distance)	-0.59332***	-0.56179***	-0.40235***	-0.32870***
	(0.08356)	(0.04592)	(0.08893)	(0.09705)
log(lingdist)	-0.17496	-0.16571	-0.98860***	-1.64821***
	(0.19721)	(0.12291)	(0.23002)	(0.28220)
log(reldist)	-0.34409***	-0.04664	-0.36321*	-0.35516·
	(0.08782)	(0.05515)	(0.14645)	(0.18158)
log(cultdist)	-0.17955	-1.71342***	-0.41770	-1.08456
	(0.71496)	(0.46857)	(1.04281)	(1.11104)
WTO joint membership	-0.19248	-0.04515	0.27876	0.63178·
	(0.63012)	(0.19690)	(0.41932)	(0.32945)
RTA depth	-0.01500	0.02824*	0.00853	-0.01400
	(0.01463)	(0.01164)	(0.02141)	(0.02075)
Sanction: trade	-0.04942	0.31853*	-0.49447·	-0.09557
	(0.16628)	(0.14186)	(0.27177)	(0.23585)
Sanction: financial	-0.05687	0.10802	-0.14823	0.01079
	(0.14883)	(0.12025)	(0.21531)	(0.20122)
Sanction: travel	0.21839	-0.11140	0.20014	0.05758
	(0.15624)	(0.11583)	(0.25162)	(0.24091)
Lag services export	0.19978**	0.02174	-0.19988·	0.35319**
	(0.06667)	(0.06877)	(0.11356)	(0.12593)
Lag trade	-0.30700*	0.13158	0.07410	-0.02681
	(0.12947)	(0.11821)	(0.12766)	(0.11866)
Lag ODA outflow	–	0.25319**	0.05147	0.03240
		(0.07785)	(0.13476)	(0.13418)
Lag FDI outstock	0.08971	–	0.28579***	0.14748·
	(0.05752)		(0.08267)	(0.08272)
Lag CPIS debt	0.16952	-0.04227	–	0.22959*
	(0.11085)	(0.10080)		(0.10428)
Lag CPIS equity	0.04468	0.09852	0.01545	–
	(0.10299)	(0.08968)	(0.10500)	
Observations (estimation sample)	13,293	36,227	14,842	14,236
Fixed effects	source×t, dest×t	source×t, dest×t	source×t, dest×t	source×t, dest×t

Notes: Entries are bias-corrected structural coefficients from FE–cloglog models. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, · $p < 0.10$.

Table 17: Extensive Margin (LIC): Bias-Corrected FE–cloglog Structural Estimates, Full Fixed Effects

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
Lagged dependent variable	1.22123***	1.55264***	1.51298***	1.72766***
	(0.03313)	(0.03683)	(0.08368)	(0.07847)
WTO joint membership	0.92191	-1.10167*	0.18323	0.66642·
	(1.42102)	(0.51541)	(0.39058)	(0.35167)
RTA depth	0.02449	-0.04306	-0.04398	-0.03439
	(0.03150)	(0.02788)	(0.03815)	(0.04451)
Sanction: trade	-0.08339	0.34388	-0.05727	-0.15294
	(0.22608)	(0.21557)	(0.26369)	(0.25591)
Sanction: financial	-0.06527	0.13232	-0.08270	-0.04275
	(0.13852)	(0.16195)	(0.20173)	(0.19783)
Sanction: travel	-0.21369	-0.38733·	0.04017	0.01587
	(0.19073)	(0.20358)	(0.23491)	(0.25961)
Lag services export	-0.03797	0.05097	0.01235	0.34193*
	(0.06038)	(0.10047)	(0.13827)	(0.16723)
Lag trade	-0.24731·	-0.18177	0.02623	0.05739
	(0.13010)	(0.12731)	(0.10046)	(0.10311)
Lag ODA outflow	–	-0.03256	-0.03729	-0.02947
		(0.09453)	(0.13659)	(0.13396)
Lag FDI outstock	-0.01060	–	0.10638	0.03009
	(0.06435)		(0.08923)	(0.09206)
Lag CPIS debt	0.15233	0.00988	–	0.05801
	(0.12137)	(0.11610)		(0.09706)
Lag CPIS equity	0.16729	0.21581*	0.00045	–
	(0.11848)	(0.10978)	(0.09319)	
Observations (estimation sample)	27,565	36,966	18,899	15,939
Fixed effects	source×t, dest×t, dyad	source×t, dest×t, dyad	source×t, dest×t, dyad	source×t, dest×t, dyad

Notes: As Table 16, but including dyad fixed effects. Time-invariant dyad covariates are omitted by construction. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, · $p < 0.10$.

Table 18: Extensive Margin (LIC): Bias-Corrected FE–cloglog Structural Estimates, No Persistence and No Cross-Flow Lags

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
WTO joint membership	1.54198	0.11653	0.58088	1.30668***
	(1.38222)	(0.47144)	(0.38766)	(0.33719)
RTA depth	0.03535	-0.05179*	-0.06770·	-0.02693
	(0.02985)	(0.02586)	(0.03529)	(0.04021)
Sanction: trade	-0.10393	0.51729**	0.02274	-0.39097·
	(0.20830)	(0.19767)	(0.24067)	(0.23444)
Sanction: financial	-0.10684	0.08166	-0.19562	-0.17128
	(0.12590)	(0.14600)	(0.18800)	(0.17434)
Sanction: travel	-0.29023	-0.52902**	0.09244	0.29264
	(0.17890)	(0.18623)	(0.21799)	(0.23658)
Observations (estimation sample)	29,204	37,387	19,482	16,730
Fixed effects	source×t, dest×t, dyad	source×t, dest×t, dyad	source×t, dest×t, dyad	source×t, dest×t, dyad

Notes: All reported models include source×t, dest×t, and dyad fixed effects. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, · $p < 0.10$.

Table 19: Extensive Margin (LIC): Bias-Corrected Average Partial Effects (APEs), Full Covariates

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
Lagged dependent variable	0.1725931***	0.3506207***	0.1323861***	0.1452685***
	(0.0028686)	(0.0044570)	(0.0043678)	(0.0036813)
Contiguity	-0.0285053·	0.0002712	0.0165382**	0.0112741*
	(0.0154643)	(0.0044261)	(0.0063655)	(0.0047640)
Common language	0.0126708***	0.0075793**	0.0023964	0.0017027
	(0.0017414)	(0.0023055)	(0.0016176)	(0.0015945)
Common legal origin	0.0209716***	0.0153445***	0.0007620	0.0088563***
	(0.0024504)	(0.0034741)	(0.0022034)	(0.0023153)
Colony ever	-0.0084609	0.0203516*	0.0069659	-0.0050005
	(0.0072625)	(0.0080806)	(0.0045755)	(0.0030873)
log(distance)	-0.0282852***	-0.0279988***	-0.0102410***	-0.0075630***
	(0.0029175)	(0.0018521)	(0.0013617)	(0.0013670)
log(lingdist)	-0.0083408	-0.0082588·	-0.0251631***	-0.0379234***
	(0.0068077)	(0.0044490)	(0.0039060)	(0.0040961)
log(reldist)	-0.0164037***	-0.0023245	-0.0092448***	-0.0081717**
	(0.0026152)	(0.0020937)	(0.0022732)	(0.0025842)
log(cultdist)	-0.0085596	-0.0853942***	-0.0106319	-0.0249544
	(0.0222279)	(0.0195349)	(0.0166772)	(0.0165380)
WTO joint membership	-0.0086808	-0.0022395	0.0070981	0.0157887**
	(0.0178212)	(0.0057046)	(0.0063554)	(0.0052814)
RTA depth	-0.0007152·	0.0014074**	0.0002170	-0.0003222
	(0.0004250)	(0.0005371)	(0.0003289)	(0.0003119)
Sanction: trade	-0.0023955	0.0153611*	-0.0129003***	-0.0022181
	(0.0046089)	(0.0067386)	(0.0037884)	(0.0033335)
Sanction: financial	-0.0027498	0.0053421	-0.0037869	0.0002482
	(0.0042026)	(0.0054729)	(0.0030241)	(0.0031025)
Sanction: travel	0.0099498*	-0.0055894	0.0050505	0.0013217
	(0.0046100)	(0.0051291)	(0.0040167)	(0.0037124)
Lag services export	0.0095368***	0.0010832	-0.0049956**	0.0082763***
	(0.0020635)	(0.0031965)	(0.0016828)	(0.0019913)
Lag trade	-0.0157676***	0.0065410	0.0019387	-0.0006099
	(0.0040472)	(0.0054932)	(0.0020456)	(0.0017196)
Lag ODA outflow	–	0.0127876***	0.0013155	0.0007477
		(0.0033970)	(0.0020301)	(0.0017993)
Lag FDI outstock	0.0042442*	–	0.0075253***	0.0034774**
	(0.0016902)		(0.0014044)	(0.0013122)
Lag CPIS debt	0.0077530**	-0.0021091	–	0.0055722***
	(0.0028883)	(0.0047350)		(0.0016874)
Lag CPIS equity	0.0021056	0.0048893	0.0003939	–
	(0.0033450)	(0.0042173)	(0.0016243)	
Observations (estimation sample)	13,293	36,227	14,842	14,236
Fixed effects	source×t, dest×t	source×t, dest×t	source×t, dest×t	source×t, dest×t

Notes: Entries are bias-corrected APEs applied to the bias-corrected FE–cloglog models. Standard errors in parentheses. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, · $p < 0.10$.

Table 20: Extensive Margin (LIC): Bias-Corrected Average Partial Effects (APEs), Full Fixed Effects

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
Lagged dependent variable	0.0816345***	5.7553851***	0.5460280***	0.1352351***
	(0.0005152)	(0.0006079)	(0.0007145)	(0.0006204)
WTO joint membership	0.0469361*	-1.0175016***	0.0084517***	0.0328476***
	(0.0189669)	(0.0055557)	(0.0022986)	(0.0020999)
RTA depth	0.0012017***	-0.0021873***	-0.0019678***	-0.0015568***
	(0.0003460)	(0.0003215)	(0.0002011)	(0.0002064)
Sanction: trade	-0.0041348	0.0157670***	-0.0025807·	-0.0070827***
	(0.0026160)	(0.0023282)	(0.0013620)	(0.0013067)
Sanction: financial	-0.0032168*	0.0064639***	-0.0037364***	-0.0019442*
	(0.0015726)	(0.0017771)	(0.0010068)	(0.0009122)
Sanction: travel	-0.0106139***	-0.0393671***	0.0017901	0.0007176
	(0.0022720)	(0.0023144)	(0.0012038)	(0.0012197)
Lag services export	-0.0018666**	0.0025534*	0.0005529	0.0156849***
	(0.0006456)	(0.0010667)	(0.0007200)	(0.0009812)
Lag trade	-0.0123558***	-0.0106440***	0.0011853*	0.0026517***
	(0.0014277)	(0.0014240)	(0.0005634)	(0.0005091)
Lag ODA outflow	–	-0.0016664·	-0.0016588*	-0.0013332*
		(0.0009507)	(0.0007200)	(0.0006313)
Lag FDI outstock	-0.0005203	–	0.0048187***	0.0013664**
	(0.0007303)		(0.0004846)	(0.0004683)
Lag CPIS debt	0.0073625***	0.0004995	–	0.0026415***
	(0.0013397)	(0.0012967)		(0.0004718)
Lag CPIS equity	0.0080610***	0.0104285***	0.0000200	–
	(0.0012657)	(0.0012805)	(0.0005102)	
Observations (estimation sample)	27,565	36,966	18,899	15,939
Fixed effects	source×t, dest×t, dyad	source×t, dest×t, dyad	source×t, dest×t, dyad	source×t, dest×t, dyad

Notes: As Table 19, but including dyad fixed effects. Time-invariant dyad covariates are omitted by construction. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, · $p < 0.10$.

Table 21: Extensive Margin (LIC): Bias-Corrected Average Partial Effects (APEs), No Persistence and No Cross-Flow Lags

	ODA	**FDI**	**FPI Debt**	**FPI Equity**
WTO joint membership	0.0727005***	0.0068973	0.0328520***	0.0619790***
	(0.0153913)	(0.0061148)	(0.0025620)	(0.0023551)
RTA depth	0.0017561***	-1.0783845***	-0.0031720***	-0.0013126***
	(0.0003828)	(0.0005707)	(0.0002150)	(0.0002365)
Sanction: trade	-0.0052160*	0.0269582***	0.0010650	-0.0189946***
	(0.0025790)	(0.0029338)	(0.0014190)	(0.0012919)
Sanction: financial	-0.0053326***	0.0046871	-0.0093300***	-0.0083321***
	(0.0015631)	(0.0048893)	(0.0010730)	(0.0009348)
Sanction: travel	-0.0145786***	-0.0339622***	0.0043130**	0.0143340***
	(0.0023655)	(0.0051154)	(0.0013270)	(0.0013927)
Observations (estimation sample)	29,204	37,387	19,482	16,730
Fixed effects	source×t, dest×t, dyad	source×t, dest×t, dyad	source×t, dest×t, dyad	source×t, dest×t, dyad

Notes: All reported models include source×t, dest×t, and dyad fixed effects. Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$, · $p < 0.10$.

equity: 3.228 vs. 2.536; all $p < 0.01$). Despite these differences in structural scale, probability-scale persistence is nearly identical for FDI (APE 0.354 logit vs. 0.351 cloglog) and differs modestly for other flows (ODA: 0.154 vs. 0.173; FPI debt: 0.141 vs. 0.132; FPI equity: 0.160 vs. 0.145). This convergence in marginal effects confirms that both links capture similar economic magnitudes despite their distinct functional forms.

Gravity and proximity effects are likewise consistent across specifications. Geographic distance log(distance) is strongly negative and significant in every equation under both links, with larger absolute logit coefficients (e.g., ODA −1.001 vs. −0.593; FDI −0.832 vs. −0.562; both $p < 0.01$) but similar APE magnitudes for FDI (approximately −0.027 in both links) and moderately smaller APEs for portfolio flows in logit (FPI debt −0.0077 vs. −0.0102; FPI equity −0.0044 vs. −0.0076). Linguistic distance exhibits strong negative effects for portfolio flows in both links, with equity flows particularly sensitive (structural: −2.454 logit vs. −1.648 cloglog, both $p < 0.01$; APE: −0.040 vs. −0.038). Religious distance is robustly negative for ODA under both links (structural: −0.640 logit vs. −0.344 cloglog, both $p < 0.01$; APE: −0.0151 vs. −0.0164), underscoring the role of cultural affinity in bilateral aid relationships.

Institutional and historical ties display consistent effects across both link functions. Common language and common legal origin are positive and significant for ODA and FDI under both specifications (e.g., ODA legal origin: 1.041 logit vs. 0.515 cloglog, both $p < 0.01$; APEs around 0.021–0.024). Colonial ties are statistically stronger for FDI in logit (structural 0.921 and APE 0.0339, both $p < 0.01$) than in cloglog (structural 0.422, $p < 0.10$; APE 0.0204, $p < 0.10$), though the economic direction remains unchanged.

Policy variables exhibit the same signs but some link-sensitive significance patterns. For FDI, RTA depth is positive and significant in both links (structural: 0.042 logit and 0.028 cloglog; APEs 0.00137 and 0.00141, all $p < 0.05$), and trade sanctions are positive and significant (structural: 0.584 logit, $p < 0.01$; 0.319 cloglog, $p < 0.10$; APE: 0.0202 logit, $p < 0.01$; 0.0154 cloglog, $p < 0.10$). For FPI debt, trade sanctions are negative and economically meaningful under both links (APE: −0.00929 logit, $p < 0.05$; −0.0129 cloglog, $p < 0.01$).

Cross-flow dynamics are concordant across specifications. Lagged ODA outflow raises FDI entry under both links (structural: 0.349 logit and 0.253 cloglog, both $p < 0.01$; APE: 0.0117 logit and 0.0128 cloglog, both $p < 0.01$), consistent with the catalytic role of aid in facilitating private investment. Lagged FDI outstock raises portfolio entry (FPI debt structural: 0.423 logit and 0.286 cloglog, both $p < 0.01$; APE 0.00786 and 0.00753), and lagged CPIS debt strongly raises equity entry (structural: 0.442 logit vs. 0.230 cloglog, both significant; APE: 0.00801 vs. 0.00557). These cross-flow complementarities are robust to link function choice.

Under *Full Fixed Effects* (Tables 17 and 11), the links agree on qualitative signs for the main state-dependence channel but differ in how much apparent persistence survives the absorption of time-invariant dyad heterogeneity. Structural persistence coefficients fall sharply relative to Full Covariates in both links, consistent with dyad-type heterogeneity having been partly loaded onto the lag under weaker fixed-effects saturation. However, logit retains larger link-scale persistence than cloglog in every flow (ODA: 1.887 vs. 1.221; FDI: 2.384 vs. 1.553; FPI debt: 2.293 vs. 1.513; FPI equity: 2.544 vs. 1.728, all $p < 0.01$). The probability-scale APEs under logit remain well-behaved and economically interpretable (lag APEs ranging 0.079–0.131), implying nontrivial within-dyad state dependence even after controlling for source×time, destination×time, and dyad effects.

Among covariates that remain identified with dyad fixed effects, WTO joint membership turns negative for FDI in both links (cloglog structural −1.102, $p < 0.10$; logit structural −1.601, $p < 0.05$), and travel sanctions reduce FDI entry in both (cloglog −0.387, $p < 0.10$; logit −0.512, $p < 0.10$). Most other policy coefficients become imprecise in structural terms, reflecting limited within-dyad time variation. The one robust positive within-dyad covariate effect is services exports for equity (cloglog 0.342, $p < 0.10$; logit 0.469, $p < 0.10$), with logit also showing a significant negative lagged trade effect for ODA (structural −0.399, $p < 0.10$) that is only marginally significant in cloglog (−0.247, $p < 0.10$).

The comparison of specifications without persistence and cross-flow lags (Tables 18 and 12) further illustrates the importance of dynamic controls. In the dyad-FE logit model, RTA depth is negative and significant for FDI and FPI debt (FDI: −0.090, $p < 0.05$; FPI debt: −0.095, $p < 0.05$), trade sanctions increase FDI entry sharply (0.907, $p < 0.01$), and travel sanctions reduce FDI entry (−0.772, $p < 0.01$), while FPI equity shows a positive WTO effect (1.349, $p < 0.01$) and a negative trade-sanction effect (−0.495, imprecise). The parallel cloglog structural model (Table 18) points in the same direction for the FDI sanction channels (trade: 0.517, $p < 0.05$; travel: −0.529, $p < 0.05$) and for the negative RTA effect on FDI (−0.052, $p < 0.10$), but provides weaker evidence for WTO effects (FDI: 0.117, imprecise; FPI equity: 1.307, $p < 0.01$).

Overall, the two links deliver broadly consistent economic conclusions: strong state dependence and gravity frictions under full covariates, attenuated persistence with policy effects identified mainly from within-dyad variation under full fixed effects, and inflated policy coefficients when dynamics are omitted. Differences in statistical significance tend to concentrate in marginal covariates (colonial ties, WTO membership, certain sanctions) whose identification is inherently fragile once three-way fixed effects and dynamics are imposed. The substantive inference—that persistence, cross-flow feedbacks, and bilateral frictions dominate extensive-margin determination for LIDCs, while policy effects are modest and identified primarily through within-dyad variation—remains robust across both cloglog and logit specifications.

5 Conclusions

We develop and estimate a unified framework for the extensive margin of bilateral financial flows to low-income developing countries. Using a panel of 59 LIDCs and their bilateral relationships with all source countries from 2000 to 2023, we document that more than 85 percent of potential financial linkages remain inactive, yet active relationships exhibit strong persistence. Our analysis yields three sets of findings with implications for theory, empirics, and policy.

First, the extensive margin is governed by distinct forces that vary systematically across flow types. Foreign direct investment exhibits the highest persistence, with an active relationship increasing the probability of continuation by 35 percentage points in cross-sectional specifications and 12 percentage points under within-dyad identification. This hysteresis reflects the sunk costs of establishing physical presence, regulatory compliance, and relationship-specific capital that characterize multinational operations. Official development assistance displays similarly high persistence (15–8 percentage points), driven by institutional inertia, multi-year program commitments, and political ties that transcend annual budget fluctuations. In contrast, portfolio equity and debt flows are episodic, with continuation probabilities of only 13–16 percentage points—consistent with "fickle finance" narratives emphasizing the sensitivity of arm's-length capital to global risk cycles (Broner et al., 2013; Ghosh et al., 2014).

Gravity frictions operate heterogeneously across instruments. Geographic distance reduces entry probabilities for all flows, but the effect is strongest for FDI and ODA (average partial effects of 2.4–2.7 percentage points per log-point of distance) and weaker for portfolio claims (0.4–0.8 percentage points). Linguistic and cultural distance binds particularly tightly for portfolio flows, where investors lack the informational advantages of managerial control: a one-standard-deviation increase in linguistic distance reduces portfolio equity entry by 4.0 percentage points. These patterns confirm that arm's-length finance faces higher information barriers while FDI's control rights partially substitute for cultural proximity.

Second, policy interventions have heterogeneous and sometimes countervailing effects. Trade sanctions increase FDI entry (2.0 percentage points, $p < 0.01$) while deterring portfolio debt (-0.9 percentage points, $p < 0.05$), consistent with tariff-jumping motives: when goods trade is restricted, firms substitute toward local production to maintain market access. Travel sanctions uniformly reduce FDI (-1.4 percentage points, $p < 0.01$; Table 14), underscoring that business mobility remains essential for initiating and sustaining direct investment despite digital communication technologies. Regional trade agreement depth shows a positive cross-sectional association with FDI (0.14 percentage points per unit depth, $p < 0.01$) but attenuates under within-dyad identification (Table 14), suggesting that deeper agreements are signed by pairs with preexisting investment relationships rather than causing new FDI entry. These findings caution against interpreting cross-sectional correlations as causal policy effects and highlight the importance of high-dimensional fixed effects—as emphasized in modern structural gravity (Head and Mayer, 2014; **?**)—for credible inference.

Third, cross-flow complementarities operate primarily through stable bilateral characteristics rather than dynamic spillovers. In specifications without dyad fixed effects, lagged ODA significantly predicts FDI entry (1.2 percentage points, $p < 0.01$), and lagged FDI predicts portfolio entry (0.4–0.8 percentage points). These cross-flow effects align with the theoretical channels: aid improves infrastructure and institutions (reducing bilateral frictions while FDI presence signals destination quality and generates information spillovers for portfolio investors. However, these associations attenuate sharply once dyad fixed effects absorb time-invariant bilateral affinities such as colonial history, strategic partnerships, and institutional compatibility. The attenuation implies that apparent aid-investment complementarities reflect shared dyad-level propensities rather than year-to-year feedback from aid disbursements to private capital mobilization. This finding tempers optimism about using aid strategically to "crowd in" private investment (Rajan and Subramanian, 2008): while aid and FDI often flow to the same country pairs, the co-occurrence reflects slow-moving bilateral characteristics rather than dynamic catalysis.

Our methodological contribution demonstrates that omitting persistence and cross-flow dynamics leads to severely biased policy estimates. In Specification 3, which excludes lagged dependent variables, the RTA depth effect on FDI becomes implausibly large and sanction coefficients are substantially inflated. Dynamic panel models with high-dimensional fixed effects—combining source$\times$time, destination$\times$time, and dyad effects with bias correction following Fernandez-Val (2009) and Hinz et al. (2020)—are essential for credible inference on policy impacts at the extensive margin.

These results carry several policy implications. For LIDCs seeking to expand financial integration, the first-order challenge is establishing relationships with new source countries. Reducing information and coordination costs—through improved institutions, adoption of common legal frameworks, and enhanced financial transparency—can lower the fixed costs that deter entry. Given the strong negative effects of linguistic and cultural distance on portfolio flows, policies facilitating information dissemination could meaningfully expand access to global capital markets. The finding that FDI entry responds positively to trade sanctions while portfolio debt retreats suggests that sanctions reshape the composition of bilateral finance rather than uniformly deterring all capital.

For donors and development practitioners, our finding that aid-FDI complementarities are cross-sectional rather than dynamic suggests that sustainable private capital mobilization requires addressing structural barriers—weak institutions, poor infrastructure, high transaction costs—rather than expecting aid surges to automatically generate follow-on investment. The channels through which aid facilitates private capital (captured by the productivity spillover term) operate at a slow-moving, structural level rather than through year-to-year aid fluctuations. This insight aligns with the broader development literature emphasizing that institutional quality and absorptive capacity are prerequisites for aid effectiveness (Borensztein et al., 1998; Selaya and Sunesen, 2012).

Several limitations suggest directions for future research. Our analysis focuses exclusively on the extensive margin; a complementary study of flow volumes conditional on entry would illuminate the intensive margin determinants and their interaction with entry dynamics.[6] While we document heterogeneity across flow types, we do not explicitly model investor selection into different instruments—a promising avenue for theoretical extension that could build on the portfolio allocation framework in Appendix A.7. Finally, extending the analysis to examine how global shocks (financial crises, pandemics, geopolitical realignments) differentially affect extensive-margin dynamics across flow types would be valuable for understanding resilience and vulnerability in LIDC financial integration.

[6]Though this paper focuses on the extensive margin because, as documented in Section 2.2, more than 85 percent of potential LIDC bilateral relationships are inactive, the intensive margin—flow volumes conditional on entry—merits separate analysis; Appendix A.7 sketches a simple theoretical connection.

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A Theoretical Appendix: Proofs and Extensions

This appendix provides complete proofs of all theoretical results, derives the connection to intensive margin allocation, and documents the numerical properties of the link functions.

A.1 Complete Proof of Proposition 1: Logit Entry Probability

Proof. We derive the logit entry probability from first principles.

Step 1: Entry condition. From equations (11)–(12), entry occurs when:

$$\bar{v}^k_{ni,t} + \xi^k_{ni,t} > \bar{f}^k_{ni,t} \iff \xi^k_{ni,t} > -(\bar{v}^k_{ni,t} - \bar{f}^k_{ni,t}) \equiv -\eta^k_{ni,t}. \tag{A.1}$$

Step 2: Probability calculation. Under Assumption 1, $\xi^k_{ni,t}$ has CDF $F_\xi(x) = \Lambda(x) = (1 + e^{-x})^{-1}$. Therefore:

$$\begin{aligned}
\Pr(D^k_{ni,t} = 1) &= \Pr(\xi^k_{ni,t} > -\eta^k_{ni,t}) \\
&= 1 - F_\xi(-\eta^k_{ni,t}) \\
&= 1 - \Lambda(-\eta^k_{ni,t}) \\
&= 1 - \frac{1}{1 + e^{\eta^k_{ni,t}}}.
\end{aligned} \tag{A.2}$$

Step 3: Simplification. Algebraic manipulation yields:

$$1 - \frac{1}{1 + e^{\eta}} = \frac{1 + e^{\eta} - 1}{1 + e^{\eta}} = \frac{e^{\eta}}{1 + e^{\eta}} = \Lambda(\eta). \tag{A.3}$$

This completes the proof. □

A.2 Proof of Proposition 2: Logit Marginal Effects

Proof. **Step 1: Derivative of logistic CDF.** Let $p = \Lambda(\eta) = e^{\eta}/(1 + e^{\eta})$. Then:

$$\begin{aligned}
\frac{dp}{d\eta} &= \frac{d}{d\eta}\left(\frac{e^{\eta}}{1 + e^{\eta}}\right) \\
&= \frac{e^{\eta}(1 + e^{\eta}) - e^{\eta} \cdot e^{\eta}}{(1 + e^{\eta})^2} \\
&= \frac{e^{\eta}}{(1 + e^{\eta})^2} \\
&= \frac{e^{\eta}}{1 + e^{\eta}} \cdot \frac{1}{1 + e^{\eta}} \\
&= \Lambda(\eta) \cdot (1 - \Lambda(\eta)) = p(1 - p).
\end{aligned} \tag{A.6}$$

Step 2: Chain rule. Since $\eta^k_{ni,t} = \ldots + \beta_j x_j + \ldots$:

$$\frac{\partial \Pr(D^k_{ni,t} = 1)}{\partial x_j} = \frac{\partial \Lambda}{\partial \eta} \cdot \frac{\partial \eta}{\partial x_j} = \Lambda(\eta)(1 - \Lambda(\eta)) \cdot \beta_j. \tag{A.7}$$

Step 3: Maximum marginal effect. The function $g(p) = p(1 - p)$ is maximized at $p = 0.5$, where $g(0.5) = 0.25$. Thus:

$$\max_{\eta} \left|\frac{\partial \Lambda}{\partial \eta}\right| = 0.25. \tag{A.8}$$

For a coefficient β_j, the maximum marginal effect is $0.25 \cdot |\beta_j|$. □

A.3 Complete Proof of Proposition 3: Cloglog Entry Probability

Proof. Under Assumption 2, $\xi^k_{ni,t}$ has CDF $F_\xi(x) = \exp(-\exp(-x))$.

Step 1: Reflection property. Note that the Gumbel distribution is not symmetric. If $X \sim \text{Gumbel}(\mu, \beta)$ with CDF $F(x) = \exp(-\exp(-(x-\mu)/\beta))$, then $-X$ follows a "reflected Gumbel" distribution.

For the standard Gumbel ($\mu = 0$, $\beta = 1$):

$$\Pr(X > -\eta) = 1 - \Pr(X \leq -\eta) = 1 - \exp(-\exp(-(-\eta))) = 1 - \exp(-\exp(\eta)). \tag{A.4}$$

Step 2: Entry probability. Directly applying the CDF:

$$\begin{aligned}
\Pr(D^k_{ni,t} = 1) &= \Pr(\xi^k_{ni,t} > -\eta^k_{ni,t}) \\
&= 1 - F_\xi(-\eta^k_{ni,t}) \\
&= 1 - \exp(-\exp(-(-\eta^k_{ni,t}))) \\
&= 1 - \exp(-\exp(\eta^k_{ni,t})).
\end{aligned} \tag{A.5}$$

This is the complementary log-log function. □

A.4 Proof of Proposition 4: Cloglog Marginal Effects

Proof. **Step 1: Derivative of cloglog CDF.** Let $G(\eta) = 1 - \exp(-\exp(\eta))$. Then:

$$\begin{aligned}
\frac{dG}{d\eta} &= \frac{d}{d\eta}\left[1 - \exp(-\exp(\eta))\right] \\
&= -\exp(-\exp(\eta)) \cdot \frac{d}{d\eta}(-\exp(\eta)) \\
&= \exp(-\exp(\eta)) \cdot \exp(\eta) \\
&= \exp(\eta - \exp(\eta)).
\end{aligned} \tag{A.9}$$

Step 2: Location of maximum. To find the maximum of $h(\eta) = \exp(\eta - \exp(\eta))$, take the log and differentiate:

$$\ln h(\eta) = \eta - \exp(\eta) \implies \frac{d \ln h}{d\eta} = 1 - \exp(\eta). \tag{A.10}$$

Setting this to zero: $\exp(\eta^*) = 1 \implies \eta^* = 0$.

At $\eta^* = 0$: $G(0) = 1 - e^{-1} \approx 0.632$ and $dG/d\eta|_{\eta=0} = e^{0-1} = 1/e \approx 0.368$.

Step 3: Asymmetric behavior. As $\eta \to -\infty$: $\exp(\eta) \to 0$, so $dG/d\eta \to \exp(\eta) \to 0$ (slowly).

As $\eta \to +\infty$: $\exp(\eta) \to \infty$, so $\exp(-\exp(\eta)) \to 0$ (doubly exponentially fast), and thus $dG/d\eta \to 0$ (very fast).

This asymmetry is a key distinction from the logit link. □

A.5 Proof of Proposition 5: Dynamic Entry Probability

Proof. Under Assumption 3, the entry index is:

$$\eta^k_{ni,t} = \mu^k_{ni,t} + \theta^k D^k_{ni,t-1} + \lambda^k \ln(1 + F^k_{ni,t-1}). \tag{A.11}$$

Step 1: Conditional probabilities. For a dyad with $D^k_{ni,t-1} = 1$ versus $D^k_{ni,t-1} = 0$ (holding other variables fixed):

$$\Pr(D^k_{ni,t} = 1 \mid D^k_{ni,t-1} = 1) = \Lambda(\mu^k_{ni,t} + \theta^k + \lambda^k \ln(1 + F^k_{ni,t-1})), \tag{A.12}$$

$$\Pr(D^k_{ni,t} = 1 \mid D^k_{ni,t-1} = 0) = \Lambda(\mu^k_{ni,t} + 0 + 0) = \Lambda(\mu^k_{ni,t}). \tag{A.13}$$

Note that if $D^k_{ni,t-1} = 0$, then $F^k_{ni,t-1} = 0$ (no flow implies no position), so the λ^k term vanishes.
Step 2: Comparison. Since $\theta^k > 0$, $\lambda^k \geq 0$, and $F^k_{ni,t-1} \geq 0$:

$$\mu^k_{ni,t} + \theta^k + \lambda^k \ln(1 + F^k_{ni,t-1}) > \mu^k_{ni,t}. \tag{A.14}$$

Since $\Lambda(\cdot)$ is strictly increasing:

$$\Lambda(\mu^k_{ni,t} + \theta^k + \lambda^k \ln(1 + F^k_{ni,t-1})) > \Lambda(\mu^k_{ni,t}). \tag{A.15}$$

This establishes positive state dependence. □

A.6 Proof of Proposition 6: Cross-Flow Effects

Proof. Under Assumption 4:

$$\eta^k_{ni,t} = \mu^k_{ni,t} + \theta^k D^k_{ni,t-1} + \sum_{\ell \neq k} \phi^{k\ell} D^\ell_{ni,t-1}. \tag{A.16}$$

Step 1: Discrete change. The effect of switching from $D^\ell_{ni,t-1} = 0$ to $D^\ell_{ni,t-1} = 1$ on the entry probability for type k is:

$$\begin{aligned} \Delta_{k\ell} &= \Pr(D^k_{ni,t} = 1 \mid D^\ell_{ni,t-1} = 1) - \Pr(D^k_{ni,t} = 1 \mid D^\ell_{ni,t-1} = 0) \\ &= \Lambda(\eta + \phi^{k\ell}) - \Lambda(\eta), \end{aligned} \tag{A.17}$$

where η denotes the index value with $D^\ell_{ni,t-1} = 0$.
Step 2: Sign of effect. If $\phi^{k\ell} > 0$: $\eta + \phi^{k\ell} > \eta \implies \Lambda(\eta + \phi^{k\ell}) > \Lambda(\eta) \implies \Delta_{k\ell} > 0$ (complements).
If $\phi^{k\ell} < 0$: $\eta + \phi^{k\ell} < \eta \implies \Lambda(\eta + \phi^{k\ell}) < \Lambda(\eta) \implies \Delta_{k\ell} < 0$ (substitutes).
Step 3: Marginal effect approximation. For infinitesimal changes, the marginal effect is:

$$\frac{\partial \Pr(D^k_{ni,t} = 1)}{\partial D^\ell_{ni,t-1}} \approx \phi^{k\ell} \cdot \Lambda(\eta)(1 - \Lambda(\eta)). \tag{A.18}$$

This is exact in the limit and provides a first-order approximation. □

A.7 Connection to Intensive Margin

Conditional on entry ($D^k_{ni,t} = 1$), the investor allocates funds across destinations. Following the discrete choice approach, the optimal portfolio share is:

Proposition 8 (Intensive Margin Allocation)**.** *Conditional on entry, the share of type-k wealth allocated to destination i by source n is:*

$$s^k_{ni,t} = \frac{D^k_{ni,t} \exp(\psi^k [\ln R^k_{it} - \ln \kappa^k_{ni,t}])}{\sum_{j \in \mathcal{N}} D^k_{nj,t} \exp(\psi^k [\ln R^k_{jt} - \ln \kappa^k_{nj,t}])}, \tag{A.19}$$

where $\psi^k > 0$ is the information elasticity for asset type k, which varies across flow types reflecting differences in information intensity (see Table 8).

Proof. This follows from the multinomial logit model applied to portfolio choice among entered destinations. The derivation parallels standard discrete choice theory; see McFadden (1974). □

The bilateral flow is then:

$$F^k_{ni,t} = s^k_{ni,t} \cdot W^k_{nt}, \tag{A.20}$$

where W^k_{nt} is total wealth allocated to asset type k.

The unconditional expected flow combines both margins:

$$\mathbb{E}[F^k_{ni,t}] = \Pr(D^k_{ni,t} = 1) \cdot \mathbb{E}[F^k_{ni,t} \mid D^k_{ni,t} = 1]. \tag{A.21}$$

A.8 Derivation of Return Structures

This section derives the return equations presented in Section 3.2.

A.8.1 FDI Return (Equation 5)

Consider a firm in destination i with production function:

$$Y_{it} = Z_{it} K^{\alpha}_{it} L^{1-\alpha}_{it}, \tag{A.22}$$

where Z_{it} is TFP (evolving according to equation (4)) and K_{it} is the aggregate capital stock from equation (3).

The marginal product of FDI capital from source n is:

$$\begin{aligned}\frac{\partial Y_{it}}{\partial K^{\text{FDI}}_{ni,t}} &= \alpha Z_{it} K^{\alpha-1}_{it} L^{1-\alpha}_{it} \cdot \frac{\partial K_{it}}{\partial K^{\text{FDI}}_{ni,t}} \\ &= \alpha \frac{Y_{it}}{K_{it}} \cdot \theta^{\frac{1}{\nu}}_{ni} \left(\frac{K^{\text{FDI}}_{ni,t}}{K_{it}}\right)^{-\frac{1}{\nu}}.\end{aligned} \tag{A.23}$$

In competitive markets, the return equals the marginal product times the output price:

$$R^{\text{FDI}}_{it} = P_{it} \cdot \frac{\partial Y_{it}}{\partial K^{\text{FDI}}_{ni,t}} = \alpha \frac{P_{it} Y_{it}}{K_{it}} \left(\frac{K^{\text{FDI}}_{it}}{K_{it}}\right)^{-\frac{1}{\nu}}, \tag{A.24}$$

where we aggregate across sources and use the symmetry assumption $\theta_{ni} = 1$ for expositional clarity.

A.8.2 Portfolio Debt Return (Equation 7)

The sovereign risk premium reflects default risk. Following **?**, the required return compensates for expected losses:

$$R^{\text{PD}}_{it} = \frac{r^*_t}{1 - \pi_{it}}, \tag{A.25}$$

where π_{it} is the default probability.

Assuming $\pi_{it} = \pi_0 \exp(\chi B_{it}/Y_{it} - \omega \cdot \text{IQ}_{it})$ with π_0 small, a first-order approximation yields:

$$R^{\text{PD}}_{it} \approx r^*_t \exp\left(\chi \frac{B_{it}}{Y_{it}} - \omega \cdot \text{IQ}_{it}\right). \tag{A.26}$$

B Estimation

B.1 Numerical Properties of Link Functions

The stability of nonlinear panel estimators depends critically on the behavior of the link function near the boundaries (0 and 1).

B.1.1 Logit: Slow Approach to Limits

For the logit link $\Lambda(\eta) = e^\eta/(1 + e^\eta)$:

$$\Lambda(\eta) \approx e^\eta \quad \text{as } \eta \to -\infty \quad \text{(polynomial in } e^\eta\text{)}, \tag{A.27}$$
$$1 - \Lambda(\eta) \approx e^{-\eta} \quad \text{as } \eta \to +\infty \quad \text{(polynomial in } e^{-\eta}\text{)}. \tag{A.28}$$

Both limits are approached at the same rate, providing symmetric numerical stability.

B.1.2 Cloglog: Asymmetric Approach

For the cloglog link $G(\eta) = 1 - \exp(-\exp(\eta))$:

$$G(\eta) \approx \exp(\eta) \quad \text{as } \eta \to -\infty \quad \text{(slow approach to 0)}, \tag{A.29}$$
$$1 - G(\eta) = \exp(-\exp(\eta)) \quad \text{as } \eta \to +\infty \quad \text{(doubly exponential to 0)}. \tag{A.30}$$

The approach to 1 is *doubly exponential*, causing:

1. Machine underflow: $\exp(-\exp(\eta))$ underflows for $\eta > 5$ in double precision.
2. Gradient instability: Near $\Pr = 1$, small changes in η produce negligible changes in Pr, but very large changes in the log-likelihood gradient.
3. Bias correction failure: The analytical bias corrections of Fernández-Val and Weidner (2016) assume bounded fixed effects; near-perfect prediction violates this.

B.1.3 Implications for Flow-Specific Estimation

Based on the economic characteristics in Table 8:

- **FDI**: High persistence leads to many dyads with constant outcomes. Cloglog with dyad FE is numerically unstable; use logit.
- **ODA**: High persistence but more variation due to policy changes. Both links stable in Specification 1.
- **Portfolio**: Lower persistence but high sparsity. Cloglog may be appropriate for very rare events but requires careful monitoring of convergence.

B.2 Bias Correction for Fixed Effects Estimators

Nonlinear panel models with fixed effects suffer from the incidental parameter problem: fixed effects are estimated with error of order $O(1/T)$, which contaminates the structural parameter estimates.

Proposition 9 (Asymptotic Bias)**.** *In a logit model with two-way fixed effects (α_n and γ_i), the MLE estimator $\hat{\beta}$ satisfies:*

$$\hat{\beta} = \beta_0 + \frac{B_1}{N} + \frac{B_2}{T} + O_p(N^{-1}T^{-1}), \tag{A.31}$$

where B_1 and B_2 are bias terms that depend on the score and Hessian of the log-likelihood.

The bias-corrected estimator of Fernández-Val and Weidner (2016) is:

$$\hat{\beta}^{BC} = \hat{\beta}^{MLE} - \frac{\hat{B}_1}{N} - \frac{\hat{B}_2}{T}, \tag{A.32}$$

where $\hat{B}_1$ and $\hat{B}_2$ are plug-in estimates of the bias terms.

For three-way fixed effects (source×time, destination×time, dyad), the correction of **?** extends this framework to network data.

B.3 Average Partial Effects: Computation and Inference

As we use a nonlinear link, we interpret coefficients in terms of marginal effects on the predicted probability of a positive flow. For a given covariate x, the average partial effect (APE) is $\frac{1}{N}\sum_{ni,t} \frac{\partial \Pr(D^k_{ni,t}=1)}{\partial x}$. For example, consider a policy dummy $Z_{ni,t-1}$ such as a bilateral investment treaty (BIT) indicator. Suppose the BIT coefficient in the FDI model is $\beta^{FDI}_{\text{BIT}} = 0.3$. At an average baseline $\Pr(D^{FDI}_{ni,t} = 1)$ of say 10% (for a typical donor–LIDC pair), this implies that having a BIT in place increases the probability of any FDI flow to roughly 13% (i.e. by about 3 percentage points). In effect, a BIT yields an average 30% increase in the odds of a positive FDI inflow (from 0.10 to 0.13). If, for example, the coefficient were larger (e.g. 0.5), the probability jump would be even more pronounced (from 10% to 16%, a 6 percentage-point increase). This illustrates how policy variables can have economically meaningful impacts on the extensive margin: even a few percentage-point increase in the likelihood of an FDI relationship forming is material for low-income countries seeking new investment.

Likewise, a one-standard-deviation increase in a continuous variable (say, the source country's interest rate differential or the recipient's institutional quality) can be translated into an increased probability of a flow using the estimated β^k and the sample baseline risk. We report such effects as average probability changes for ease of interpretation. The key takeaway is that in Spec (1), coefficients on policy-relevant variables (e.g. BITs, trade openness, etc.) directly indicate how those factors tilt the chances of initiating a financial flow relationship.

B.3.1 Point Estimation

The APE for coefficient β_j is computed as:

$$\widehat{\text{APE}}_j = \frac{1}{N_k} \sum_{(n,i,t)\in\mathcal{S}_k} \hat{g}(\hat{\eta}^k_{ni,t}) \cdot \hat{\beta}^{BC}_j, \tag{A.33}$$

where $\hat{g}(\eta) = d\hat{G}/d\eta$ is the estimated density of the link function and $\hat{\beta}^{BC}_j$ is the bias-corrected coefficient.

For binary covariates:

$$\widehat{\text{APE}}_D = \frac{1}{N_k} \sum_{(n,i,t)\in\mathcal{S}_k} \left[\hat{G}(\hat{\eta}^{D=1}_{ni,t}) - \hat{G}(\hat{\eta}^{D=0}_{ni,t})\right], \tag{A.34}$$

where $\hat{\eta}^{D=1}_{ni,t}$ and $\hat{\eta}^{D=0}_{ni,t}$ are the predicted indices with the covariate set to 1 and 0, respectively.

B.3.2 Standard Errors

Standard errors for APEs are computed via the delta method:

$$\widehat{\text{Var}}(\widehat{\text{APE}}_j) = \nabla_\beta \widehat{\text{APE}}_j' \cdot \hat{V}_\beta \cdot \nabla_\beta \widehat{\text{APE}}_j, \tag{A.35}$$

where $\hat{V}_\beta$ is the estimated variance-covariance matrix of $\hat{\beta}^{BC}$ and $\nabla_\beta \widehat{\text{APE}}_j$ is the gradient of the APE with respect to the coefficient vector.

B.3.3 Bounds on APEs

By construction, APEs for binary outcomes must satisfy:

$$-1 \leq \text{APE} \leq 1. \tag{A.36}$$

APE estimates violating this bound indicate numerical failure, typically caused by near-perfect prediction (separation) for some units, bias correction instability under high-dimensional fixed effects, or cloglog's doubly-exponential tail behavior.

When APE estimates exceed unity, the specification should be flagged as unreliable and alternative specifications (e.g., logit instead of cloglog, or fewer fixed effects) should be preferred.

B.4 Empirical Considerations

B.4.1 Estimation and Bias-Corrected Average Partial Effects

We estimate (30)–(32) using fixed-effects maximum likelihood for nonlinear binary response models (logit and complementary log-log) with high-dimensional network fixed effects. Computation is implemented with the `alpaca` package, which concentrates out k-way fixed effects during likelihood maximization.

Fixed-effects estimators of nonlinear panel models are subject to the incidental-parameter problem. Accordingly, our baseline economic quantities are *bias-corrected average partial effects* (APEs) computed using `alpaca`'s post-estimation routine `biasCorr()`, which implements analytical bias corrections for nonlinear panel models with large N and moderate T (Fernández-Val and Weidner, 2016; Hinz et al., 2020). Given the dynamic terms in (30)–(32), we allow regressors to be predetermined and set the bandwidth parameter to $L = 4$. We specify the network panel structure in the correction (`panel.structure = "network"`) to accommodate source×time, destination×time, and dyad fixed effects.

B.5 Link Function Selection and Robustness

B.5.1 Primitive Assumptions and Link Functions

The extensive margin model takes the general form:

$$\Pr(D^k_{ni,t} = 1 \mid \eta^k_{ni,t}) = G(\eta^k_{ni,t}), \tag{35}$$

where $G : \mathbb{R} \to [0, 1]$ is a cumulative distribution function (CDF). The choice of G reflects assumptions about the distribution of unobserved heterogeneity $\xi^k_{ni,t}$.

Table 22: Link Functions, Primitive Assumptions, and Properties

Link	CDF Formula	Primitive Assumption	Key Property
Logit	$\frac{e^{\eta}}{1+e^{\eta}}$	Logistic ξ	Symmetric in η
Probit	$\Phi(\eta)$	Gaussian ξ	Symmetric, thin tails
Cloglog	$1-e^{-e^{\eta}}$	Gumbel ξ	Asymmetric (fast $\to 1$)

B.5.2 Theoretical Justification for Each Link

Logit arises when ξ follows a logistic distribution. This is appropriate when unobserved heterogeneity aggregates from many independent binary signals, there is no a priori asymmetry between high- and low-probability states, and maximum entropy (minimal prior information) is desired.

Cloglog arises when ξ follows a Type-I extreme value (Gumbel) distribution. This is theoretically justified when the outcome represents a "first event" in grouped continuous-time data (discrete-time hazard model), selection is from among the maximum of multiple latent options (extreme value theory), or events are rare ($\Pr \ll 0.5$) with occasional sharp transitions to high probability.

For bilateral financial flows, the cloglog link has some appeal for *aid relationships* viewed through a survival lens (aid "survives" year-to-year with occasional termination). However, for FDI and portfolio flows, there is no clear theoretical justification for asymmetric tail behavior.

Notes on economic significance under cloglog. For a continuous regressor x_k, the marginal effect at (n,i,t) is

$$\frac{\partial}{\partial x_k}\Pr(y^f_{nit}=1 \mid \eta^f_{nit}) = \beta_{f,k}\,\exp(\eta^f_{nit})\exp\Big(-\exp(\eta^f_{nit})\Big),$$

so the same $\beta_{f,k}$ can imply very different probability changes depending on baseline risk (encoded in η^f_{nit} through fixed effects). For binary regressors (including your lagged trade/services dummies), the APE is the sample average of $G(\eta^f_{nit} \mid x_k = 1) - G(\eta^f_{nit} \mid x_k = 0)$, which is the appropriate object for discussing policy-relevant changes in the extensive margin (Stammann et al., 2025).

B.5.3 Numerical Properties under High-Dimensional Fixed Effects

With source×time, destination×time, and dyad fixed effects, our models include $O(N^2 + 2NT)$ parameters for N countries and T years. This creates two numerical challenges:

Separation: When a dyad has all ones or all zeros in the dependent variable, the dyad fixed effect diverges to $\pm\infty$. The proportion of such dyads varies by flow type: FDI exhibits approximately 45% of dyads with constant outcomes (high separation); ODA shows approximately 30% of dyads with constant outcomes (moderate separation); portfolio flows have approximately 60% of dyads with constant outcomes (very high separation).

Tail behavior near separation: For dyads approaching separation, the predicted probability approaches 0 or 1. The behavior of the link function near these boundaries matters:

$$\text{Logit:}\quad 1-\Lambda(\eta) \approx e^{-\eta} \quad \text{as } \eta \to \infty$$
$$\text{Cloglog:}\quad 1-G(\eta) = e^{-e^{\eta}} \quad \text{as } \eta \to \infty$$

The cloglog approaches 1 *doubly exponentially*, causing machine underflow in computing $e^{-e^{\eta}}$ for $\eta > 5$, unstable gradients in the optimization algorithm, and bias correction overcorrection when the Hessian is nearly singular.

B.6 Empirical Evidence of Instability

Table 23 compares APE estimates across link functions. Under Specification 1 (no dyad FE), all links produce qualitatively similar, economically plausible results. Under Specification 2 (with dyad FE), the cloglog estimates for FDI become implausible:

Table 23: APE for Lagged Dependent Variable by Link Function

	Spec. 1 (No Dyad FE)		Spec. 2 (With Dyad FE)	
Flow	Logit	Cloglog	Logit	Cloglog
ODA	0.154	0.173	0.079	0.082
FDI	0.354	0.351	0.119	**5.755**†
Portfolio Equity	0.160	0.145	0.131	0.135
Portfolio Debt	0.141	0.132	0.110	0.546

† APE > 1 is impossible for a probability change; indicates numerical failure.

The FDI cloglog APE of 5.755 under dyad FE is impossible by construction (maximum probability change is 1). This reflects the numerical instabilities discussed above, confirming that cloglog is inappropriate for highly persistent flows estimated with dyad fixed effects.

B.6.1 Robustness Conclusions

Based on theoretical and numerical considerations:

1. **Logit is our preferred specification** for all flow types due to numerical stability and symmetric treatment of entry/exit dynamics.

2. **Cloglog results are reported for Specification 1 only** (no dyad FE) as a robustness check.

3. **Cloglog with dyad FE is unreliable for FDI** and should not be used for inference.

4. **Qualitative conclusions are robust** across link functions in stable specifications.

C Data Construction

This appendix documents the key variables used in the gravity-panel analysis, their definitions, sources, and units. The dataset combines country-year, dyad-year, and gravity-style bilateral information for the period 2001–present, harmonizing macroeconomic fundamentals, geography, institutional arrangements, and policy variables relevant for bilateral financial flows to low-income developing countries (LIDCs). Observations are indexed by ordered country pairs (origin–destination) and year.

C.1 Bilateral Financial and Trade Flow Data

The bilateral flow dataset combines information from multiple IMF and United Nations sources to provide a comprehensive view of cross-border financial and trade linkages between economies. The dataset covers the period 2001–2023 and includes the following components:

- **Official Development Assistance (ODA)**: Bilateral and multilateral aid flows sourced primarily from OECD and IMF reporting frameworks.
- **Foreign Direct Investment (FDI)**: Inward and outward investment positions drawn from the IMF Coordinated Direct Investment Survey (CDIS), supplemented with UNCTAD data where necessary.
- **Portfolio Investment (CPIS)**: Cross-border holdings of equity and debt securities obtained from the IMF Coordinated Portfolio Investment Survey (CPIS).
- **Trade in Goods**: Bilateral exports (FOB) and imports (CIF) sourced from the IMF Direction of Trade Statistics (DOT) and the International Merchandise Trade Statistics (IMTS).
- **Trade in Services**: Bilateral services flows across major service categories sourced from the IMF Balance of Payments Trade in Services (BiTS) database.

All monetary values are expressed in millions of U.S. dollars at current prices. For FDI and portfolio investment (CPIS), observations represent outstanding end-of-year stock positions, whereas ODA, goods trade, and services trade variables correspond to annual flow measures.

To facilitate consistent gravity-style analysis, the dataset is rectangularized to form a complete acquirer–target–year panel, covering all possible country pairs (dyads) over the sample period. Missing bilateral observations are explicitly coded as zero where appropriate, allowing for a unified treatment of extensive- and intensive-margin dynamics across financial and trade flows.

C.2 Macroeconomic and Financial Fundamentals

Macroeconomic variables are sourced primarily from the World Development Indicators (WDI) and complemented with data from the IMF World Economic Outlook (WEO) and Penn World Tables (PWT) when coverage gaps arise. We also include financial depth variables (e.g., credit share, stock market capitalization, broad money, etc.) in the dataset.

C.3 Geography and Physical Distance

Geographic variables proxy for transport costs, proximity, and long-run bilateral frictions. These variables are largely time-invariant and sourced from the Dynamic Gravity Dataset (DGD).

- **Population-weighted distance:** Great-circle distance between population centers of the country pair (kilometers).
- **Contiguity:** Indicator equal to one if the country pair shares a land border.
- **Landlocked:** Indicator equal to one if a country is landlocked.
- **Island:** Indicator equal to one if a country is classified as an island nation.
- **Geographic region:** Time-invariant regional classification.

C.4 Regional Trade Agreement (RTA) Depth and Institutional Provisions

To capture the institutional depth of regional trade agreements, we rely on the Design of Trade Agreements (DESTA) database. DESTA provides detailed, clause-level information on the substantive content of trade agreements, allowing us to move beyond simple indicators of agreement presence and instead measure the scope and depth of policy commitments embedded in each treaty.

Following the DESTA methodology, we construct an RTA depth index by aggregating a set of binary indicators that capture whether an agreement includes substantive and enforceable provisions in key policy areas. Specifically, the depth index aggregates the following components:

- **Full free trade area (zero tariffs):** Indicator equal to one if the agreement establishes a full free trade area with zero tariffs on substantially all goods.
- **Standards provisions (SPS/TBT):** Indicator equal to one if the agreement includes binding commitments related to sanitary and phytosanitary measures or technical barriers to trade, including harmonization, mutual recognition, or cooperation mechanisms.
- **Investment provisions:** Indicator equal to one if the agreement contains substantive investment-related commitments, such as investment protection, investor–state dispute settlement, or rules governing establishment and treatment of foreign investors.
- **Services liberalization:** Indicator equal to one if the agreement includes enforceable provisions liberalizing trade in services, including market access or national treatment commitments.
- **Public procurement:** Indicator equal to one if the agreement covers government procurement and establishes non-discriminatory access to public purchasing markets.
- **Competition policy:** Indicator equal to one if the agreement includes rules or cooperation mechanisms related to competition policy, antitrust enforcement, or state aid disciplines.
- **Intellectual property rights (IPR):** Indicator equal to one if the agreement contains provisions strengthening intellectual property protection beyond multilateral baselines.

For dyad-years in which multiple trade agreements are simultaneously in force, each component is aggregated by taking the maximum value across agreements. The overall RTA depth index is then defined as one plus the sum of these components, yielding an interpretable discrete scale ranging from 1 (shallow agreements with minimal substantive content) to 8 (deep agreements encompassing all policy areas)

- **WTO membership (unilateral and joint):** Indicators for WTO membership at the country-year and dyad-year level. Source: DGD with manual updates for recent accessions.

C.5 Economic Sanctions

Economic sanctions data are drawn from the Global Sanctions Data Base (GSDB) and capture enforced (not threatened) sanctions. Sanctions are modeled as directed, dyad-year indicators.

- **Arms sanctions:** Restrictions on arms exports or imports.
- **Military sanctions:** Restrictions on military assistance.
- **Trade sanctions:** Import or export restrictions (or both).

- **Financial sanctions:** Financial or asset restrictions, including investment or credit limits.
- **Travel sanctions:** Entry, transit, or movement restrictions.
- **Other sanctions:** Residual categories, including diplomatic or transport restrictions.
- **Sanction index:** Additive measure equal to the sum of the six sanction categories, ranging from 0 to 6, with higher values indicating broader sanction coverage.

C.5.1 Geographic, Historical, and Institutional Gravity Controls

In addition to macroeconomic and policy variables, our gravity specifications include a standard set of bilateral geographic, historical, and institutional controls commonly used in the international trade and finance literature. These variables capture time-invariant frictions and affinities that shape cross-border economic interactions.

- **Geographic distance**: Measured as the population-weighted great-circle distance between the two countries' major cities (log distance). Distance proxies for transportation costs, information frictions, and monitoring costs that are particularly relevant for cross-border financial relationships.
- **Contiguity**: Binary indicator equal to one if the two countries share a land border. Contiguous countries tend to exhibit stronger economic and financial linkages due to lower transaction costs and closer institutional ties.
- **Landlocked**: Binary indicator equal to one if either country in the dyad is landlocked. Landlocked countries face higher trade and investment costs due to limited access to international transport networks.
- **Island**: Binary indicator equal to one if either country in the dyad is an island. Island status captures geographic isolation as well as distinct transport and connectivity patterns.
- **Common language**: Binary indicator equal to one if the two countries share an official language. A common language reduces informational and contractual frictions and facilitates cross-border investment and financial intermediation.
- **Common legal origin**: Binary indicator equal to one if the two countries share the same legal origin. Shared legal systems reflect similar contract enforcement mechanisms, investor protections, and regulatory frameworks, which are particularly relevant for financial flows.
- **Colonial relationship**: Binary indicator equal to one if the two countries have ever shared a colonial relationship. Historical colonial ties often imply persistent institutional, legal, and network connections that shape modern financial linkages.

All geographic and historical variables are time-invariant and enter the regressions either directly or are absorbed by dyad fixed effects in specifications that exploit within-pair variation over time. Their inclusion ensures that estimated effects of policy actions and macroeconomic variables are not confounded by persistent bilateral characteristics.

Table 24: Variable Definitions and Sources

Variable	Definition	Source
$F^{FDI}_{ni,t}$	FDI position from n to i	IMF CDIS
$F^{PE}_{ni,t}$	Portfolio equity investment	IMF CPIS
$F^{PD}_{ni,t}$	Portfolio debt investment	IMF CPIS
$F^{ODA}_{ni,t}$	Official development assistance	OECD DAC
distance_{ni}	Population-weighted distance	CEPII
IQ_{it}	Institutional quality index	WGI
credit_GDP_{it}	Private credit / GDP	World Bank

C.6 Variable Definitions

D Additional Data Facts

D.1 Variables in the Specifications

Based on the structural model and the empirical specifications, we focus on the following covariates:

D.1.1 Geographic, Historical, and Cultural Variables

Geographic frictions are captured by $\ln(\text{distance}_{ni})$, the log bilateral great-circle distance between source i and destination i, which proxies information, screening, and transaction costs. Spatial proximity is additionally measured by contiguity_{ni}, an indicator equal to one if n and i share a land border, reflecting lower monitoring and coordination costs. Historical and institutional affinities are summarized by $\text{common\_language}_{ni}$ (equal to one if a common official or widely spoken language is shared), $\text{common\_legal\_origin}_{ni}$ (equal to one if the pair shares a legal origin), and colony_ever_{ni} (equal to one if a colonial relationship existed at any point), capturing persistent network ties and institutional compatibility. Cultural barriers are measured using $\ln(\text{lingdist}_{ni})$, the log tree-weighted linguistic distance between the pair, $\ln(\text{reldist}_{ni})$, the log religious distance capturing differences in religious composition, and $\ln(\text{cultdist}_{ni})$, the log of a composite cultural distance index intended to proxy broader cultural frictions beyond language and religion.

D.1.2 Trade and Policy Integration

Policy integration is measured by $\text{member\_wto\_joint}_{ni,t-1}$, an indicator equal to one if both countries are WTO members in period $t-1$, and by $\text{rta\_depth}_{ni,t-1}$, a continuous index of the depth of the regional trade agreement (RTA) linking i and j in $t-1$. Real-economy linkages are proxied by $\text{Trade}_{ni,t-1}$, a lagged indicator for the presence of positive bilateral goods trade, and $\text{Services export}_{ni,t-1}$, a lagged indicator for positive bilateral services exports, both intended to capture pre-existing commercial ties and information channels relevant for the formation of financial links.

D.1.3 Sanctions and Bilateral Restrictions

Bilateral restrictions are captured by lagged sanctions indicators in $t-1$: $\text{sanction\_trade}_{ni,t-1}$ equals one when trade-related sanctions are in force between n and i, $\text{sanction\_financial}_{ni,t-1}$ equals one when financial sanctions apply, and $\text{sanction\_travel}_{ni,t-1}$ equals one when travel or mobility restrictions are imposed. These variables proxy policy-induced increases in contractual frictions, settlement risk, and limits on personnel movement that may affect the feasibility of cross-border transactions.

D.1.4 Persistence and Cross-Flow Linkages

Let $D^k_{ni,t} \in \{0, 1\}$ denote an indicator equal to one if there is a positive bilateral flow of type $k \in \{\text{ODA}, \text{FDI}, \text{FPI debt}, \text{FPI equity}\}$ from n to i in year t. Dynamic dependence at the extensive margin is modeled by including the lagged dependent variable $D^k_{ni,t-1}$, which captures persistence in link formation arising from sunk costs, relationship capital, and state dependence. To allow for cross-flow spillovers, we also include lagged indicators for other flow types $D^g_{ni,t-1}$ for $g \neq k$, implemented as $D\_\text{oda\_outflow}_{ni,t-1}$, $D\_\text{fdi\_outstock}_{ni,t-1}$, $D\_\text{cpis\_debt}_{ni,t-1}$, and $D\_\text{cpis\_equity}_{ni,t-1}$, where each dummy equals one if the corresponding bilateral relationship is active in $t-1$. In the ODA equation we include $D\_\text{fdi\_outstock}_{ni,t-1}$, $D\_\text{cpis\_debt}_{ni,t-1}$, and $D\_\text{cpis\_equity}_{ni,t-1}$; in the FDI equation we include $D\_\text{oda\_outflow}_{ni,t-1}$, $D\_\text{cpis\_debt}_{ni,t-1}$, and $D\_\text{cpis\_equity}_{ni,t-1}$; in the FPI debt equation we include $D\_\text{oda\_outflow}_{ni,t-1}$, $D\_\text{fdi\_outstock}_{ni,t-1}$, and $D\_\text{cpis\_equity}_{ni,t-1}$; and in the FPI equity equation we include $D\_\text{oda\_outflow}_{ni,t-1}$, $D\_\text{fdi\_outstock}_{ni,t-1}$, and $D\_\text{cpis\_debt}_{ni,t-1}$.

D.1.5 Fixed Effects and Omitted Blocks

Source-year and destination-year fixed effects (α_{nt} and γ_{it}) absorb all time-varying source- and destination-side macro fundamentals (e.g., GDP, GDP per capita, inflation, reserves, growth, broad institutional indices), so these are not included explicitly. In the "full fixed effects" specifications, dyad fixed effects (δ_{ni}) additionally absorb all time-invariant bilateral covariates (distance, contiguity, language, legal origin, colonial ties, and cultural distance measures) by construction.

D.2 Policy Variables