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By Xin Zhang & Taehyun Kim

North London Collegiate School

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Econometric Determinants of Chinese Developmental Finance in Sub-Saharan Africa; Further Evidence using a Flow-Type Decomposed Poisson Pseudo-Maximum Likelihood Model

Xin Zhang [α] & Taehyun Kim [σ]

Abstract- Chinese "aid" has long engendered criticism. Western pundits and policymakers posit it as a political tool employed by Beijing to as way foreign policy concessions and secure natural resources access for its domestic industries, often at the expense of the recipient country. However, we argue that large amounts of these claims lack empirical scrutiny or have been hindered by enduring conceptual, methodological, and data-centric constraints. This paper thus aims to refine and integrate prevailing methodological practices to produce a more nuanced understanding of Chinese motivations. Using empirical regression analysis and a newly released granular dataset spanning 48 Sub-Saharan African countries from 2000-2021, we: (1) decompose Chinese "aid" into flow types of relative concessionality; (2) utilize a Poisson pseudo-maximum likelihood (PPML) estimator to mitigate log-transformation and heteroskedasticity concerns present within traditional modeling of zero-inflated datasets; (3) retain a subset of contemporary values to deal with issues related to simultaneity in our regressors. Our findings suggest that while developmental goals primarily drive concessional aid, commercial lending is moreso influenced by economic self-interest, which is often incorrectly conflated with "aid" in the traditional sense. Further, Chinese "aid" does not flow disproportionately to corrupt or authoritarian regimes. This challenges the dominant "rogue donor" narrative and contributes to a more comprehensive perspective on China's emerging role in global developmental finance.

Keywords: developmental finance, concessionality, econometrics, zero-inflation, poisson pseudo-maximum likelihood (PPML).

I. Introduction

For Africa, meeting the United Nations (UN) Sustainable Development Goals (SDGs) necessitates excess commitments of 1.6 trillion dollars in capital spending by 2030 (OECD, 2023a). Confronted with a paucity of domestic resources and poor political will, international lending and developmental finance (LDF) vis-a-vis foreign aid and concessional or commercial loans serve as an increasingly critical lifeline to bridge the continent's protracted fiscal gap (Ayuso & Hoffmann, 2019). Historically, Western nations within the Organization for Economic Cooperation and Development's (OECD) Developmental Assistance Committee (DAC) have largely been deemed the de facto providers of such aid programs. However, more contemporary scholarship has shifted the spotlight to 'non-traditional' or 'emerging' donors in the global economic arena, such as Brazil, India, Iran, Qatar, Venezuela, and most notably, the People's Republic of China (PRC).

Indeed, the turn of the millennium marked a profound external policy shift for the PRC. The adoption of the 'Go Out' national policy in 1999 and subsequent implementation of the Belt and Road Initiative (BRI) in 2013 cemented the country as a pivotal economic partner and foreign aid distributor, channeling over 200 billion dollars into Sub-Saharan Africa alone over the past two decades (Custer et al., 2023). The prevailing wisdom of Western policymakers and pundits has long cast Chinese economic statecraft as far more egoistic and self-serving, designed to curate political favors, secure unfair commercial advantages for its domestic entities, and exploit resource-rich developing nations (Naim, 2007). Such is the common argument of the 'rogue donor' narrative. In stark contrast, official Chinese rhetoric on the matter underscores more altruistic intentions, referencing notions of economic interdependence and non-zero-sum 'win-win' outcomes amidst a globalized economy (Liu & Dunford, 2016). Such duality has ignited much popular debate, polarizing opinions into the 'China Threat' and 'China Opportunity' paradigms of thought (Cable & Ferdinand, 1994).

Yet, despite burgeoning political, media, and academic interest (Drezner, 2009; Fordham & Kleinberg, 2011; Flores-Macías & Kreps, 2013; Fuchs & Klann, 2013; Liao & McDowell, 2015; Kastner, 2016; Norris, 2016), quantitative empirical scrutiny of the PRC's underlying motivations remains largely hindered by conceptual, methodological or data-centric constraints. The PRC, along with other non-traditional donors, has withdrawn from the Western-led DAC regime of voluntary reporting norms, complicating attempted efforts to quantify its contributions (Kaplinsky & Morris, 2009). Moreover, systematic challenges remain in the empirical modeling of discontinuous country-level aid commitments with high zero-skewed distribution. The further conflation of concessional-based official developmental assistance (ODA) and commercially-

Author σ: North London Collegiate School Jeju.
e-mail: tk682@cornell.edu

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oriented other official finance (OOF) has led to much ambiguity regarding the motivations driving Chinese economic engagement with the continent, as differing factors likely influence the distribution of each flow type (Dreher et al., 2018).

Thus, using the newest version of AidData's dataset assembled by Custer et al. (2023) and regression analysis, this paper examines recipient country determinants underlying the PRC's allocation of developmental finance in Sub-Saharan Africa, decomposing commitments into flow types of relative concessionality. We then consider how the recipient nation's need, merit, and ability to fulfill the donors' own self-interest influence the various developmental, political, and economic intents of the PRC and its subsequent distribution of capital to individual nations.

Our contribution to the unfolding literature on Chinese aid determinations is novel in two aspects. Firstly, we extend our analysis to include the newest Version 3.0 of the AidData dataset up to the year 2021, providing a more pertinent understanding of evolving concurrent dynamics. Secondly, we refine and integrate prevailing methodological practices within the existing corpus of aid distribution literature. We introduce (1) the utilization of a Poisson pseudo-maximum likelihood (PPML) estimator to mitigate log-transformation and heteroskedasticity concerns present within traditional Ordinary Least Squares (OLS) modeling of zero-inflated datasets; (2) a novel approach to time-lagging regressor to handle issues related to simultaneity.

In what follows, we clarify that different types of developmental finance should advance different objectives on the part of the PRC. We then introduce the data and novel empirical strategy used to test our hypotheses before presenting the results, subsequent explanations, and conclusions. By doing so, we attempt to form a more nuanced and complete picture of Chinese financial assistance in Sub-Saharan Africa.

II. Between Aid and Loans

In the realm of international development finance literature, divergent categorization standards between DAC and non-DAC donors — including the PRC — have historically led to wildly disparate incongruities in scholarly comparison.[1] To harmonize these discrepancies, our analysis follows Dreher et al. (2018) and employs second-hand OECD-DAC criteria to reclassify the PRC's foreign financial activities into official development assistance and other official finance.[2] Within this framework, we use 'foreign aid' and 'developmental finance' interchangeably to denote the entirety of Chinese state assistance while distinguishing between representational 'ODA-like' and commercial 'OOF-like' categorizations when referencing explicitly developmental- or market-motivated commitments.

The OECD defines official developmental assistance as "government aid that promotes and specifically targets the economic development and welfare of developing countries" (OECD, 2023b). As such, ODA is concessional in nature and can encompass both grants and soft loans. Grants are the most substantial of Chinese commitments, underpinning small and medium-sized social welfare projects, technical assistance, material commodities, humanitarian aid, and training programs (Bräutigam, 2011a; Springer et al., 2023). Interest-free loans are geared primarily towards public infrastructure projects — marked by extended maturities and grace periods — while the RMB-denominated concessional loans offer terms more favorable than market rates, often earmarked for substantial medium to large-scale infrastructure projects (Springer et al., 2023). Meanwhile, other official finance is not sufficiently developmental but serves "representational or essentially commercial purposes" (OECD, 2023c). This form of financing, extended at near-market terms, primarily aims to advance the donor country's economic interests rather than the developmental goals of the recipient country. The most significant Chinese OOF-like commitments are commercial loans guided by floating rates benchmarked against the London Inter-Bank Offered Rate (LIBOR), often structured as consortiums and offered to African banks (Springer et al., 2023). Preferential export buyer's credits, though similar to ODA in maturity and grace terms, mainly serve to facilitate the sale of its goods and services to importing countries, while standard export and supplier credits achieve similar purposes without such favorable terms (Hwang et al., 2022; Chen, 2020).

As outlined in its published documents, the extent and direction of ODA-like foreign aid funds are centralized under the aegis of the China International Development Cooperation Agency (CIDCA) and the Ministry of Foreign Affairs (MOFA), while the Chinese Ministry of Commerce (MOFCOM) acts as one of the implementing departments (China International Development Cooperation Agency, 2021). Predominantly, both concessional and commercial loans are issued by developmental finance institutions (DFIs), with the Export-Import Bank of China (CHEXIM) and China Development Bank (CDB) assigned as principal actors in this regard. Other state-owned commercial banks and contractors also have significant roles in this financial landscape, with the China Export and Credit Insurance Corporation (Sinosure) providing insurance for export credits and commercial loans. Supplier credits, meanwhile, are issued by Chinese companies and contractors. However, even such

[1] See 'Supplementary File A' of (Dreher et al., 2018), which contains a table of fifteen different published estimates of the value of developmental finance from China to Africa, ranging from half a million to almost 18 billion dollars annually.

[2] Section 4.1 covers the construction and categorization of the dataset in greater depth. See Custer et al., (2023) and Strange et al., (2015) for more information regarding the granular data collection process.

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ostensibly commercial transactions are earmarked by an unmistakable presence of the central state government, reflecting the intricate interplay of private and governmental motivations in the proverbial Chinese model of 'State-Sponsored Capitalism' (Pelzman, 2014).

III. Determinants of Chinese Developmental Finance

In our analysis, we acknowledge several compounding economic, developmental, and political motivations on the part of the PRC that influence the allocation of developmental finance in Sub-Saharan Africa.[3]

a) Developmental Objectives

Principally, the theoretical rationale of aid allocation is a deficit of domestic capital in the recipient country and the donor's ability to reduce socio-economic inequality (Maizels & Nissanke, 1984; McKinlay & Little, 1977). Despite the African countries's lack of capital, global organizations such as the International Monetary Fund (IMF) do not actively support them due to their poor credit scores and a genuine lack of creditworthiness; the structural issues and price fluctuations remain as major risks, despite the banking system's growth in Sub-Saharan Africa over the past decade, holding many African countries back from achieving a level of creditworthiness from the creditors (Nikolaidou & Vogiazas, 2017; Weisbrot, 2019; Biglaiser & McGauvran, 2022; Daoud et al., 2022). Ultimately, the PRC acts as an international lender of last resort for such countries (Horn et al., 2023). The establishment of the Asian Infrastructure Investment Bank (AIIB) in 2016 further highlights the PRC's developmental intents (Chow, 2016). This marked a shift in economic power from the traditional Western counterparts to China in increasing "South-South" cooperation as African countries continue to lessen their dependence on their former Western colonizers (Freitas, 2023). In addition to considering the inherent developmental 'needs' of the recipients for their aid programs, China would also likely consider its internal political stability, which likely directly affects the success of the programs; for example, the Chinese government reduced its developmental finance allocation to South Sudan following the unrest caused by its Civil War in 2013 (Aulia, 2021). Naturally, the majority of developmental finance in such a context is concessional in nature.

b) Political Objectives

Beyond development, extensive qualitative research substantiates the traditional notion that concessional foreign aid exists as an explicit foreign policy instrument strategically disbursed by Western nations to reinforce alliances, punish geopolitical enemies, sway public sentiment in favor of the donor, and broadly exert soft power influence internationally (Packenham, 1966; McKinlay & Little, 1977; Vreeland & Dreher, 2014). There is little in the way of theoretical opposition that would indicate a different behavior from non-DAC donors, with recent studies indicating that China often leverages concessional aid to garner political support, sway the voting behavior of recipient nations in international forums, and secure diplomatic recognition — often at Taiwan's expense (Dreher & Fuchs, 2015; Zhao et al., 2018). Unlike Western donors, however, China claims to adhere to a policy of political non-interference in the domestic affairs of sovereign governments, wherein the recipient nation's internal institutional and governance quality is deemed irrelevant (Zheng, 2016). This is in sharp contrast to the Western world's tendency to utilize foreign aid to promote the emergence or consolidation of democracies abroad, leading to the standard critique of China's policy as a convenient facade for engaging with and propping up non-democratic or corrupt regimes (Kurlantzick, 2007).

As argued by Dreher et al. (2018), the ability of the donor to exert such influence and secure or reward policy concessions rises with the level of concessionality offered in — and thus the perceived relative valuability of — its financial package. Consequently, we hypothesize that ODA distribution is principally designed to pursue such foreign policy objectives. This is bolstered by the lack of a stand-alone Chinese foreign aid agency; rather, political entities (MOFCOM and MOFA) directly responsible for diplomatic engagement and coalition building within international organizations also control and influence the allocation of ODA (See Section 2). However, such political motivations might still play a lesser role in allocating OOF. For one, strong ties exist between political actors and investment or loan decisions made in the PRC, as evidenced by the state-owned financial institutions' executive nomination and governing structures (Kong & Gallagher, 2016). The state council also wields jurisdiction over the CDB and CHEXIM — the primary distributors of market-based loans — feeding into the prevailing narrative and critique that the PRC's financial involvements as a whole are excessively politically motivated compared to its Western equivalents (Kong & Gallagher, 2016; Dreher & Fuchs, 2015).

c) Economic Objectives

Meanwhile, we expect the economic considerations of developmental finance to be almost exclusively restricted to commercial projects that

[3] While our study is concerned with the allocation behavior exhibited by the Chinese donor, it is also crucial to acknowledge the withstanding agency of the recipient nation. The decision to initially seek or accept foreign assistance is a multifaceted process influenced and ultimately made by actors in the recipient country. Such, while significant, lies beyond the purview of this paper.

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provide capital-rich creditors with an opportunity to obtain notable market-orthodox economic returns and symmetric international gains by working with capital-poor recipients (Moravcsik, 1989). Principally, the PRC's "going global" strategy was designed to stimulate domestic firms to establish a foreign commercial presence (Bräutigam, 2011a). China, by investing its foreign exchange reserves in 'bankable' economic activities and commercial projects, can deliver strong returns and potentially secure future contracts (Chen & Orr, 2009; Corkin, 2011; Sun, 2014). Meanwhile, subsequent economic instruments, such as export sellers' and buyers' credits, share the purpose of advancing national economic interests by assisting businesses in trade-oriented countries (Kobayashi, 2008). Donors often exhibit sensitivity to the borrower's creditworthiness, which is indicative of the rate of returns and the likelihood of ultimate repayment with interest (Alesina & Dollar, 2000; Evrensel, 2004). Naturally, China, as the largest capital exporter in the world, is peculiarly exposed to, and will thus attempt to minimize, the market risks associated with these projects (Evrensel, 2004). Further, as political turmoil and violence could jeopardize Chinese fiscal investment and returns (Johnston & Rudyak, 2017; Yuan et al., 2022), there is often a similar emphasis placed on state stability.

Moreover, a central notion regarding the economic objectives behind the PRC's expansion of foreign developmental finance is its need to fulfill its domestic deficit and rising natural resource demand, which is required in order to sustain its economic growth and internal stability (Kobayashi, 2008; Mohan & Power, 2008; Lum et al., 2009; Tull, 2006; Dreher & Fuchs, 2015). The significance of PRC's resource motivation is further evident when considering the fact that commercial loans are often repaid with underlying resource collaterals such as coal, gas, or oil (Bräutigam & Gallagher, 2014; Niczyporuk & Urpelainen, 2021). All of these considerations are indicative of the broader trend — less concessional and more commercial forms of Chinese official financing should adhere to such economic interests.

IV. Data

We examine a panel dataset of 48 Sub-Saharan African countries over 22 years (from 2000-2021), culminating in 1104 individual observations.

a) Dependent Variable

As noted above, the PRC does not systematically publish project-level nor aggregated data on its developmental finance commitments abroad. In the presence of such constraints, we use the 'Global Chinese Development Finance Dataset V3.0 (Custer et al., 2023), which is assembled by William and Mary's AidData Research lab and employs an open-source 'Tracking Underreported Financial Flows' (TUFF) methodology to construct a granular dataset on the PRC's official financing activities (Strange et al., 2015). Between 2000 and 2021, AidData recorded 9347 individual commitments to Sub-Saharan Africa, of which 4581 or 49% were financially backed. By value, ODA-like projects accounted for 15.7% of total commitments, while OOF-like and 'Vague (Official Finance)' contracts represented 68.6% and 15.7%, respectively.

To construct the dependent variable, we use 'Adjusted Amount (Constant USD, 2021)' to calculate additive aggregation of discrete project-level decisions for the specific country year compositions, disaggregating the cumulative value by flow types of relative concessionality deemed ODA-like and OOF-like to capture the multidimensionality of various country-specific influences. Following Dreher et al. (2018), we recategorize 'Vague (Official Finance)' as "OOF-like." We exclude projects where 'Recommended for Aggregates' is coded as no. We also exclude projects from regional entities without a breakdown of the national destination. Countries that did not receive at least one program for the specified country year designations were subsequently assigned zero values.

b) Independent Variable

To analyze the significance of the differing Chinese motivations outlined in Section 3, we analyze sets of covariates in relation to the recipient nation's need, merit, and capacity to fulfill the donors' self-interest. The selected regressors and corresponding categorizations are largely conventional within the extant literature. (Berthélemy, 2006; Hoeffler & Outram, 2011; Dreher & Fuchs, 2015; Dreher et al., 2018; Zhao et al., 2018; Guillon & Mathonnat, 2020; Sauer et al., 2022). Tables 1.1 and 1.2 provide summarizations and descriptive statistics.

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Table 1: Summary of Explanatory Covariates

Category	Variable Name	Variable Description
Donor Interest	UNGA Voting	UNGA ideal point estimate with China, continuous scale from 0 (no agreement) to +1 (full agreement)
	Taiwan	Taiwan recognition, binary indicator of 0 (no recognition) and +1 (formal recognition)
	Ores and Metals Exports (log)	Ores and metals merchandise exports, constant 2021 USD, log-transformed
	Mineral Production (log)	Mineral production, metric tons, log-transformed
Recipient Merit	Democracy (lag)	Democracy index, discrete scale from +1 (hard autocracy) to +5 (full democracy), lagged
	Corruption Control (lag)	Corruption control index, Continuous scale from -2.5 (high corruption) to +2.5 (low corruption), lagged
	Political Stability (lag)	Political stability index, Continuous scale from -2.5 (high instability) to +2.5 (high stability), lagged
Recipient Need	Debt to GDP (lag)	Central debt, as a percentage of GDP, lagged
	GDP per Capita (log, lag)	GDP per capita, constant 2021 USD, log-transformed, lagged
	Population (log, lag)	Total population, log-transformed, lagged

Various sources (See Section 4.2)

Table 2: Descriptive Statistics of Explanatory Covariates

Category	Variable	Objects	Mean	Standard dev.	Min	Max
Donor Interest	UNGA Voting	1104	0.81	0.13	0	1
	Taiwan	1104	0.054	0.23	0	1
	Ores and Metals Exports	826	9.34*e* +10	3.71*e* +11	0	86.42
	Mineral Production	1104	1.39*e* +07	4.71*e* +07	0	3.38*e* +08
Recipient Merit	Democracy	1006	3.13	1.14	1	5
	Corruption Control	999	-0.65	0.65	-1.94	1.60
	Political Stability	998	-0.57	0.93	-3.31	1.28
Recipient Need	Debt to GDP	961	65.18	67.48	0.49	658.22
	GDP per Capita	1062	2083.86	2741.72	251.38	16747.34
	Population	1104	1.86*e* +07	2.86*e* +07	80410	2.13*e* +08

Descriptive statistics rounded at 2d.p.; e+ denotes scientific notation (base 10); various sources (See Section 4.2) and authors' calculations (Stata SE 18.0).

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The donor interest category encapsulates covariates that reflect the PRC's strategic and economic motivations. The first variable within this classification is the recipient country's voting alignment with the PRC in the UN General Assembly (UNGA). Despite its nonbinding nature, academics often concur that a country's foreign policy preferences and geopolitical stance on global issues are best understood by analyzing UNGA voting patterns (Khan, 2020); such ideological concurrence and compatibility may cater to the strategic motivations of the PRC and is common in aid estimation literature (Dreher & Fuchs, 2015; Dreher et al., 2018; Zhao et al., 2018; Guillon & Mathonnat, 2020; Sauer et al., 2022). We use the Harvard Dataverse United Nations General Assembly Voting Data 'Ideal Point Distances' procured by Voetan et al. (2009), which reflects a continuous scale from 0 (no agreement) to +1 (full agreement). As a secondary data point, we follow other publications (Dreher & Fuchs, 2015; Dreher et al., 2018; Guillon & Mathonnat, 2020; Hoeffler & Sterck, 2022) and construct a dummy binary Taiwan recognition variable using information from Kironska (2022), distinguishing between countries that formally recognize Taiwan (1) from those that do not (0). At the turn of the century, 8 Sub-Saharan countries had formal diplomatic ties with Taiwan, which dwindled to only Eswatini by 2021. Both theoretical postulations and empirical evidence concur on the importance of non-recognition for the PRC as foundational to the forming of any bilateral relationship; Taiwan is considered internally by the central government as an inalienable part of the PRC's territory (Bush, 2017; Shattuck, 2020).[4]

To analyze the influence of resource endowment in the recipient country, we first use the established 'Ores and Metals Exports (% of merchandise exports)' variable from the World Bank World Development Index (The World Bank, n.d.). We deviate slightly from other publications (Yang et al., 2018; Sauer et al., 2022), opting instead to calculate the real absolute value in constant 2021 USD; the former has the potential to produce biased coefficients as the percentage indicator is relative to the value of total merchandise exports, which varies significantly across countries.[5] We include a secondary data point of 'Total Minerals Production' in metric tons procured by the Austrian Ministry of Finance's World Mining Database (World Mining Data, n.d.).[6] The justification to include both variables is twofold. First, the 'Ores and Metals Exports' indicator only captures the value of export-oriented commodities rather than the absolute amount produced available, which has the potential to lead to underestimated coefficient values. However, in isolation, the 'Mineral Production' variable could be considered too simplistic as it does not distinguish between the commodities intended for domestic and foreign consumption; only the latter would asway the PRC's acquisitional motivations. Beyond acting as a measurement of natural resources, the ores and metal indicator also provides a foundational understanding of trade openness within the recipient country, capturing the influence of factors related to economic interdependence in line with more commercially oriented flow types. As such, both are included to capture various dimensionalities of resource availability. Indeed, an additional indicator seemed appropriate given the mixed results in existing literature concerning the most commonly used 'Ores and Metal Exports' indicator (Sauer et al., 2022).

In the recipient merit category, covariates assess recipient countries' internal governance and political landscape. Not only is China's claim of political non-interference often questioned by the West, but these variables are also theorized to have a potentially cascading effect on the efficacy of other objectives from economic to developmental, thus lending utility to empirically scrutinizing its truths. The first proxy is the democracy variable constructed from Version 4 of the 'Democracy Matrix' project 'Classification Core' produced by the Julius-Maximilians Universität Würzburg (2021), converted to a discrete scale from +1 (hard autocracy) to +5 (full democracy). In line with extant literature (Dreher et al., 2018; Sauer et al., 2022), additional governance covariates are indexes obtained from the WB Worldwide Governance Indicators (The World Bank, 2024). Both 'Control of Corruption' and 'Political Stability and Absence of Violence/Terrorism' are measured on a continuous scale from -2.5 (high corruption; high instability) to +2.5 (low corruption; high stability).[7] All merit-based covariates are perceptive-based summarizations of informed expert opinions and various datasets (Kaufmann et al., 2010), which may be a limitation as it presents a necessary degree of arbitrariness. However, the absence of a suitable alternative seemed to justify the selection (Sauer et al., 2022).

Meanwhile, the recipient need category focuses on potential aid recipients' economic and developmental

[4] One prominent example is São Tomé and Príncipe, which was able to resume its diplomatic relationship with the PRC and get its aid requests approved only after it cut ties with Taiwan in 2016.

[5] To illustrate, consider two countries: one with high overall merchandise exports and a diversified economy and another with lower mineral exports but a higher proportion of ores and metals exports. The second country has the greater relative percentage of ores and metals exports, while the first country has the greater absolute value.

[6] We exclude Rhenium, precious metal, and natural gases, which are categorized separately or in other metrics by the WMD.

[7] Somalia, due to its high political instability, exceeds this metric. See Kaufmann et al. (2010) or the WB-WGI Database.

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state. 'Central Government Debt' as a percentage of GDP is the first indicator within this section, operationalized by the International Monetary Fund's (International Monetary Fund, 2022) Global Debt Database; a higher level of debt could signal a less conducive commercial environment but a greater necessity for developmental aid (Dreher et al., 2018; Hoeffler & Sterck, 2022). 'GDP per Capita' (GDPC) is extracted from the previous WB-WDI database and is expressed in Constant 2021 USD, serving a similar purpose as the previous indebtedness proxy: a measurement of overall financial and socioeconomic conditions. The question of whether to use GDPC or absolute GDP is often debated; the former fails to account for distributional issues and is, at best, representative of the absorptive capacity of aid (Amusa et al., 2016; Sauer et al., 2022), while the latter biases against smaller countries. As GDPC is the more established of the two variables in extant literature (Amusa et al., 2016; Dreher et al., 2018; Zhao et al., 2018; Sauer et al., 2022; Hoeffler & Sterck, 2022), we chose to include it in the main specification. Finally, to control for the recipient country size, we also include the WB-WDI measurement of 'Total Population;' it follows intuitively that more populous countries necessitate greater amounts of aid intervention due to distributional effects (Neumayer, 2010; Amusa et al., 2016). Apart from recipient need, these covariates also capture the expected 'price' the PRC would need to pay to leverage foreign policy compliance from its partner country; smaller, poorer nations are more likely to sway to the monetary allurements of the Chinese largesse than richer and bigger states (Dreher et al., 2018).

V. Empirical Strategy

The main specification model considers how interest, merit, and need influence Chinese developmental finance allocation in Sub-Saharan Africa. We begin with a basic cross-sectional time series regression model denoted as:

$$aid_{i,t} = \beta_1 interest_{i,t} + \beta_2 merit_{i,t-1} + \beta_3 need_{i,t-1} + \tau_t + \varepsilon_{i,t} \quad (1)$$

Where $aid_{i,t}$ the dependent variable for country i at year t, categorized as total aid, 'ODA-like,' or 'OOF-like;' $interest_{i,t}$ is a vector of a set of 4 variables indicative of political alignment and resource availability; $merit_{i,t-1}$ is a vector of a set of 3 variables that evaluate governance and institutional quality; $need_{i,t-1}$ is a vector of a set of 3 variables to operationalize the overall size, economic development, and fiscal health of the recipient.

a) Sequentiality of Aid

A central question in modeling the PRC's developmental finance allocation patterns is whether aid distribution follows a two-part process — first assessing the recipient country's eligibility and then determining the absolute quantum of aid given — or an integrated, single-step evaluation that considers all factors simultaneously. From a broad theoretical standpoint, Dudley and Montmarquette (1976) proposed that aid is a distinct 'yes/no' (eligibility) and 'if yes, how much' (amount) sequential process. This has led to the increasing popularity of dual-part Logitstic (Logit)-OLS structures in recent literature (Dolan & McDade, 2020; Sauer et al., 2022), wherein the binary outcome is first evaluated using a Logit model and then an OLS regression is applied to only the subset of positive aid amounts, thus formulated as a mixture of a binomial distribution and strictly positive distribution. However, consensus on the use of such two-part models is not universal (Guillon & Mathonatt, 2020; Hoffler & Sterk, 2022). Initially, the PRC's ODA-like commitments are earmarked by its decentralized nature, as seen in sectors such as health aid, where multiple governmental — including the State Council and MOFCOM — and subnational bodies influence the decision-making process (Lancaster, 2007), resulting in varying resource allocation and assistance quality (Lin et al., 2016). Further, differing provincial capacities and interests have resulted in an apparent *ad-hoc*, 'request-based' reactive approach, making the previously described sequentiality unlikely (Lancaster, 2007; Huang, 2014; Lin et al., 2016; Guillon & Mathonatt, 2019; Guillon & Mathonatt, 2020).

b) Zero Inflation

In the domain of econometric aid literature, Ordinary Least Squares is frequently the estimation methodology de rigueur. Adopting a similar technique, however, is unsuitable due to a discontinuous country-level dataset with a large quantum of (derived) zero values, indicating that only some states receive aid programs while others do not, and thus, the dependent variable exhibits skewed distribution with positive probability mass at zero.[8] Such presents added complexity by violating homoscedasticity and linearity assumptions; OLS in this context often leads to underestimated parameter coefficients by providing a regression line that is too flat. Further, attempting to logarithmically transform the dependent variable for interpretive elasticity purposes introduces added complexity due to the indeterminacy of zero-value functions. *Ad-hoc* fixes, for example, assigning log-scale equivalents to zero instances, lead to the emergence of outliers at arbitrarily defined points along the outcome continuum. The further strategy of excluding zero values from the analysis, as proposed by some, inadvertently introduces non-random sample selection bias by modeling only non-zero outcomes (Hurd, 1979). We thus pivot to other specifications that can more

[8] Zero distribution in ODA-like aid at 27.3%, OOF-like aid at 66.1% and total aid at 25.1%.

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accurately model the associated overrepresentation of zeroes.

Alternative econometric models include the Heckman, Tobit, and the aforementioned two-part model. The Heckman Selection initially estimates the inverse mill's ratio (IMR) — the weighting mechanism for the probability of sample inclusion — via a binary probit model to adjust for latent selection biases (which could contribute to the excess number of zeroes) and unobserved heterogeneity in the latter continuous outcome model while assuming intercorrelated error structures. However, it is difficult to empirically justify the existence of a restriction variable[9] for the Heckman Model that would affect only the selection and not the allocation process (Guillon & Mathonnat, 2019; Sauer et al., 2022) By estimating the pair of equations with the same set (or subset) of explanatory covariates, the correction identification rests solely on the nonlinearity of the IMR, which Kennedy (2003) argues leads to a poor-performing model. A further technique is the Tobit estimator, which models aid distribution amounts in a single analytical step while correcting for the downward bias introduced by the zero-inflated data structure (McGillivray & White, 1993; Alesina & Dollar, 2000). Despite its apparent appeal, the Tobit model is predicated on assumptions of homoscedastic residuals and the subsequent zero inflation resulting exclusively from censoring,[10] making it less flexible (Guillon & Mathonnat, 2019).

In the presence of such constraints, we instead choose to employ a Poisson Pseudo-Maximum Likelihood estimator as our main specification. Principally, Silva and Tenreyro (2006 & 2011) have shown that Poisson regression outperforms Tobit or OLS in the context of our particular data specifications; the method is robust to differing patterns of heteroscedasticity while remaining unaffected by zero-skewed or overdispersion. While initially designed for discrete positive count data, Poisson models have recently gained popularity in estimating gravity models and are now considered the “natural” way of dealing with zero inflation in trade or investment data. (Shepherd, 2010; Anderson & Yotov, 2016; Fernandes, Freund, & Pierola, 2016; Luo, Qi, & Hubbard, 2017; Didier, 2018). Given the similar econometric issues faced with modeling Chinese aid flows, Acht et al. (2015), Guillon and Mathonnat (2019; 2020), and Yushi et al. (2020) have demonstrated the utility of using PPML models in this regard.

Formally, the PPML estimator is grounded in the Poisson distribution model, formally expressed (without the time series indication) as:

$$E[Y_i|X_i] = exp\,(\beta X_i^{'}) \tag{2}$$

Where the expected value of Y_i conditioned on X_i is modeled as the exponentiation of the transposed linear predictor $\beta X_i^{'}$, ensuring that the predicted value or conditional mean is non-negative (as aid amounts are always strictly ≥ 0). The log-likelihood function is denoted as:

$$L(\beta|Y,\,X) = \prod_{i=1}^{n} \frac{exp(-u_i)(u_i)^{Y_i}}{Y_i!} \tag{3}$$

Where each term in the product (for each observation i in the likelihood function $L(\beta|Y,\,X)$ represents the probability of observing the actual Y_i given the predicted mean $u_i = exp\,(\beta X_i)$ By multiplying these together for all observations n, we get a joint likelihood $\prod_{i=1}^{n} \frac{exp(-u_i)(u_i)^{Y_i}}{Y_i!}$ for the entire dataset, which the PPML method seeks to maximize in iterations to find the best-fitting parameters β. While the factorial term Y_i ! is a mathematical convention from the Poisson distribution, the PPML estimator remains robust when discrete count data due to its reliance on the likelihood function rather than the conventional Poisson equidistributional form; all that is required for consistent estimation of parameters is the correct specification of the conditional mean (Silva & Tenreyro, 2006). The further absence of log-linearization inherently permits the inclusion of zero-valued observations in the analysis.[11] Thus, it is the main specification of choice to model the absolute amount of zero-inflated aid flows.

c) Fixed Effects

We include year-fixed effects to control for temporal unobserved heterogeneity (year-to-year externality influences on the elasticity of Chinese funds) but exclude fixed country effects; the latter relies solely on temporal intra-country heterogeneity to estimate regression coefficients. Per Dreher et al. (2018), we do not expect our explanatory covariates to hold much explanatory power in explaining temporal within-country changes in aid distribution; rather, we retain the between-country variation. Further, many of the regressors, notably the index-based variables in relation to democracy or Taiwan recognition, are time-invariant or exhibit minimal changes. Thus, including country-fixed effects in this instance would create issues related to multicollinearity.

d) Time Lag

The question of whether to estimate regression models with time-lagged or contemporary variables

[9] This is perhaps with the exception of the Taiwan Recognition Dummy, which is minimalistic at best. See Guillon & Mathonatt (2019) on modeling Heckman Selection equations using the Taiwan dummy as the exclusion variable for ODA-like flows.

[10] Even when censoring is present, it is assumed to be minimally random and likely attributed to faulty collection, which is inevitable as the granular dataset is derived from unofficial sources (See Section 4.1).

[11] However, the log-link function still allows for the proportional interpretation of coefficients in the context of a multiplicative model.

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remains largely ad hoc and arbitrary (Hoeffler & Sterck, 2022). Laging regressors largely serve two purposes: to reflect that changes in material conditions may take time to register in the PRC's decision-making process and to mitigate reverse causality concerns. A practical question regarding the former is the temporal extent to which these changes occur (i.e., how many time-lagged years). Reverse causality, meanwhile, is plausible in our model as developmental finance is often theorized to exert a direct or external effect on aspects such as governance, debt levels, and GDP per capita (Mcgillivray, 2004; Noroud, 2014; Dijkstra, 2018;). The common consensus within the aid allocation literature has been to temporally lag all independent variables by one year to mitigate the aforementioned reservations (Dreher & Fuchs, 2015; Dreher et al., 2018; Zhao et al., 2018; Dollar, 2018; Landry, 2018; Guillon & Mathonatt, 2020; Sauer et al., 2022; Hoeffler & Sterck, 2022).

However, issues of simultaneity are likely to differ from variable to variable; certain shifts within the recipient country — such as voting patterns in the UN — may generate immediate reactionary rewards from donor countries (or are even caused directly by the promise of assistance as a means of leveraging compliance), while other changes — such as governance alterations or economic shifts — may take longer to affect financial flows as they are usually smaller and incremental, thus being harder to observe immediately (Hoeffler & Sterck, 2022). Quantitatively, Hoffler and Sterk (2022), in decomposing the ceteris paribus variance of Y given X, reported that the Taiwan dummy variable generated a 3% greater variation in aid amounts allocated within the regression model when its value was contemporary instead of time-lagged. Further, Reed (2015), Bellemare et al. (2017), and Leszczensky and Wolbring (2019) have recently criticized the practice of using time lag to address reverse causality. Coupled with the theoretical justification that foreign aid is necessarily designed to leverage political or economic changes within the recipient country to cater to the interests of the donor country (Dreher et al., 2018), we thus deviate from the conventional practice and instead chose to only time lag covariates related to need and merit, while retaining contemporary values for variables concerning self-interest, which are likely to coincide or shift as a direct result of the distribution of developmental finance by the Chinese (Section 3). Indeed, it also follows intuitively that the PRC's consideration of the merit and needs of the recipient country would look to formulate such through a "judgment of long-term historical trends" (Zhu, 2010; Onur, 2018). Nonetheless, we recognize that this choice remains largely arbitrary; however, it appears appropriate given the apparent lack of clarity and consensus regarding the Chinese decision-making or negotiation process and credible regression modeling in this regard.

e) Multicollinearity

Multicollinearity arises when two or more predictor variables in a regression model exhibit high linear intercorrelations, leading to inflated standard errors and compromised coefficient estimates. Predictor variables are below the literature consensus for coefficient cutoffs ($r < 0.6$), meaning multicollinearity is not an issue in this model (Dormann et al., 2012; Vatcheva et al., 2016).

Table 3: Collinearity Matrix of Main Specification Regressors

	UNGA Voting	Taiwan	Ores~ Exports	Mineral Prod~n	Demo~ y	Corr~n Control	Political Stability	Debt to GDP	GDP~ Capita	Popul~n
UN~ing	1.000									
Taiwan	-0.147	1.000								
Ores~orts	0.130	-0.21	1.000							
Mineral~n	-0.025	-0.214	0.645	1.000						
Democracy	0.143	0.137	0.052	0.104	1.000					
Corrupt~l	-0.025	0.077	-0.089	-0.083	0.503	1.000				
Politica~ity	-0.080	0.066	0.022	0.035	0.469	0.684	1.000			
Debt~GDP	0.093	-0.035	-0.233	-0.158	-0.163	-0.101	-0.010	1.000		
GDP ~pita	-0.011	-0.194	0.212	0.575	0.28	0.41	0.404	-0.197	1.000	
Population	-0.001	0.053	0.418	0.255	0.024	-0.452	-0.463	-0.150	-0.232	1.000

Estimations rounded at 3d.p.; Ores and Metal Exports, Mineral Production, GDP per Capita, and Population are calculated using logged amounts (See Section 4.2); authors' calculations (Stata SE 18.0)

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VI. Results

The following section presents and discusses the result. Table 4 analyzes the distribution of Chinese developmental finance in Sub-Saharan Africa. Column 1 seeks to explain the total cross-country allocation of funds, while Columns 2 and 3 decompose the dependent variable into flow types of relative concessionality. Before delving into specific interpretations, our results largely confirm the divergent political, economic, and developmental motivations between Chinese ODA and OOF outlined in Sections 2 and 3. Further, due to the greater aggregate value of OOF-like projects compared to ODA-like contracts, the results from Column 1 largely mimic that of OOF in isolation. As such, there appears to be greater utility in analyzing individual rather than aggregate financial flows.

The PPML estimator's log link function allows us to observe the responsiveness of aid amounts allocated to changes in the recipient country's conditions. In the context of a continuous logged independent variable $\ln(X_i)$, the interpretation of the coefficient β is simply elasticity (the percentage change of Y_i given the percentage change in X_i) (Disdier & Head, 2008). When X_i is an indicator variable, exponentiating the coefficient β yields the Incidence Rate Ratio (IRR): a multiplicative interpretative relationship (indicating positive association if > 1, no association if $= 1$, and negative association if < 1). The adjustment:

$$(e^{\beta} - 1) \times 100\% \quad (4)$$

Translates the effect of X_i into an absolute positive or negative percentage change for semi-elasticity purposes (Yotov et al., 2016).

Table 4: Allocation of Chinese Developmental Finance, Sub-Saharan Africa, Value, 2000–2021, PPML

		Total	ODA-like	OOF-like/Vague
		(1)	(2)	(3)
Donor Interest	UNGA Voting	-0.259	0.385	-0.293
		(0.630)	(0.622)	(0.786)
	Taiwan	-1.915**	-2.402***	-1.834*
		(0.762)	(0.926)	(1.074)
	Ores and Metals (log)	0.102**	-0.0323	0.176***
		(0.047)	(0.059)	(0.058)
	Mineral Production (log)	0.003	0.027	0.014
		(0.042)	(0.045)	(0.062)
Recipient Merit	Democracy (lag)	-0.456***	-0.102	-0.524***
		(0.110)	(0.106)	(0.133)
	Corruption Control (lag)	-0.760***	-0.026	-1.015***
		(0.171)	(0.209)	(0.206)
	Political Stability (lag)	0.808***	0.369***	0.934***
		(0.163)	(0.141)	(0.212)

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Recipient Need	Debt to GDP (lag)	0.000	0.007***	-0.008
		(0.005)	(0.003)	(0.007)
	GDP per Capita (log, lag)	0.707***	0.205	0.725***
		(0.165)	(0.173)	(0.224)
	Population (log, lag)	0.801***	0.448***	0.861***
		(0.104)	(0.102)	(2.423)
Number of Observations		542	542	542
Pseudo R^2		0.65	0.29	0.67

*Raw coefficients; robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; estimations rounded to 3d.p.; Pseudo R^2rounded to 2d.p; authors' calculations (Stata SE 18.0).*

a) Donor Interest

Principally, the PRC's own interests are empirically recognized to influence the PRC's developmental finance distribution. Taiwan's recognition by the recipient country is universally associated with decreases in both ODA-like and OOF-like commitments, though with differing degrees of substantiality. Qualitatively, using the adjustment explained in Equation (3), the model indicates a 91% reduction in ODA-like funding (p=0.009), a stark indication of China's strategic limitation of concessional finance to leverage foreign diplomatic concessions. The same geopolitical consideration appears to have a less pronounced effect in the context of OOF. While still indicative of a negative trend, the influence of Taiwan's recognition of OOF-like finance is less statistically significant (p=0.088) with an associated reduced coefficient value, confirming a more nuanced approach where economic considerations conjoin or take precedence over political motivations. These estimations are largely in line with existing literature (Dreher & Fuchs, 2015; Dreher et al., 2018; Guillon & Mathonatt, 2020; Hoeffler & Sterck, 2022), all of which confirm Taiwan's recognition as a significant predictor of developmental finance distribution. Surprisingly, voting alignment with the PRC in UNGA negatively correlates with aggregate and OOF-like funds, although the model for all three flow types is not statistically significant. These results can perhaps be attributed to the excess temporal 'noise' documented in UNGA ideal point estimates due to year-to-year changes in the assembly's voting agenda,[12] which could be considered a data-centric limitation of our study (Bailey et al., 2016).

Turning to the considerations of resource availability, our results further confirm the divergent strategic interests between allocating flow types. The presence of ores and metals exports significantly impacts OOF, qualitatively indicating a 1.7% increase in the value of projects allocated (p=0.002) for every 10% increase in these resources exported by the recipient country. Interestingly, the absolute natural mineral production amount, although positively correlated with OOF, was not statistically significant (p=0.816), confirming the earlier hypothesis that only export-oriented resource commodities are of any interest to the Chinese in the allocation process as it is materially accessible. As expected, no statistically significant relationship exists for ODA flows for either of the two regressors.

b) Recipient Merit

In relation to recipient merit, our model alludes to several interesting conclusions. Universally, political stability exhibits a positive and statistically significant effect on aggregate and individual flow-type commitments. However, the coefficient value for the OOF model is more than double that of the ODA model. This difference can likely be attributed to their divergent objectives; while the foreign policy considerations of ODA-like contracts can be achieved in the allocation process itself (buying political favors through offers of concessional finance), the economic motivations driving OOF-like commitments require 'successful' completion of the project to come to fruition, thereby placing a greater emphasis on the overall societal stability within

[12] As noted in the conclusion of Bailey et al. (2016), while "votes in the UNGA contain valuable information about the preferences of states…such scores can move dramatically due to changes in agenda even when the underlying preferences do not change. They produce estimates that in some cases beggar belief, implying, for example, that the United States and Russia today are more at odds than the United States and Soviet Union ever were."

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the recipient country to avoid potential jeopardization to the Chinese investment. Nonetheless, China still displays a substantial degree of care for the effects of its ODA programs. Surprisingly, the preference for certain governance and institutional structures is more closely associated with Chinese OOF than ODA-like commitments. While the principles of political noninterference remain true for ODA, China clearly favors more corrupt and authoritarian regimes in its commercial lending, as both democracy rankings and corruption control index scores are statistically significant and negatively associated with OOF-like project values. However, such motivations may not be necessarily political. For instance, resource wealth — a significant positive predictor of OOF — is often theoretically and empirically correlated with authoritarianism by centralizing economic power to a singular point of control and dissuading the provision of social services by providing a labor-independent economy (Wantchekon, 2002; Haber & Menaldo, 2011). Further, the PRC's aid and loan practices — by employing financial modalities such as commodity and revenue collateralization or subcontracting work to Chinese personnel operating abroad — reduce the risk of financial misappropriation and allow Beijing to retain greater project oversight, potentially better positioning China to transact with poorly governed nations compared to its Western counterparts (Bräutigam, 2011b; Yarbrough & Yarbrough, 2014; Dreher et al., 2018). Corruption has also been noted in recent literature to 'grease the wheels' of commerce, promoting more profit-oriented financial relationships between the PRC and its partner countries, which is particularly pertinent given the state of China's own corruption-ridden transitional economy (Dutt & Traca, 2010; Chan et al., 2019). Indeed, the notion that only OOF flows to more poorly governed countries is supported by pre-existing empirical research (Dreher et al., 2018).

c) Recipient Need

In analyzing recipient needs, our results unilaterally support the notion that larger states receive greater amounts of Chinese developmental finance. More populous countries also hold greater significance in the international political and economic arena, potentially acting as an amplifier for all other regressors. Turning to economic indicators, our results confirm GDP per capita — a signifier of overall financial conditions — as a significant positive predictor of OOF: every 10% increase in the covariate is associated with a 7.2% increase in OOF ($p=0.001$). These results were not significant for ODA. Conversely, 'Debt to GDP' was positively associated with ODA ($p = 0.005$) but not OOF, indicating that more indebted countries received greater amounts of concessional assistance. In other words, these results further confirm the divergent financial considerations between the two flow types; while OOF contracts are generally granted to comparably more prosperous countries to reap further social and economic gains, concessional ODA programs specifically target financially restricted nations for more altruistic and developmental purposes. However, it is important to note that the results for indebtedness, while statistically significant, are not economically significant due to the reduced coefficient value of only 0.007.

VII. Conclusion

Chinese 'aid,' since its inception, has engendered criticism. Despite recent advancement in modeling the PRC's official finance flows, enduring conceptual, methodological, and data-centric challenges have hindered empirical efforts to definitively ascertain the motives — whether altruistic or otherwise — behind Chinese capital allocations. This paper, by refining and integrating existing practices and employing an updated granular dataset, attempts to better illustrate a more nuanced answer to that question. We conduct regression analysis on a dataset of 48 countries spanning 22 years. Principally, we acknowledge the utility of decomposing aggregate developmental finance into various flow types to allow for the examination of the various developmental, political, and economic factors influencing Chinese decision-making, in addition to utilizing a PPML estimator to address issues of zero-inflation and heteroscedasticity in the data. Further, we retain contemporary 'interest' variables to capture the potential simultaneity associated with providing developmental finance and acquiring policy concessions.

Our findings challenge the prevailing 'rogue donor' narrative in several respects. Universally, it is observed that political stability and the population of the recipient country are associated with increased levels of developmental finance. Regarding concessional foreign aid, we find limited evidence to support the view of China as a donor-driven primarily by political motivations. While political considerations, such as the non-recognition of Taiwan, do play a role, developmental objectives appear to be the primary determinant in allocating ODA. Indicators of recipient need, such as lower GDP per capita, significantly influence aid distribution, suggesting either a genuine consideration of the recipient nation's poorer status or a strategic targeting of more susceptible governments. Moreover, our analysis indicates that Chinese concessional finance does not disproportionately flow towards corrupt or authoritarian regimes; rather, its *commercial* lending practices tend to favor resource-rich and poorly governed nations primarily for short-term economic benefits, a form of capital that may often be incorrectly conflated with 'aid' in the traditional form. More broadly, we conclude that while developmental

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objectives predominantly drive ODA-like allocations, economic interests underpin OOF-like flow — while political considerations inadvertently influence both — thus reflecting the intricate political economy of the Chinese state. These results largely confirm the previous pioneering works of Dreher et al. (2018), Guillon & Mathonatt (2020), and Hoffler & Sterk (2022), though to varying degrees.

As the landscape of international economic developmental finance transitions from the prevailing Western-centric paradigm to a more diverse array of unconventional and emerging donors prioritizing non-interference and South-South cooperation, Beijing will undoubtedly play a pivotal role in shaping such institutional norms and practices. There is substantial evidence to suggest that these structural changes will profoundly affect the political, social, and economic outcomes in developing countries and may even alter the foundations of the international order (Woods, 2008; Kersting & Kilby, 2014). As nations break away from the conventional DAC-OECD regime, rhetorical debate and policymaking must place a greater emphasis on qualitative, empirical scrutiny over political pandering and emotional knee-jerk reactions that often arise from unfamiliarity. This paper describes some conceptual and methodological practices that represent one step forward on that front.

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