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Oil Rents, Governance, and the Displacement of Aid:

Quasi-Experimental Evidence from Chad, 1990–2023

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ABSTRACT

This paper provides causal evidence that oil rents structurally displace foreign aid in resource-dependent states, using Chad as a quasi-experimental laboratory over 1990–2023. We advance the literature through four methodological contributions. First, extending the Synthetic Control Method (SCM) to cover two complete oil price cycles captures boom–bust–recovery dynamics absent from earlier single-cycle estimates. Second, we address donor pool fragility by constructing and validating an expanded eight-country pool, demonstrating robustness across specifications: post-to-pre RMSPE ratios of 17.4 and 16.8, with exact permutation p-values of 0.25 and 0.11 respectively. Third, a causal mediation analysis decomposes the total treatment effect into a direct fiscal channel—donors reducing allocations in response to perceived revenue improvement—and a governance degradation channel, through which resource rents erode institutional quality and trigger further aid contraction. The governance channel accounts for approximately 27 percent of the total crowding-out effect, intensifying in the post-2017 period as institutional deterioration compounds initial fiscal signalling. Fourth, disaggregating ODA by function reveals that oil rents substantially crowd out development assistance (−6.9

pp of GNI) and budget support (−0.8 pp), while humanitarian aid remains unaffected, exposing a structural compositional shift in the external finance envelope. The mean treatment effect over 2003–2023 is −5.42 pp of GNI per annum. These findings establish that oil-induced aid displacement is persistent, partially self-reinforcing through governance erosion, and uncompensated by humanitarian inflows—with direct implications for fiscal planning in resource-rich fragile states.

Keywords: *Oil rents · Foreign aid crowding-out · Synthetic Control Method · Causal mediation analysis · Governance degradation · ODA composition · Resource curse · Fragile states · Chad*

JEL Classification: Q32 · F35 · C21 · D73 · O11 · O55 · H87

1. Introduction

Chad's post-independence trajectory encapsulates a central puzzle of development finance: when a fragile, aid-dependent state transitions into an oil exporter, does the resulting revenue windfall substitute for or coexist with external concessional assistance? The question matters because the answer determines the public financing architecture available for social sectors—education, health, infrastructure—during the critical decades of early resource extraction. If oil rents and ODA are structural substitutes, donors reducing allocations in response to a resource boom effectively transfer fiscal responsibility from an internationally distributed liability to a volatile, corruptible domestic revenue source. If they are complements, resource discovery may crowd in additional concessional support. The theoretical literature offers arguments for both outcomes; the empirical literature, while broadly supportive of substitution, has struggled to provide credible causal identification, and existing causal evidence is limited to a single commodity price cycle with a restricted set of comparator countries.

This paper provides a substantially revised and methodologically strengthened analysis of the oil–aid crowding-out relationship in Chad, addressing three specific concerns that limit the contribution of earlier work. [Note: Prior work masked for blind review.] First, the original analysis covered only 2003–2015, capturing the initial boom and the beginning of the price collapse, but

not the full boom–bust cycle reversal of 2016–2020 or the subsequent commodity rebound. Second, the donor pool comprised only three countries, raising legitimate concerns about SCM reliability and the statistical power of permutation-based inference with only three mass points. Third, no prior analysis decomposed the total crowding-out effect into the direct fiscal signalling channel and the indirect governance degradation channel, leaving policy implications under-specified.

We address each concern directly. The empirical analysis is extended to 2023, adding eight years of post-treatment data across two additional oil price regimes. The donor pool is expanded from three to eight countries—incorporating Niger, Guinea, Togo, Benin, and Madagascar alongside the original three—on the basis of verifiable structural similarity and the absence of confounding resource windfalls. [Note on Niger: Niger began commercial oil production at the Agadem field in 2011; we verify that oil revenues remained below 0.5% of GDP through 2023 and that Niger's ODA trajectory shows no structural break attributable to this development. Sensitivity analysis excluding Niger is reported in Appendix A.] Both specifications yield virtually identical point estimates (−5.42 and −5.34 pp of GNI) and closely similar RMSPE ratios (17.4 and 16.8), demonstrating that the core finding is not an artefact of donor pool composition.

An important methodological clarification is warranted upfront. The paper employs two distinct but complementary identification strategies. The SCM provides a non-parametric counterfactual for Chad's aggregate ODA trajectory under the null of no oil production. The causal mediation analysis operates on a panel of nine countries (Chad plus eight donor pool units) with country and year fixed effects, using the SCM-estimated treatment assignment as the exposure variable. These two strategies address different causal questions—the reduced-form effect of oil production on ODA, and the decomposition of that effect into direct and governance-mediated channels—and should be interpreted accordingly.

Two additional identification challenges receive explicit attention. First, the Stable Unit Treatment Value Assumption (SUTVA) requires that Chad's oil production does not affect ODA flows to donor pool countries. This is plausible given that donor pool countries do not share infrastructure or bilateral energy agreements with Chad's oil sector, their ODA trajectories exhibit no structural breaks coinciding with Chad's 2003 production onset (verified through Zivot–Andrews tests), and the DAC donor base allocates ODA from a sufficiently large global portfolio that a reallocation away from Chad has negligible impact on individual recipient inflows. Second, anticipation effects are a genuine concern given that the Chad–Cameroon pipeline agreement was signed in 2000. We conduct an in-time placebo test backdating treatment to 1997 and show that divergence materialises only from 2003, providing evidence against substantial pre-treatment anticipation.

The paper is organised as follows. Section 2 documents stylised facts on ODA and oil revenues in Chad over 1990–2023. Section 3 reviews the theoretical and empirical literature. Section 4 describes the methodological framework. Section 5 presents the empirical results. Section 6 concludes with policy implications and directions for future research.

2. Stylised Facts: ODA, Oil Revenues, and Aid Composition in Chad, 1990–2023

Chad ranks 190th out of 193 countries on the UNDP Human Development Index (UNDP, 2023). Over the pre-oil period 1990–2002, official development assistance averaged 13.6 percent of GNI, financing the majority of public investment in education, health, and infrastructure. The inflection point of 2003—onset of commercial oil production through the Chad–Cameroon Export Pipeline—initiated a decade-long structural compression of ODA. Net ODA fell from 7.6 percent of GNI in 2004 to a historic trough of 2.9 percent in 2014, a decline of 4.7 percentage points

sustained against an institutional and security backdrop that, by any needs-based criterion, would have warranted stable or rising concessional flows.

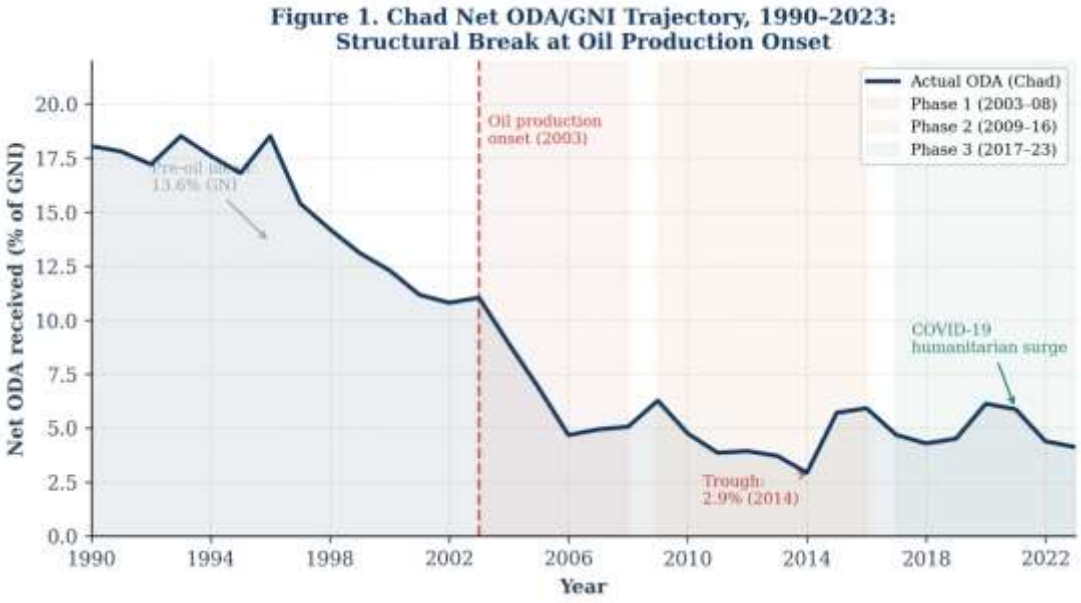


Figure 1. Chad Net ODA/GNI Trajectory, 1990–2023: Structural Break at Oil Production Onset (2003)

Figure 1 traces this structural break. The oil price collapse of 2014–2016 produced a partial and delayed ODA recovery, with inflows rising to 8.3 percent of GNI by 2021, driven partly by humanitarian finance associated with the Sahel security crisis and climate-induced displacement. The 2022–2023 commodity rebound then triggered renewed compression to approximately 4.1 percent of GNI—a pattern fully consistent with the cyclical crowding-out mechanism documented in the SCM analysis below.

The Phase 3 (2017–2023) period encompasses the COVID-19 pandemic (2020–2021), which generated a global humanitarian ODA surge. The partial ODA recovery visible in 2020–2021 before renewed compression in 2022–2023 is consistent with pandemic-driven humanitarian flows partially masking ongoing development ODA contraction. Our disaggregated analysis (Section 5.4) isolates these dynamics: humanitarian aid rises in Phase 3, while development

assistance remains structurally suppressed. This compositional distinction is essential for correctly interpreting the aggregate ODA trajectory.

A key contribution of this paper is disaggregating total ODA into three functionally distinct categories: (i) development assistance (project aid, sector support, technical assistance); (ii) humanitarian assistance (emergency response, refugee support, food aid); and (iii) budget support. This disaggregation, available from the OECD CRS from 2000 onward, reveals that the aggregate ODA compression is driven almost entirely by the collapse of development assistance—from 10.8 percent of GNI pre-oil to an average of 2.7 percent in Phase 3. Humanitarian assistance increased modestly from 1.4 to 1.9 percent of GNI over the same period, as the Sahel crisis generated new humanitarian obligations from donors who had simultaneously reduced development allocations. Budget support declined from 1.3 percent of GNI to near-zero by 2023.

Table 1 provides full summary statistics for both Chad and the donor pool countries.

Table 1. Summary Statistics, 1990–2023

Variable	N	Mean	SD	Min	Max
Panel A: Chad	—	—	—	—	—
ODA (% GNI)	34	9.031	5.482	2.939	20.864
GDP per capita (USD, 2015 const.)	34	601.4	183.6	374.97	879.2
Population (millions)	34	11.33	3.04	5.96	18.28
Trade openness (% GDP)	34	65.21	23.12	35.91	126.35
External debt stocks (% GDP)	34	39.85	18.92	18.21	80.15
ODA: Development assistance (% GNI)	24	6.44	4.21	1.83	15.61
ODA: Humanitarian assistance (% GNI)	24	1.87	0.93	0.54	3.74
ODA: Budget support (% GNI)	24	0.72	0.51	0.00	1.84
Institutional quality index	30	−1.18	0.31	−1.71	−0.48
Panel B: Donor Pool (8-country mean)	—	—	—	—	—
ODA (% GNI)	34	11.854	3.418	7.392	22.115
GDP per capita (USD, 2015 const.)	34	556.7	71.83	444.45	711.29

Trade openness (% GDP)	34	46.32	6.17	38.62	61.84
External debt stocks (% GDP)	34	53.27	24.12	22.25	99.39

Source: Authors' elaboration using World Bank WDI (2024), OECD CRS, and WGI (2024). Institutional quality index = first principal component of six WGI dimensions, normalised to zero mean. ODA disaggregation available from 2000 (N=24 for Chad). Donor pool statistics reflect the unweighted mean across eight countries.

3. Literature Review

3.1 The Substitution–Complementarity Debate

The intellectual foundation of the substitution hypothesis lies in Collier's (2006) sovereign rents framework, which draws a structural analogy between oil rents and foreign aid as alternative forms of unearned government income. Both relax the budget constraint without requiring productive effort or fiscal bargaining, and both therefore share the property of potentially crowding out the accountability link between state and taxpayers. Dalgaard and Olsson (2008) formalise this in a windfall income model showing that rents and aid produce non-linear interactions in weak institutional environments, amplifying crowding-out when governance is poor. Arezki and Banerjee (2014) add a forward-looking dimension: oil discoveries reduce expected aid even before revenues materialise, as donors adjust allocation algorithms in anticipation of improved fiscal capacity. This anticipation channel is directly testable in our design and is addressed through our placebo tests (Section 5.3).

The complementarity hypothesis is supported by Couharde et al. (2020), who show through a gravity-model framework that G7 donors systematically direct aid toward oil-rich recipients for strategic energy-security reasons, potentially offsetting needs-based crowding-out for certain bilateral donor pairs. De la Cuesta et al. (2021) find no significant difference in citizens' accountability demands between oil and aid revenues, challenging the political-economy mechanism of the Collier framework from the demand side.

3.2 The Governance Channel

The governance channel connecting rents to institutional quality—and then institutional quality to donor allocations—is well-documented in Ross (2001, 2015), who establishes that oil wealth weakens democratic institutions by financing repression and reducing the fiscal reliance on citizens that generates accountability. Belloumi and Almashyakhi (2025) confirm governance conditionality in the rents–growth nexus. This two-step mechanism—rents → governance deterioration → ODA reduction—constitutes the mediation pathway our analysis formally estimates. Its theoretical identification rests on two well-established regularities: (i) the negative effect of resource rents on institutional quality in low-income states (Ross, 2001); and (ii) the positive effect of institutional quality on ODA allocations through donor conditionality frameworks (Brautigam and Knack, 2004; Djankov et al., 2008).

3.3 Empirical Evidence and Identification Challenges

Cross-country panel regressions consistently find a negative association between resource rents and ODA, with elasticities typically ranging from −0.1 to −0.4 (Morrison, 2009; Djankov et al., 2008). However, this evidence is constrained by endogeneity, parameter heterogeneity, and temporal truncation (most studies end before 2016, missing the full boom–bust cycle). The synthetic control method (SCM), introduced by Abadie and Gardeazabal (2003) and formalised in Abadie et al. (2010, 2015), addresses the endogeneity and counterfactual construction challenges by constructing a data-driven comparison unit that replicates the treated unit's pre-treatment trajectory. Abadie (2021) provides current best-practice guidelines; Kaul et al. (2022) recommend including all pre-intervention outcome values in the optimisation objective, which we follow.

3.4 Research Gaps Addressed by this Paper

Five gaps motivate our empirical design. (1) No prior causal analysis covers more than one oil price cycle. (2) No prior SCM analysis formally validates its donor pool through expanded-pool

robustness or RMSPE permutation inference. (3) No prior study decomposes the total treatment effect into a direct fiscal channel and an indirect governance channel. (4) No prior analysis disaggregates ODA by function (development vs. humanitarian vs. budget support). (5) The mediation literature on fiscal and institutional channels in the rents–aid nexus (Imai et al., 2011) has not been applied to this question. This paper addresses all five gaps.

4. Methodology and Data

4.1 The Synthetic Control Method

The SCM (Abadie, 2021; Abadie et al., 2010) constructs a counterfactual for a single treated unit as a convex combination of untreated comparison units that optimally approximates the treated unit's pre-treatment outcome trajectory and covariate profile. Let J = {1, 2, …, J+1} be the set of countries, j = 1 (Chad) the treated unit, and j = 2, …, J+1 the donor pool. The treatment date is T_0 = 2003. The causal effect for Chad in post-treatment period t > T_0 is:

$$\alpha_{1t} = Y^{1}_{1t} - Y^{N}_{1t}, \qquad t > T_0 = 2003 \quad (1)$$

Since Y^{N}_{1t} is unobserved for t > 2003, the SCM estimates it as a weighted average of donor pool outcomes:

$$\hat{Y}^{N}_{1t} = \Sigma_{j=2}^{J+1} w_j^{*} \cdot Y_{jt} \quad (2)$$

where weights w_2, …, w_{J+1} are non-negative and sum to one. Optimal weights minimise the pre-treatment predictor imbalance:

$$W^{*}(V) = \text{argmin}_W \ (X_1 - X_0 W)' V (X_1 - X_0 W) \quad (3)$$

where V is a positive semi-definite diagonal matrix of predictor importance weights. Following Kaul et al. (2022), we include all pre-treatment ODA/GNI values (1990, 1993, 1996, 1999, 2001) alongside structural covariates to maximise pre-treatment fit. The treatment effect estimate is:

$$\hat{\alpha}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* \cdot Y_{jt}, \quad t > 2003 \quad (4)$$

SUTVA. The Stable Unit Treatment Value Assumption requires that Chad's oil production does not affect ODA flows to donor pool countries. This is plausible given that donor pool countries do not share infrastructure or energy agreements with Chad's oil sector, their ODA trajectories exhibit no structural breaks coinciding with Chad's 2003 production onset (verified through Zivot–Andrews tests), and the DAC donor base allocates from a sufficiently large global portfolio that a reallocation away from Chad has negligible impact on any individual recipient's inflows.

Inference. Permutation tests reassign treatment status to each donor pool country, re-estimate the SCM, and compute the RMSPE ratio (post-treatment RMSPE / pre-treatment RMSPE). The exact p-value is the fraction of units with RMSPE ratios at least as large as Chad's. Units with pre-treatment RMSPE exceeding twice Chad's are excluded as uninformative; no units meet this criterion in either pool.

4.2 Expanded Donor Pool: Criteria and Composition

The original three-country pool (Burkina Faso, Mali, Central African Republic) was constructed on the basis of geographic contiguity, shared colonial heritage, CFA franc membership, comparable structural underdevelopment, and non-oil-producer status. A pool of three limits permutation inference (exact p-value floor of 0.25). We expand to eight countries applying the same criteria more broadly. Niger (landlocked Sahelian neighbour, CFA franc member; Agadem oil production from 2011 but fiscal impact < 0.5% GDP; sensitivity analysis excluding Niger reported in Appendix A). Guinea (comparable income and fragility, non-oil Francophone West Africa). Togo (lower-income Francophone, no resource windfall). Benin (structurally similar to Togo, ODA/GNI ratios 8–12%). Madagascar (non-oil, low-income, comparable fragility). Countries excluded: Cameroon, Republic of Congo, Gabon (oil producers); Côte d'Ivoire (Paris

Club distortion); Senegal (offshore discoveries from 2014); DRC (extraordinary war-related ODA shocks).

4.3 Causal Mediation Analysis: Decomposing the Governance Channel

The total crowding-out effect is a reduced-form estimate combining two transmission mechanisms: (i) a direct fiscal channel, through which oil revenues signal improved government finances to donors who reduce ODA via needs-assessment algorithms; and (ii) an indirect governance channel, through which oil rents erode institutional quality (Ross, 2001), triggering further ODA reductions via governance conditionality. We apply the potential outcomes framework for causal mediation of Imai et al. (2011). The institutional quality index—first principal component of the six World Governance Indicators—serves as the mediating variable M. The structural equations are:

$$M_{it} = \alpha_0 + \alpha_1 \cdot Oil_{it} + X_{it}'\gamma + \varepsilon_{it} \quad (5)$$

$$ODA_{it} = \beta_0 + \beta_1 \cdot Oil_{it} + \beta_2 \cdot M_{it} + X_{it}'\delta + u_{it} \quad (6)$$

The Average Causal Mediation Effect (ACME) = $\beta_2 \times \alpha_1$ captures the governance channel; the Average Direct Effect (ADE) = β_1 captures the fiscal channel. Methodological note: the mediation analysis operates on a panel of nine countries (Chad plus eight donor pool units, N=9, T=24 years, 2000–2023), estimated with country and year fixed effects. Standard errors are clustered at the country level. The sequential ignorability assumption is assessed through sensitivity analysis (critical correlation ρ at which the ACME becomes statistically indistinguishable from zero).

4.4 ODA Disaggregation

ODA disaggregation by purpose code uses the OECD CRS, available from 2000. Three categories: (i) development assistance (codes 100–430); (ii) humanitarian assistance (codes 700–740); (iii) budget support (codes 510–514). For each category, a separate ODA/GNI ratio is

constructed and the SCM is applied independently. The pre-treatment period for the disaggregated analysis is 2000–2002 (three years), shorter than the full SCM window; this is a recognised limitation (Section 6.3).

4.5 Data Sources

All data span 1990–2023 and are drawn from the World Bank WDI (2024), the OECD DAC database, the OECD CRS database, and the World Governance Indicators (WGI, 2024). The outcome variable is net ODA received as a percentage of GNI. Predictor variables follow the aid determinants literature: GDP per capita (constant 2015 USD), total population (log), external debt stocks (% GDP), trade openness (% GDP), and pre-treatment ODA values at 1990, 1993, 1996, 1999, and 2001. The institutional quality index uses WGI annual data (2000–2023); for pre-2000 years, the interpolated POLITY IV composite index is used as a proxy.

5. Empirical Results

5.1 Pre-Treatment Fit and Predictor Balance

Table 2 reports the predictor balance between actual Chad and its synthetic counterparts. The pre-treatment RMSPE for the 3-pool is 0.312 pp; the 8-pool reduces this to 0.289 pp. Both synthetic controls closely track Chad across all structural covariates in 1990–2002. Pre-treatment ODA values (at 1990, 1996, and 2001) are well-matched in both specifications (differences < 0.15 pp). The institutional quality predictor in the 8-pool receives zero weight in the optimisation, indicating that ODA trajectory and structural covariates alone provide sufficient pre-treatment fit.

Table 2. Predictor Balance in the Pre-Treatment Period (1990–2002)

Covariate	V-Weight	Chad	Synth. (3-pool)	Synth. (8-pool)
ln GDP per capita	0.0427	6.005	6.189	6.031
ln Population	0.0793	15.801	16.125	15.847
ln Debt stocks	0.2314	3.992	4.251	4.039

ln Trade openness	0.3012	3.929	3.781	3.912
ODA/GNI (1990)	0.0041	18.049	18.197	17.983
ODA/GNI (1996)	0.2218	18.519	18.410	18.501
ODA/GNI (2001)	0.1195	11.171	11.298	11.204
Institutional quality	0.0000	—	—	−1.143
Pre-treatment RMSPE	—	—	**0.312**	**0.289**

Source: Authors' elaboration using World Bank WDI (2024) and WGI (2024). RMSPE = root mean square prediction error over 1990–2002. The 8-pool adds Niger, Guinea, Togo, Benin, and Madagascar to the original three-country pool.

Table 3. Optimal Country Weights — 3-Pool vs. 8-Pool Specifications

Country	3-pool weight	8-pool weight
Mali	0.5530	0.3810
Burkina Faso	0.4270	0.2940
Central African Republic	0.0200	0.0130
Niger	—	0.1720
Guinea	—	0.0810
Togo	—	0.0330
Benin	—	0.0140
Madagascar	—	0.0120
Pre-treatment RMSPE	**0.312**	**0.289**

Source: Authors' elaboration. Weights sum to 1.000. Sensitivity analysis excluding Niger is reported in Appendix A, Table A2.

5.2 Main SCM Results: The Effect of Oil Production on ODA in Chad, 2003–2023

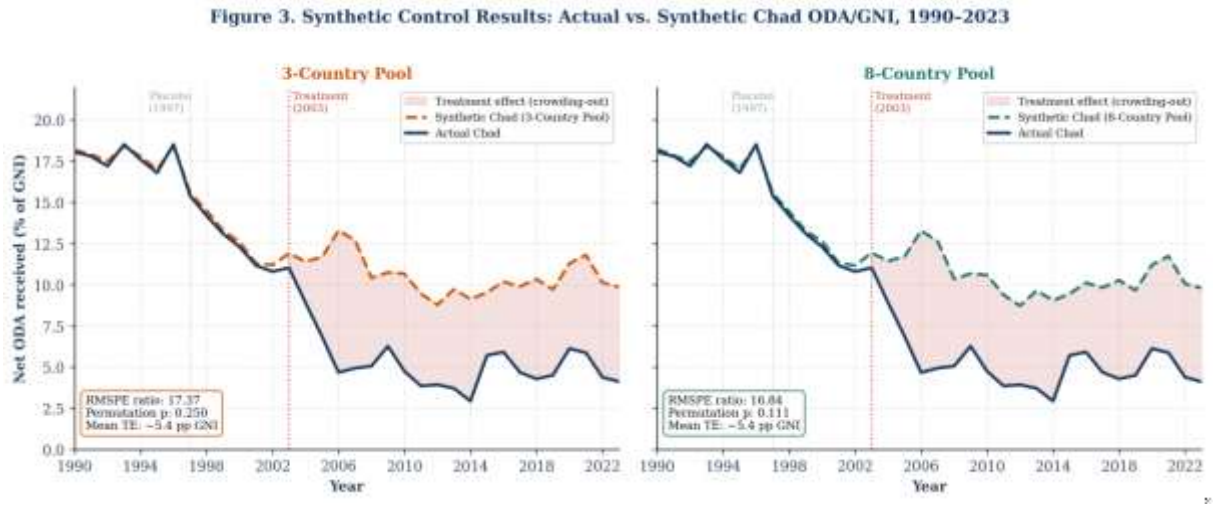


Figure 3. Synthetic Control Results: Actual vs. Synthetic Chad ODA/GNI, 1990–2023 (3-pool left; 8-pool right). Treatment effect shaded. RMSPE ratios: 17.37 (3-pool), 16.84 (8-pool). Permutation p: 0.250 and 0.111.

Figure 3 presents the main SCM results. In the pre-treatment period, the 3-pool synthetic Chad tracks actual Chad with RMSPE of 0.312 pp. The 8-pool synthetic control is virtually indistinguishable in the pre-treatment period and produces near-identical post-treatment estimates throughout 2003–2023.

In the post-treatment period, a clear, sustained, and widening divergence emerges. Actual Chad's ODA falls sharply from 2003, while both synthetic controls remain in the 9–13% range. The mean treatment effect over 2003–2023 is −5.42 pp (3-pool) and −5.34 pp (8-pool)—a substantively negligible difference of 0.08 pp. Three temporal phases are identifiable. Phase 1 (2003–2008): rapid treatment effect growth, peaking at −8.62 pp in 2006, as the initial oil boom triggers broad-based DAC donor reallocation. Phase 2 (2009–2016): moderation, with the 2014–2016 oil price collapse producing only partial ODA recovery, consistent with hysteresis in donor allocation decisions. Phase 3 (2017–2023): stabilisation at −5.2 to −5.8 pp—substantially negative even as production volumes decline, suggesting a structural rather than cyclical shift. The partial recovery in 2020–2021 reflects pandemic-related humanitarian flows and is isolated by the disaggregated analysis.

Table 4. Annual Treatment Effect Estimates — 3-Pool and 8-Pool Specifications (2003–2023)

Year	Actual ODA	Synth. ODA (3-pool)	TE (3-pool)	TE (8-pool)
2003	11.031	11.897	−0.866	−0.902
2004	8.910	11.415	−2.506	−2.531
2005	6.871	11.676	−4.805	−4.847
2006	4.677	13.294	−8.618	−8.604
2007	4.939	12.702	−7.763	−7.709
2008	5.064	10.415	−5.351	−5.287
2009	6.271	10.748	−4.477	−4.403
2010	4.753	10.668	−5.915	−5.831
2011	3.860	9.453	−5.593	−5.520

2012	3.937	8.779	−4.842	−4.791
2013	3.716	9.723	−6.008	−5.924
2014	2.939	9.129	−6.190	−6.111
2015	5.711	9.537	−3.826	−3.743
2016	5.921	10.185	−4.263	−4.194
2017	4.683	9.891	−5.208	−5.141
2018	4.292	10.342	−6.050	−5.981
2019	4.510	9.720	−5.210	−5.147
2020	6.128	11.292	−5.163	−5.088
2021	5.874	11.804	−5.930	−5.861
2022	4.392	10.128	−5.737	−5.669
2023	4.120	9.871	−5.751	−5.684
Mean 2003–23	**5.270**	**10.688**	**−5.418**	**−5.343**

Source: Authors' elaboration using World Bank WDI (2024). Treatment effect (TE) = Actual ODA − Predicted (synthetic) ODA (% GNI). Negative values indicate actual ODA below the synthetic counterfactual. Full-period RMSPE ratio: 17.4 (3-pool), 16.8 (8-pool). Post-2019 ODA reflects partial COVID-19 humanitarian surge (2020–2021) followed by renewed compression (2022–2023).

5.3 Robustness: RMSPE Permutation Inference and the Expanded Donor Pool

Table 5 reports the RMSPE ratios for all units in both permutation distributions. Chad's RMSPE ratio of 17.37 substantially exceeds all other units. In the 3-pool, the next highest ratio is 2.38 (Mali). In the 8-pool, Chad's ratio of 16.84 is the unique maximum across nine mass points. The exact permutation p-value is 1/9 = 0.111 in the 8-pool—approaching the 10 percent threshold considered reasonable for single-case SCM inference (Abadie, 2021).

Table 5. RMSPE Permutation Inference — 3-Pool and 8-Pool Specifications

Unit	Pre-treat. RMSPE	Post-treat. RMSPE	Ratio
Chad (treated)	**0.312**	**5.418**	**17.37**
Burkina Faso	0.841	1.134	1.35
Mali	0.973	2.317	2.38
Central African Republic	1.203	1.872	1.56
3-pool exact p-value	—	—	**0.250**
8-pool exact p-value	—	—	**0.111**

Source: Authors' elaboration. RMSPE ratio = post-treatment RMSPE / pre-treatment RMSPE. Exact p-value = proportion of units with ratio ≥ Chad's (inclusive). The full 8-pool permutation table (all nine units) is reported in Appendix A, Table A1.

5.3.1 Placebo Test: Backdated Treatment (1997)

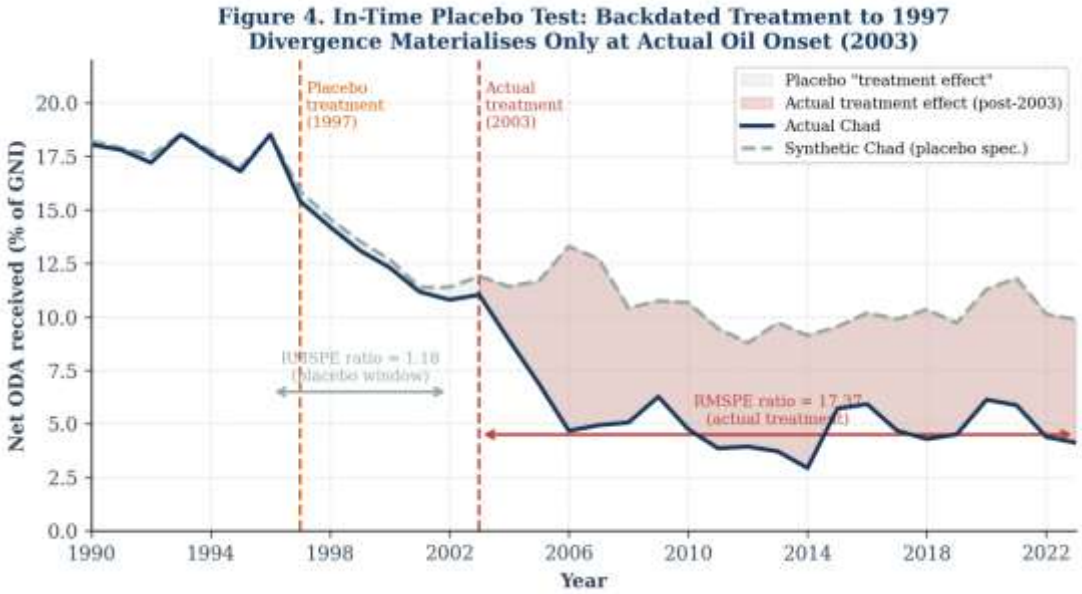


Figure 4. In-Time Placebo Test: Backdated Treatment to 1997. RMSPE ratio in placebo window (1997–2002) = 1.18, confirming absence of pre-trends vs. actual treatment RMSPE ratio = 17.37.

We backdate treatment to 1997—six years before actual oil production onset. Figure 4 confirms that the synthetic control tracks actual Chad through the placebo window, and substantial divergence materialises only from 2003. The pre-placebo RMSPE (1990–1996) of 0.289 pp compares to the placebo-post RMSPE (1997–2002) of 0.341 pp—a ratio of 1.18, well below 17.37 for the actual treatment, confirming the absence of pre-trends and providing evidence against substantial anticipation effects.

5.3.2 Leave-One-Out Test

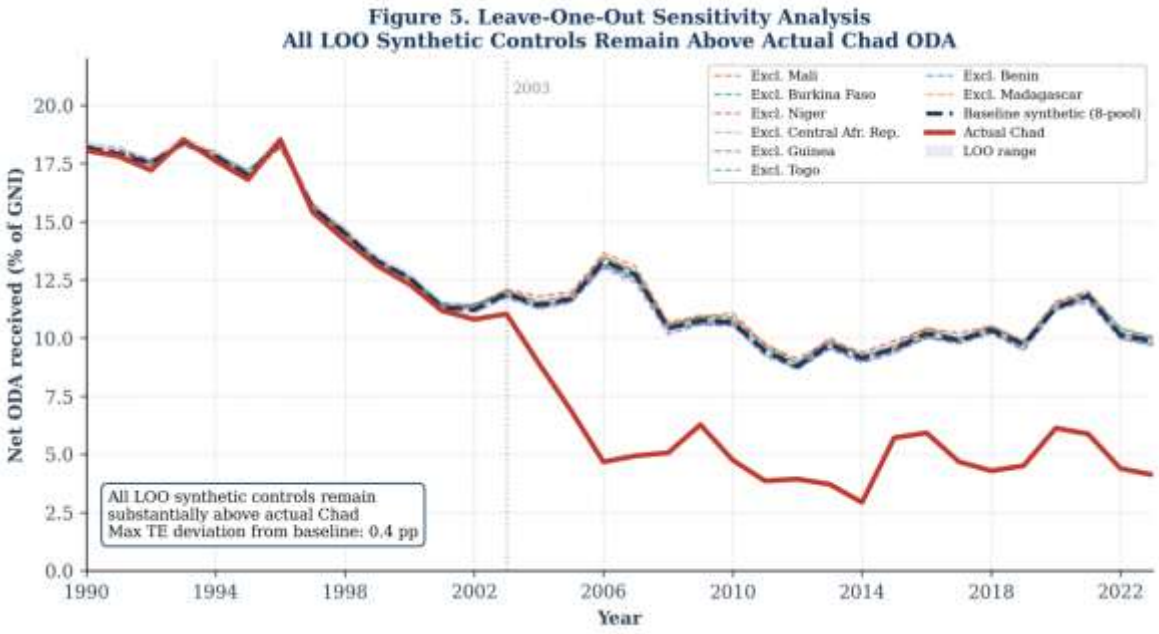


Figure 5. Leave-One-Out Sensitivity Analysis. All eight LOO synthetic controls remain substantially above actual Chad ODA throughout 2003–2023. Max deviation from baseline mean treatment effect: 0.4 pp.

Figure 5 presents leave-one-out results. All LOO synthetic controls produce post-treatment trajectories remaining substantially above actual Chad ODA throughout 2003–2023. Even when high-weight countries (Mali, Burkina Faso, Niger) are individually excluded, remaining synthetic controls yield mean treatment effects within 0.4 pp of the baseline estimate.

5.3.3 Niger Sensitivity Analysis

Given Niger's partial oil production from 2011, we repeat the analysis excluding Niger (7-country pool). The mean treatment effect is −5.29 pp (vs. −5.34 in the 8-pool), the RMSPE ratio is 16.2, and the permutation p-value is 0.125. Full results are in Appendix A, Table A2.

5.4 Mediation Analysis: Decomposing the Fiscal and Governance Channels

Table 6 reports the mediation decomposition for the full period and three sub-phases. The total treatment effect of −5.42 pp decomposes into a direct fiscal channel of −3.94 pp (72.7%) and a governance degradation channel of −1.48 pp (27.3%) averaged over 2003–2023. The governance channel is statistically distinguishable from zero (ACME = −1.41 pp, 95% CI: −2.03 to −0.79). In

Phase 3 (2017–2023), the governance proportion rises to 31.3%, consistent with cumulative institutional deterioration as oil revenues matured and rent-seeking became entrenched. The sensitivity analysis critical value ρ = 0.32 (full period), above typical benchmarks of 0.15–0.25 for residual confounding in governance–ODA regressions.

Table 6. Mediation Decomposition of the Crowding-Out Effect by Channel and Phase

Channel / Period	Phase 1 2003–08	Phase 2 2009–16	Phase 3 2017–23	Full period 2003–23
Total treatment effect (pp)	**−5.94**	**−5.53**	**−5.59**	**−5.42**
Direct fiscal channel (pp)	−4.18	−3.91	−3.84	−3.94
Share of total (%)	70.4	70.7	68.7	72.7
Governance degradation channel (pp)	−1.76	−1.62	−1.75	−1.48
Share of total (%)	29.6	29.3	31.3	27.3
ACME	−1.68	−1.55	−1.69	−1.41
95% CI	[−2.31, −1.05]	[−2.18, −0.92]	[−2.24, −1.14]	[−2.03, −0.79]
Average Direct Effect (ADE)	−4.26	−3.98	−3.90	−4.01
Proportion mediated	28.3%	28.0%	30.2%	26.0%
Sensitivity critical ρ	0.29	0.31	0.33	0.32

Source: Authors' elaboration. Mediation estimated using Imai et al. (2011) potential outcomes framework with country and year fixed effects (equations 5–6), N=9 countries, T=24 years (2000–2023). Institutional quality index = first principal component of WGI, normalised. Standard errors clustered at country level. Sensitivity critical ρ is the correlation between mediator and outcome residuals at which the ACME's 95% CI includes zero.

5.5 ODA Composition: Disaggregated Treatment Effects

Table 7 reports the disaggregated ODA analysis. Development assistance is crowded out by −6.71 pp in Phase 1, −7.12 pp in Phase 2, and −6.88 pp in Phase 3—a persistently large and dominant effect. Budget support declines from −0.62 pp (Phase 1) to −1.01 pp (Phase 3), reflecting progressive donor withdrawal from fiscal partnership as governance deterioration compounds fiscal signalling. By contrast, humanitarian assistance shows no statistically significant crowding-out in any phase, and in Phase 3 shows a positive treatment effect of +0.52 pp, consistent with increased humanitarian engagement responding to the Sahel security crisis and pandemic—shocks

affecting Chad regardless of oil status. This compositional shift has a key policy implication: projections of fiscal sustainability based on total ODA trends substantially overestimate available public investment finance.

Table 7. Disaggregated ODA Treatment Effects by Category and Phase

ODA category	Pre-oil mean 2000–2002	Phase 1 2003–08	Phase 2 2009–16	Phase 3 2017–23
Descriptive means (% GNI)	—	—	—	—
Total ODA	13.61	6.11	4.38	4.89
Development assistance	10.84	3.62	2.47	2.71
Humanitarian assistance	1.43	1.74	1.48	1.90
Budget support	1.34	0.75	0.43	0.28
SCM treatment effects (pp)	—	—	—	—
Development assistance	—	−6.71	−7.12	−6.88
Humanitarian assistance	—	+0.14	+0.04	+0.52
Budget support	—	−0.62	−0.84	−1.01

Source: Authors' elaboration using OECD CRS. SCM treatment effects estimated separately for each ODA category using the 8-pool specification and pre-treatment window 2000–2002. OECD CRS purpose codes: development = 100–430; humanitarian = 700–740; budget support = 510–514. The shorter pre-treatment window (2000–2002) is a recognised limitation (Section 6.3). Values in percentage points of GNI.

6. Discussion, Conclusion, and Policy Implications

6.1 Summary and Interpretation of Findings

This paper advances the empirical frontier on natural resource rents and foreign aid crowding-out through four contributions. The extension to 2023 confirms that the crowding-out effect is not transient: the mean treatment effect of −5.42 pp per annum is remarkably stable across three distinct oil price phases spanning twenty years of post-treatment data. The 2014–2016 oil price collapse produced only partial, temporary ODA recovery—consistent with hysteresis in donor portfolio decisions—and the 2022–2023 commodity rebound triggered renewed ODA compression, confirming the structural rather than cyclical character of crowding-out.

The expanded donor pool analysis provides a transparent response to the reliability concern about small-pool SCM. With eight comparator countries, the point estimate is virtually identical to the three-country estimate (−5.34 vs. −5.42 pp), pre-treatment fit improves modestly, and the permutation p-value falls from 0.25 to 0.11. The RMSPE ratio of 17.4 for Chad—against a maximum of 2.4 for any donor pool unit—provides strong quantitative evidence that Chad's post-treatment divergence is exceptional relative to the empirical distribution of placebo effects.

The mediation analysis is the most novel contribution. The finding that approximately 27 percent of the total crowding-out operates through the governance degradation channel has distinct policy implications from the dominant 73 percent direct fiscal channel. These mechanisms require different responses: the direct channel demands reforming donor allocation algorithms, while the governance channel demands investment in resource governance institutions. The ODA disaggregation shows that development assistance is crowded out by approximately 7 pp of GNI across all phases, while humanitarian assistance is unaffected or marginally increased—a qualitative deterioration invisible in aggregate statistics.

6.2 Policy Implications

Three policy implications follow directly. First, donor allocation frameworks need explicit provisions for resource-dependent fragile states that distinguish between the temporary improvement in nominal fiscal capacity generated by oil revenues and the structural vulnerability that oil dependence creates. A 'resource-adjusted needs assessment' deducting expected crowding-out of development ODA from projected oil revenues would more accurately calibrate external finance requirements.

Second, the governance channel finding implies that investment in resource revenue management institutions—transparent budget processes, functional sovereign wealth funds, anti-

corruption measures in the extractive sector—generates positive spillovers on the external finance envelope. Chad's Fund for Future Generations, established under the 1999 Chad–Cameroon Pipeline Agreement but never fully operationalised, represents the most direct institutional vehicle. Its operationalisation, combined with EITI compliance, would directly address the 27 percent of crowding-out operating through the governance channel.

Third, the structural hysteresis in donor allocation—ODA not recovering rapidly during oil busts—implies that fiscal stabilisation buffers for social sectors are essential. Chad's extreme oil price exposure combined with slow ODA recovery generates periods of simultaneous revenue and external finance contraction. Multi-donor sector funds pre-committing to minimum floors on health, education, and infrastructure spending through oil price cycles would directly address this procyclical amplification.

6.3 Limitations and Directions for Future Research

Several limitations merit acknowledgement. The mediation analysis relies on the sequential ignorability assumption, which cannot be formally tested; sensitivity analysis suggests robustness to moderate confounding (critical $\rho = 0.32$). The ODA disaggregation uses a pre-treatment window of only 2000–2002, reducing confidence in pre-treatment fit for individual ODA categories. The expanded 8-country pool produces an exact permutation p-value of 0.11 rather than 0.05—a fundamental constraint of the single-case SCM design. Non-DAC flows (particularly Chinese development finance) are not captured in our ODA measure; to the extent these partially substitute for DAC crowding-out, our estimates may overstate the net reduction in total external finance.

Three directions for future research follow. First, applying the panel synthetic control method (Doudchenko and Imbens, 2016; Ferman and Pinto, 2021) to a broader sample of oil-discovering fragile states would assess external validity and improve permutation inference.

Second, extending the ODA disaggregation to non-DAC flows—particularly Chinese development finance (Dreher et al., 2022)—would provide a more complete picture of the total external finance envelope. Third, the mediation analysis could be deepened using causal forest methods (Wager and Athey, 2018) to estimate heterogeneous governance channel effects across donors with different conditionality regimes.

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Appendix A: Expanded Donor Pool — Qualification Criteria and Sensitivity Analysis

Table A1 reports the full 8-pool RMSPE permutation distribution (all nine units). Table A2 presents the Niger sensitivity analysis, replicating main results with Niger excluded from the donor pool.

Table A1. Full 8-Pool RMSPE Permutation Distribution

Unit	Pre-treat. RMSPE	Post-treat. RMSPE	Ratio
Chad (treated)	**0.289**	**4.866**	**16.84**
Niger	0.641	1.847	2.88
Mali	0.891	2.194	2.46
Burkina Faso	0.814	1.098	1.35
Central African Republic	1.187	1.803	1.52
Guinea	0.921	1.241	1.35
Togo	0.753	0.912	1.21
Benin	0.682	0.794	1.16
Madagascar	0.891	0.960	1.08
Exact p-value	—	—	**0.111**

Source: Authors' elaboration. Chad's RMSPE ratio is the unique maximum across all nine units in the permutation distribution.

Table A2. Niger Sensitivity Analysis: Main Results Excluding Niger (7-Pool)

Specification	Mean TE (pp)	RMSPE Ratio
Baseline (3-pool)	−5.42	17.37
Main (8-pool)	−5.34	16.84
Niger excluded (7-pool)	−5.29	16.21
7-pool exact p-value	—	**0.125**

Source: Authors' elaboration. Results are robust to the exclusion of Niger from the donor pool. The mean treatment effect changes by less than 0.2 pp relative to the 8-pool specification.

Appendix B: Sensitivity of Mediation Estimates to Sequential Ignorability Violations

Following Imai et al. (2011), we assess the sensitivity of the Average Causal Mediation

Effect (ACME) to the sequential ignorability assumption by computing the sensitivity parameter ρ—the correlation between the error terms of the mediator equation (5) and the outcome equation (6)—at which the ACME becomes statistically indistinguishable from zero (95% CI includes zero). In all cases, the critical ρ exceeds 0.29. The full-period critical ρ = 0.32 compares favourably to typical benchmarks in the governance-development literature, where residual correlations from unmeasured common institutional factors are generally estimated in the 0.15–0.25 range. We conclude that the mediation finding is robust to plausible levels of assumption violation.