

Resource Dependence, Fiscal Accountability and Regional Diversification in Zambia: Subnational Evidence from a Mining Economy

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Abstract

Resource-rich regions are often assumed to experience a subnational resource curse, but the inference may depend on how extraction and diversification are measured. This article examines Zambia's ten provinces using a balanced 2016–2021 panel from official provincial accounts and an auxiliary 2019–2021 fiscal panel constructed from 149 local-authority audit tables. Overall diversification is measured as one minus a 19-sector gross value added Herfindahl-Hirschman index, with mining's provincial output share capturing resource dependence. Two-way fixed effects, small-cluster wild-bootstrap inference, between-within decomposition, first differences, influence tests and alternative diversification measures are used. The pooled association is strongly negative, but the preferred within-province mining coefficient is imprecise ($\beta = -0.339$, $p = 0.402$; wild-bootstrap $p = 0.800$). The between-province coefficient is negative ($\beta = -0.490$, $p < 0.001$) but disappears when North-Western Province is excluded. When mining is removed from the diversification index, however, mining dependence is positively associated with non-extractive diversification ($\beta = 0.448$, $p = 0.004$), while manufacturing share shows no significant response. Transfer dependence does not mediate the mining-diversification relationship. The findings challenge deterministic interpretations of the subnational resource curse and show that overall concentration, non-extractive variety and productive transformation are distinct outcomes. For mining-region policy, the relevant question is not simply whether extraction raises concentration, but whether mineral development builds local linkages, productive capabilities and accountable fiscal institutions.

JEL classification: Q32; Q33; H71; H77; R11; O55

1. Introduction

Natural-resource abundance poses a persistent analytical paradox. Mineral extraction can relax foreign-exchange and fiscal constraints, finance infrastructure and create demand for local suppliers; it can also produce enclave economies, volatile public revenues, rent-seeking incentives and weak incentives to build broad tax bases. The resource-curse literature has therefore moved away from treating resources as intrinsically harmful toward asking which institutional, political and productive structures convert resource rents into development (Mehlum et al. 2006; van der Ploeg 2011; Venables 2016). Yet much of this literature remains national in scale. That is problematic because extraction is spatially concentrated, fiscal systems redistribute revenues across territories, and the costs and benefits of mining are experienced unevenly across places (Aragón and Rud 2013; Caselli and Michaels 2013; Borge et al. 2015; Manzano and Gutiérrez 2019). Breul and Atienza (2022) make this regional scale explicit, arguing that diversification in mining regions is multi-scalar, path-dependent and temporally differentiated.

Zambia is a demanding case for a subnational test. Copper has shaped the country's political economy for more than a century, but contemporary mineral production is geographically concentrated in Copperbelt and, increasingly, North-Western Province. Mining has also shaped the spatial form of Zambian towns: recent evidence shows that inherited settlement patterns and material dependencies can constrain the development of post-mining economies (Mukumba et al. 2026). At the same time,

local governments operate within an intergovernmental system in which own-source revenues coexist with the Local Government Equalisation Fund (LGEF), Constituency Development Fund (CDF), grants in lieu of rates and other transfers. The World Bank's Zambia Urbanization Review describes councils as weak and underfunded and documents large disparities in their capacity to raise own-source revenue (World Bank 2022). Zambia's 2023 National Decentralisation Policy similarly identifies erosion of the local revenue base, weaknesses in valuation and revenue administration, and limitations in the intergovernmental transfer architecture (Government of Zambia 2023). The fiscal geography of mining is therefore not equivalent to the geography of extraction.

This distinction matters for accounting and accountability. A region can host a large mine without retaining a commensurate share of mining rents locally, while a non-mining council can be highly dependent on central transfers. Conversely, mining municipalities may have unusually strong property-rate and fee bases. Treating resource dependence, transfer dependence and fiscal accountability as interchangeable risks obscuring the actual institutional mechanism. Recent research reinforces this point. Masi et al. (2024) show that a fiscal resource curse is contingent on political institutions and fiscal capacity; Collazos-Ortiz and Schakel (2024) find that administrative efficiency conditions local fiscal effort in resource-rich Colombian municipalities; and Contreras and Orihuela (2026) provide municipal evidence that resource revenues can weaken fiscal incentives. These studies make the fiscal channel testable, but they do not justify assuming it in advance.

A second problem is measurement. Diversification is often proxied by a concentration index built from sector shares, while resource dependence is measured by the extractive-sector share of the same sector vector. When mining becomes large, the HHI necessarily rises even if the remaining non-extractive economy becomes more internally diverse. In that case, a negative mining-diversification coefficient partly reflects an accounting identity rather than a behavioural resource-curse mechanism. This is not a technical footnote. It determines whether policy should focus on reducing the relative size of extraction, deepening manufacturing and supplier linkages, improving fiscal institutions, or strengthening diversity within the non-mining economy.

The article addresses these issues through three questions. First, is mining dependence associated with lower provincial economic diversification in Zambia once persistent province characteristics and national year shocks are controlled? Second, does the result survive alternative definitions that remove mining from the diversification index and focus separately on manufacturing? Third, does local fiscal dependence provide an observable mechanism connecting resource dependence to diversification? I construct a balanced panel of all ten provinces for 2016–2021 (60 observations) using official provincial GDP by production, and an auxiliary fiscal panel for 2019–2021 from 149 council-year Budget and Income tables reported by the Office of the Auditor General.

The results are deliberately less convenient than a standard resource-curse narrative. Pooled and between-province patterns suggest strong concentration in mining-intensive provinces, but the preferred two-way fixed-effects estimate is statistically indistinguishable from zero. The between effect is driven

heavily by North-Western Province. Once mining is removed from the diversification index, the sign reverses: greater mining exposure is associated with more, not less, diversity among non-extractive activities. Nor is there evidence that transfer dependence mediates the relationship in the auxiliary fiscal panel. These findings do not demonstrate that mining is benign. They demonstrate that 'resource curse' claims depend on the spatial and calculative architecture through which dependence and diversification are made visible.

The paper contributes in four ways. Empirically, it provides a province-level panel test for Zambia rather than extrapolating from national aggregates. Methodologically, it makes the compositional coupling between an extractive share and an HHI outcome explicit and treats non-extractive diversification as a necessary counterfactual estimand rather than a discretionary robustness check. Theoretically, it reframes the proposed subnational fiscal accountability trap as a contingent institutional configuration whose links must be observed rather than assumed. From a public-sector accounting perspective, it separates calculative visibility from substantive accountability: fiscal ratios reveal who raises and receives funds, but not whether budget information produces answerability, citizen voice or corrective action (Haustein and Lorson 2023; Barbera, Sicilia and Steccolini 2024). Finally, it connects diversification to SDG localisation, arguing that productive transformation (SDGs 8 and 9), distributional inclusion (SDG 10), environmental responsibility (SDGs 12 and 13) and accountable institutions (SDGs 16 and 17) must be evaluated jointly.

2. Literature review and theoretical development

2.1 From the national resource curse to subnational heterogeneity

The early resource-curse literature associated resource dependence with slower long-run growth, macroeconomic volatility and weak institutions (Sachs and Warner 2001; Auty 1993). Subsequent work qualified this determinism. Institutional quality mediates outcomes (Mehlum et al. 2006), the composition and appropriability of resources matter (Boschini, Pettersson and Roine 2013), and policy can transform rents into productive assets (van der Ploeg 2011; Venables 2016). The relevant question is therefore not whether minerals are a curse in the abstract, but which mechanisms transmit extraction into economic and institutional outcomes.

Subnational research sharpens this question because national averages hide spatial asymmetry. Mining may raise wages, demand and public revenue near production sites while also displacing agriculture, intensifying inequality or producing local fiscal windfalls (Aragón and Rud 2013; Loayza and Rigolini 2016). Brazilian evidence shows that oil windfalls do not automatically translate into improved local living standards (Caselli and Michaels 2013). Norwegian evidence identifies a local natural-resource curse working through public-sector labour allocation and political incentives (Borge et al. 2015). Manzano and Gutiérrez (2019) consequently argue that subnational analysis requires explicit attention to fiscal arrangements and territorial institutions.

For Zambia, this spatial approach is especially important because the mining frontier has shifted. The historical Copperbelt combines extraction with older urban, industrial and service agglomerations, whereas North-Western Province exhibits a more recent and exceptionally mining-intensive economic structure. These trajectories are embedded in a longer political economy of mining and uneven local linkages (Fraser and Larmer 2010; Gamu et al. 2015). More recent work on Zambia's local-content agenda shows that domestic supplier capacity, finance and inter-sectoral linkages remain constraints on using mining to generate structural transformation (Kragelund 2024). Provinces therefore differ not only in resource abundance but in urbanisation, inherited infrastructure, supplier ecosystems and the maturity of non-mining sectors. A cross-sectional coefficient can easily confound resource dependence with these long-lived territorial characteristics. Fixed effects are consequently not a statistical embellishment; they operationalise a theoretical distinction between persistent territorial structure and within-province change.

2.2 Fiscal dependence, accountability and the proposed subnational fiscal accountability trap

Fiscal sociology and decentralisation theory imply that the source of public revenue can shape accountability. Governments relying on broad local taxation have stronger incentives to build administrative capacity and may face stronger demands to justify expenditure, while externally financed jurisdictions can experience weaker tax bargaining and softer budget constraints. Yet decentralisation can also improve responsiveness when authority, resources and accountability are aligned (Faguet 2014). The direction of the relationship is therefore institutionally contingent rather than universal.

Recent empirical evidence supports a conditional interpretation. Adanu (2024) revisits the interaction of intergovernmental transfers and local revenues in Ghana. Collazos-Ortiz and Schakel (2024) show that administrative efficiency affects whether natural-resource revenues undermine municipal fiscal effort in Colombia. Masi et al. (2024) locate fiscal resource-curse effects within broader political and fiscal-capacity conditions, while Contreras and Orihuela (2026) document municipal fiscal-resource-curse dynamics in Peru. Together these studies suggest a plausible chain: resource rents can weaken own-source mobilisation or intensify transfer dependence, which may reduce fiscal discipline and the incentive to construct a diversified local tax base. But each link must be observed rather than presumed.

I call this hypothesised chain a subnational fiscal accountability trap: extractive dependence may be associated with a fiscal structure that weakens locally generated revenue, reduces reciprocal fiscal relations with citizens and narrows incentives for productive diversification. The trap is conceptually attractive but demanding empirically. In Zambia, mineral taxes are largely national, the LGEF is redistributive, CDF allocations are politically and administratively distinct from mining revenue, and mining councils can raise property rates from industrial assets. A positive relationship between mining and fiscal autonomy is therefore possible even if the national economy is resource dependent. This institutional decoupling is precisely why the fiscal mechanism requires direct testing.

Moreover, fiscal autonomy is not synonymous with accountability. A high own-source-revenue share may reflect a rich tax base, coercive fees, urban property values or effective administration; a low share may reflect poverty, central assignment of major taxes or deliberate equalisation. Evidence that transparency can shape municipal taxation further underlines that revenue mobilisation is institutionally mediated rather than mechanically produced (Cifuentes-Faura et al. 2024). Public-sector accounting makes fiscal flows visible, but substantive accountability also requires comprehensible reporting, answerability and mechanisms through which citizens and oversight bodies can challenge decisions (Haustein and Lorson 2023; Ferry and Midgley 2024). I therefore refer to transfer dependence and revenue execution as fiscal-accountability proxies, not as complete measures of accountability.

2.3 Diversification, structural transformation and the accounting problem of HHI

Diversification is a multidimensional process. A resource-rich province can diversify by expanding manufacturing, tradable services and supplier industries; by increasing the number of productive non-mining activities; or simply by growing construction, retail and public services around a mining boom. These pathways differ substantially in productivity, resilience and sustainability. Ross and Werker (2024) show that diversification in resource-rich Africa is possible but uneven, while Blankenship et al. (2024) emphasise that urgency, interests and policy design shape diversification in resource-dependent economies. Heim et al. (2023) highlight technological spillovers and collaborative policy as routes through which resource sectors can support diversification rather than crowd it out. Zambia-specific evidence adds an important qualification: local-content policies have not automatically generated structural transformation (Kragelund 2024), and downstream critical-mineral ventures face barriers to meaningful local participation (Cervantes Barron et al. 2024).

The HHI is transparent and comparable, but it embeds a compositional constraint. If mining's share rises substantially, the overall concentration index changes partly because mining itself is one of the components being squared. Regressing $1-HHI$ on mining share can therefore conflate two questions: whether mining occupies a large share of provincial output and whether the remaining economy is internally diversified. This problem is particularly acute when one province, such as North-Western in Zambia, reaches mining shares approaching four-fifths of GVA in some years. The formal decomposition presented in Section 3.2 shows exactly when the mechanical component makes the marginal relationship negative. A credible resource-curse interpretation must therefore be triangulated with a diversification measure that removes mining and with narrower indicators of structural deepening such as manufacturing share.

This distinction also matters for sustainable development. Diversification into low-productivity retail or carbon-intensive activities is not equivalent to a just transition. Resource dependence can restrict green development through institutional and productive channels (Dong et al. 2024), while regional diversification can generate new environmental and distributional trade-offs. The relevant objective is

not diversification at any cost but capability-building diversification that creates decent work, productive linkages and resilience.

2.4 SDG localisation and subnational fiscal capacity

The 2030 Agenda makes the subnational scale unavoidable. SDG 8 concerns decent work and sustained, inclusive growth; SDG 9 concerns productive infrastructure, industrialisation and innovation; SDG 10 highlights distribution; SDG 12 and SDG 13 require resource-efficient and climate-consistent production; SDG 16 foregrounds effective, accountable institutions; and SDG 17 emphasises fiscal and institutional partnerships. Localising these goals means translating national commitments into territorial budgets, investments and measurable outcomes (United Nations 2015; OECD 2024).

Recent sustainability research stresses that local SDG implementation is relational and cross-sectoral. Bandari et al. (2024) show that local sustainability requires governance arrangements capable of managing spillovers across scales, while Cheema et al. (2024) emphasise institutional alignment in local government systems. Public-sector accounting research similarly shows that financial sustainability, transparency and reporting architecture matter for the capacity of local governments to translate resources into sustainable outcomes (Bisogno et al. 2024; Dabbicco et al. 2025; Kaur 2025). This is crucial for mining regions: reporting resource revenues without tracing productive, social and environmental additionality can create transparency without developmental accountability.

For Zambia, the SDG implication is not that a higher diversification index automatically signals SDG progress. A province could become statistically more diversified while decent work deteriorates, inequality rises or environmental pressures intensify. Conversely, an extractive province could use mining-generated capabilities to widen the non-extractive production base while its overall HHI remains high because mining itself is dominant. The empirical analysis therefore treats SDG localisation as an interpretive accountability layer rather than coding the SDGs directly into the dependent variable. Figure 1 summarises the resulting integrated theoretical framework linking resource dependence, fiscal accountability, diversification and SDG localisation.

2.5 Hypotheses and critical expectations

Table 1
Hypotheses and critical empirical expectations

Test	Proposition	Theoretical basis	Critical qualification
H1	Higher mining dependence is associated with lower overall provincial diversification.	Resource-curse / structural concentration channel.	Expected negative; vulnerable to mechanical HHI coupling.
H2	Higher mining dependence is associated with greater transfer dependence / weaker fiscal autonomy.	Subnational fiscal accountability trap.	Ambiguous in Zambia because mining taxes are central while mining councils may have stronger local tax bases.
H3	Transfer dependence is associated with lower diversification, controlling for mining exposure.	Fiscal incentives / accountability channel.	Expected negative if transfer dependence weakens local revenue bargaining and development incentives.
H4	Transfer dependence mediates part of the resource dependence-diversification association.	Integrated fiscal-resource mechanism.	Requires significant a and b paths and a non-zero indirect effect.
Robustness	Mining dependence is negatively associated with non-extractive diversification and manufacturing share.	Genuine structural crowding-out interpretation.	If this fails, H1 should not be interpreted as broad-based crowding out.

3. Research design

3.1 Data construction and unit of analysis

The primary dataset is a balanced panel of Zambia's ten provinces over 2016–2021, yielding 60 province-year observations. Sectoral provincial gross value added and GDP at market prices are taken from the Zambia Statistics Agency's official Provincial GDP 2016–2021 at current prices workbook. Provincial GDP is compiled using a top-down production approach consistent with the 2008 System of National Accounts and regional-accounts guidance. The dataset reports 19 mutually exclusive production activities, allowing the same sector architecture to be applied across all provinces and years (Zambia Statistics Agency 2023).

Population and urbanisation controls are aligned to the provincial series using official population projections employed in the data compilation. GDP per capita is calculated in nominal kwacha. The analysis uses current-price sector shares rather than real growth rates because the research question concerns the contemporaneous structure of provincial production. Year fixed effects absorb national inflation and common nominal shocks; the interpretation is therefore about relative within-province structural change rather than real growth.

The fiscal dataset is separately constructed from Office of the Auditor General reports for financial years 2019, 2020 and 2021 (Office of the Auditor General Zambia 2020, 2021, 2022). The reports contain council-level Budget and Income tables separating locally generated income from national support such as the LGEF, CDF and other grants. I extracted 149 council-year observations for which both local and national-support subtotals were cleanly identifiable: 42 councils in 2019, 64 in 2020 and 43 in 2021. These are aggregated to province-year ratios, producing 30 province-year observations. This design is materially stronger than using a national fiscal indicator, but it remains an audit-based sample rather than a census of all councils. The varying composition is explicitly treated as a limitation.

The audit evidence is particularly relevant because it captures accounting relationships that formal decentralisation documents alone cannot reveal. However, it should not be mistaken for a direct accountability index. The reports identify uncollected revenues, unsupported payments, delayed projects and weaknesses in financial records, but coding all quantified audit findings consistently across councils and years would require a separate content-analysis protocol. The present paper therefore restricts fiscal proxies to transparent Budget and Income ratios and does not convert heterogeneous audit exceptions into a synthetic governance score.

3.2 Variables

Table 2
Variable construction and empirical role

Variable	Operationalisation	Role	Interpretive caution
Diversification index	$D_{it} = 1 - \sum_k s_{kit}^2$, across 19 GVA sectors	Primary outcome	Higher = more diversified.
Mining share	m_{it} = mining and quarrying GVA / total provincial GVA	Primary explanatory variable	Structural resource dependence; not provincial mining rent.
Non-extractive diversification	$D_{it}^* = 1 - \sum_j q_{jit}^2$ after deleting mining and renormalising remaining shares	Robustness outcome	Removes mechanical mining-HHI coupling.
Market non-extractive diversification	$1 - \text{HHI}$ after excluding mining and core public-service sectors, with remaining shares renormalised	Robustness outcome	Focuses more closely on private/market production diversity.
Manufacturing share	Manufacturing GVA / total provincial GVA	Structural transformation outcome	Tests industrial deepening/crowding out.
Transfer dependence	National-support actual income / total actual income of audited councils in province-year	Fiscal mechanism	Auxiliary 2019–2021 sample; changing audit coverage.
Fiscal autonomy	Locally generated actual income / total actual income of audited councils in province-year	Fiscal mechanism	Exact complement of transfer dependence in extracted categories.
Local revenue execution	Locally generated actual income / locally generated income budget	Fiscal capacity proxy	Can exceed 1 when collections exceed budget.
GDP per capita	Nominal provincial GDP / population	Control	Logged in regressions.
Urban share	Urban population / total provincial population	Control	Captures agglomeration and economic structure.

Measurement decomposition. Let m_{it} denote mining share and q_{jit} the share of non-mining sector j after the non-mining economy is renormalised to sum to one. The manuscript's overall and non-extractive diversification measures can then be related exactly:

$$D_{it} = 1 - \sum_k s_{kit}^2 \quad (1)$$

$$\text{HHI}_{it} = m_{it}^2 + (1 - m_{it})^2 \text{HHI}_{it}^* \quad (2)$$

$$D_i = 1 - m_i^2 - (1 - m_i)^2 \text{HHI}_i \quad (3)$$

$$\partial D_i / \partial m_i = 2[\text{HHI}_i - m_i(1 + \text{HHI}_i)] \quad (4)$$

Holding non-extractive concentration fixed, Eq. (4) is negative once $m_i > \text{HHI}_i / (1 + \text{HHI}_i)$. The negative mechanical component therefore becomes stronger as mining occupies a larger share of output. This identity motivates the non-extractive HHI and manufacturing-share specifications rather than treating them as optional robustness checks. Figure 2 summarises the resulting conceptual and empirical framework, from data construction and measures through estimands, inference diagnostics and interpretation.

3.3 Econometric specification and inference

The baseline specification estimates within-province change in diversification as a function of mining dependence, time-varying controls, province fixed effects and year fixed effects. Province fixed effects absorb time-invariant characteristics such as geography, inherited infrastructure and long-standing institutional differences; year effects absorb national shocks common to all provinces, including inflation, macroeconomic instability and the COVID-19 shock. The model is written formally below. Standard errors are clustered by province.

$$D_i = \beta m_i + X_i' \gamma + \alpha_i + \lambda + \varepsilon_i \quad (5)$$

The small number of clusters is an important inferential constraint. With only ten provinces, conventional asymptotic cluster-robust p-values may be unreliable. I therefore treat the restricted wild-cluster bootstrap-t test with 1,999 replications as a principal small-cluster diagnostic, consistent with recent guidance on more reliable cluster-robust inference when the number of clusters is small (MacKinnon et al. 2023). I also estimate first differences, leave-one-province-out models, between-province regressions and a correlated-random-effects/Mundlak decomposition. Together these estimands distinguish persistent spatial differences from within-province dynamics rather than forcing them into one coefficient.

For the between-within decomposition, mining dependence is separated into its province mean and its within-province deviation; first differences provide a complementary change specification:

$$D_i = \beta W(m_i - \bar{m}_i) + \beta B \bar{m}_i + X_i' \gamma + \lambda + u_i \quad (6)$$

$$\Delta D_i = \beta \Delta m_i + \Delta X_i' \gamma + \Delta \lambda + \Delta \varepsilon_i \quad (7)$$

The fiscal mechanism is assessed only for 2019–2021. The mediation exercise is deliberately exploratory: transfer dependence is first modelled as a function of mining share, after which diversification is modelled jointly on mining share and transfer dependence. The indirect effect is the product of the estimated a and b paths and is evaluated using a 3,000-replication province-block

bootstrap. Given $N = 30$, ten clusters and changing audit coverage, this is a mechanism probe rather than a definitive causal mediation design.

The exploratory fiscal mechanism is represented by two linked equations, with indirect effect $\alpha \times \beta$:

$$T_{it} = \alpha m_{it} + X'_{it} \gamma + \alpha_i + \lambda_t + u_{it} \quad (8)$$

$$D_{it} = c' m_{it} + b T_{it} + X'_{it} \gamma_\beta + \alpha_i + \lambda_t + \varepsilon_{it} \quad (9)$$

No instrumental variable is available that plausibly shifts provincial mining exposure while satisfying the exclusion restriction for diversification over this short window. I therefore avoid causal verbs. Fixed effects improve comparability but do not solve reverse causality, time-varying omitted variables or measurement error. This restraint is substantive: a credible null or measurement-sensitive result is more informative than a causal claim unsupported by the design.

4. Results

4.1 Descriptive patterns

Table 3
Descriptive statistics

Variable	N	Mean	SD	Min	Max
Overall diversification (1-HHI)	60	0.814	0.122	0.386	0.909
Mining share of provincial GVA	60	0.120	0.212	0.000	0.780
Manufacturing share of GVA	60	0.037	0.061	0.000	0.222
Non-extractive diversification	60	0.844	0.030	0.742	0.900
GDP per capita (kwacha)	60	16,318.1	12,924.4	5,608.6	69,619.3
Urban population share	60	0.346	0.261	0.118	0.863
Notes: Shares and diversification indices are expressed on a 0–1 scale. GDP per capita is nominal kwacha and is logged only in regression models. The distribution of mining share is highly right-skewed, motivating influence and alternative-estimand checks.					

The descriptive statistics immediately reveal the central identification challenge. Mean overall diversification is 0.814, but the minimum is only 0.386, reflecting an extremely concentrated province-year. Mining's mean GVA share is 0.120 with a standard deviation of 0.212 and a maximum of 0.780. This distribution is strongly right-skewed rather than a smooth continuum of resource dependence. North-Western Province occupies the high-exposure tail, while many provinces report little mining GVA. A linear pooled regression can therefore be dominated by a small number of structurally unusual observations.

The pooled Pearson correlation between mining share and the overall diversification index is -0.912 ($p < 0.001$). Read literally, this appears to provide overwhelming evidence of a resource curse. Yet the Spearman correlation is only 0.070 ($p = 0.593$), already indicating that the apparent relationship is not a stable monotonic rank association. Excluding North-Western Province reverses the Pearson correlation to + 0.327 ($p = 0.016$). This contrast is a warning against treating a visually striking cross-sectional pattern as a general provincial law.

4.2 Two-way fixed-effects estimates

Table 4
Two-way fixed-effects estimates (dependent variable: overall diversification index)

Variable	FE1	FE2	FE3
Mining share of GVA	-0.310 (0.351)	-0.339 (0.405)	
Mining share of GDP			-0.354 (0.426)
ln GDP per capita		-0.058 (0.029)	-0.058 (0.030)
Urban share		0.257 (0.522)	0.263 (0.530)
Province fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
N	60	60	60
Notes: province-clustered standard errors in parentheses. FE1 uses mining/GVA only; FE2 adds logged GDP per capita and urbanisation; FE3 replaces mining/GVA with mining/GDP. With ten clusters, wild-cluster bootstrap inference is reported in the text.			

The preferred FE2 mining coefficient is -0.339 (clustered SE 0.405; $p = 0.402$). The sign is consistent with H1, but the estimate is too imprecise to reject zero. A restricted wild-cluster bootstrap produces $p = 0.800$, making the inferential conclusion stronger rather than weaker: the data do not establish that within-province increases in mining dependence systematically reduce overall diversification over 2016–2021. The alternative mining/GDP specification is similar ($\beta = -0.354$, $p = 0.406$).

This result differs sharply from the pooled pattern. The between-province regression produces $\beta = -0.490$ ($p < 0.001$), while the correlated-random-effects decomposition estimates a negative and significant province-mean component but an insignificant within component. More importantly, when North-Western Province is removed from the between regression, the mining coefficient becomes + 0.063 ($p =$

0.195). The cross-sectional resource-curse story is therefore heavily contingent on one highly mining-intensive province.

First differences provide no rescue for a strong causal interpretation: the mining coefficient is -0.528 ($p = 0.277$). Leave-one-province-out fixed-effects estimates remain imprecise. These results are compatible with several possibilities: the six-year window may be too short for structural diversification responses; mining shares may be endogenous to sector-specific price movements; within-province changes may be modest relative to cross-sectional differences; or the genuine development effects of mining may operate through linkages and institutions not captured by aggregate sector shares.

4.3 Does the result survive a non-extractive definition of diversification?

Table 5
Sensitivity to alternative diversification outcomes

Outcome / estimand	Mining coefficient	SE	p-value	N
Overall diversification (preferred FE2)	-0.339	0.405	0.402	60
Non-extractive diversification	0.448	0.157	0.004	60
Market non-extractive diversification	0.475	0.189	0.012	60
Manufacturing share	-0.093	0.092	0.312	60
Notes: All coefficients are from two-way fixed-effects specifications with province and year effects and the same controls as the preferred baseline. Province-clustered standard errors are shown; p-values are asymptotic and should be read alongside the small-cluster diagnostics reported in the text.				

The alternative-outcome tests materially change the interpretation. Once mining is removed from the HHI and the remaining sectors are renormalised, the mining coefficient is positive and statistically significant ($\beta = 0.448$, $p = 0.004$). Using an index restricted more closely to market non-extractive sectors yields $\beta = 0.475$ ($p = 0.012$). By contrast, mining exposure is negatively but insignificantly associated with manufacturing share ($\beta = -0.093$, $p = 0.312$).

This is the paper's most important methodological result. The negative pooled association between mining and overall diversification cannot be read straightforwardly as evidence that extraction hollows out the rest of the provincial economy. A large mining share mechanically raises the HHI, but the non-mining economy can simultaneously become more diverse. In accounting terms, the result depends on the denominator and composition rule used to construct 'diversification'. In theoretical terms, enclave concentration and non-extractive variety can coexist.

The positive non-extractive coefficient should not be romanticised. It is compatible with mining-induced demand for construction, trade, transport and services, yet such proliferation need not generate productivity growth, technological learning or tradable capabilities. The insignificant manufacturing

coefficient is therefore substantively important. Zambia's challenge may be less the number of non-mining activities than their productivity, local ownership, technological depth and insertion into domestic value chains. This reading is consistent with capability and linkage perspectives (Heim et al. 2023) and with Zambia-specific evidence that local content and downstream value addition face constraints in supplier capability, finance and local participation (Kragelund 2024; Cervantes Barron et al. 2024). Figure 4 summarises the sensitivity of the mining coefficient across these alternative diversification measures.

4.4 Fiscal dependence and the accountability mechanism

Table 6
Auxiliary fiscal-accountability regressions 2019–2021

Model	Mining share	Transfer dependence	Local revenue execution	N
F1	-0.558 (0.451)			30
F2	-0.552 (0.440)	-0.025 (0.063)		30
F3	-0.576 (0.465)		-0.019 (0.031)	30
F4	-0.617 (0.497)	-0.029 (0.063)		30
Notes: Auxiliary province-year fiscal panel 2019–2021 (N = 30). Province-clustered standard errors are in parentheses. Transfer dependence and fiscal autonomy are accounting ratios, not direct measures of answerability or sanctioning capacity. Wild-cluster and block-bootstrap inference is reported in the text.				

The fiscal evidence does not support the proposed subnational fiscal accountability trap. In the FE model containing mining share and transfer dependence, the mining coefficient is -0.552 ($p = 0.210$) and transfer dependence is -0.025 ($p = 0.693$). Wild-cluster bootstrap p -values are 0.478 for mining and 0.652 for transfer dependence. Local revenue execution is likewise insignificant. The path from mining dependence to transfer dependence is near zero statistically ($p = 0.826$).

The estimated mediation effect is -0.0058 and its 3,000-replication province-block bootstrap 95% interval spans - 0.971 to 0.128. H4 is therefore not supported. This null should not be converted into a claim that fiscal institutions do not matter. The audit-based fiscal sample changes composition across years, major mineral taxes accrue nationally, and transfer dependence is a fiscal-relationship measure rather than a direct measure of answerability. The result is narrower: the available evidence does not justify saying that mining reduces diversification by making provincial local governments more transfer dependent.

Indeed, Zambia's fiscal architecture makes such a simple mechanism unlikely. A mining-intensive province may contain councils with strong own-source capacity because mines and urban property expand the rateable base, while rural councils in non-mining provinces may depend heavily on equalisation transfers. National redistribution can therefore reverse the spatial correlation predicted by a classic rentier-state account. The fiscal system is not merely an intervening variable; it re-maps resource revenues across space.

5. Discussion

5.1 A resource curse, a measurement artefact, or territorial heterogeneity?

The results do not support a binary verdict that Zambia either has a subnational resource curse or that mining promotes diversification. They reveal three different empirical objects. Overall sectoral concentration is strongly associated with mining in cross-section; within-province change in overall diversification is negative but imprecisely estimated; and diversity inside the non-extractive economy rises with mining exposure in the preferred alternative specification. These are not contradictory findings. They answer different questions about sectoral weight, non-mining variety and structural transformation.

The distinction is sharpened by the HHI decomposition. Because mining share enters the overall concentration formula directly, the mining coefficient is partly exposed to a deterministic compositional channel. This does not make the HHI 'wrong': overall concentration is a legitimate characteristic of an economy dominated by one sector. It does mean, however, that the coefficient cannot by itself identify crowding out, Dutch disease or institutional deterioration. A stronger empirical practice is to report the overall index alongside a renormalised non-extractive index and transformation outcomes such as manufacturing, employment productivity, export sophistication and supplier upgrading. The contribution is therefore not a claim that earlier concentration measures are invalid, but that the estimand must be matched to the substantive mechanism being asserted.

The divergence between the between- and within-province results also points to territorial path dependence. Figure 3 makes North-Western Province's leverage visually explicit: its unusually high mean mining share and low overall diversification are structurally different from the cluster formed by the other provinces. The between coefficient is consequently informative about the geography of Zambia's production structure, but its collapse after North-Western is excluded cautions against treating that geography as a universal dynamic law. The within estimate asks a narrower question—whether increases in mining dependence over six years coincide with declining diversification inside a province—and the available data do not answer that question precisely.

This interpretation also refines the enclave thesis. An enclave is defined not simply by a high mining share but by weak domestic linkages, limited technological spillovers, externalised procurement and

restricted diffusion of capabilities. A province can therefore be concentrated in accounting terms while supporting a broader ecosystem of services and suppliers; conversely, it can be statistically diversified through low-productivity activities without achieving structural transformation. Recent Zambia evidence reinforces this distinction from several directions. Local-content and downstream critical-mineral studies show that local participation and capability upgrading are not automatic (Kragelund 2024; Cervantes Barron et al. 2024), while research on Zambian mining cities shows that inherited spatial form can itself become a material dependency that constrains post-mining diversification (Mukumba et al. 2026). The development issue is therefore whether mining reorganises local capabilities and linkages, not merely whether more sectors appear in the GVA vector.

5.2 Rethinking the subnational fiscal accountability trap

The fiscal null result is theoretically consequential because it rejects the simplest version of the proposed mechanism. The original chain implied that mining dependence would increase transfer dependence, weaken local revenue bargaining and thereby inhibit diversification. Zambia's institutional architecture interrupts that sequence: mineral taxation is largely centralised, equalisation transfers are redistributive, and mining municipalities can possess sizeable property and fee bases. Production, rent collection, redistribution and local spending therefore occur at different territorial scales. A spatial match between mining intensity and local fiscal dependence should not be expected without first mapping these assignments.

This motivates a more defensible concept—a subnational fiscal-accountability configuration rather than a universal trap. Such a configuration has at least five components: where mineral rents are collected; how formula-based and discretionary transfers redistribute revenue; which local tax handles remain available; whether administrations can assess, collect and execute those revenues; and whether reporting generates answerability and corrective action. Evidence from Colombia and Peru shows why local fiscal effort can be affected by resource revenues (Collazos-Ortiz and Schakel 2024; Contreras and Orihuela 2026), but Zambia shows why the same causal ordering cannot simply be transported across intergovernmental systems.

The null must also be interpreted against measurement limitations. Transfer dependence describes the composition of observed income, not the quality of fiscal governance. The audit reports document gaps between budgeted and collected local revenues, delayed collection, unsupported transactions and record-keeping weaknesses, so a high local-revenue share can coexist with weak execution or internal control. Conversely, a transfer-dependent council may administer grants effectively. Changing audit coverage across years further adds composition noise to the province-level fiscal ratios. These features can attenuate a true relationship and are a reason to treat the mediation result as an explicit non-confirmation, not evidence that fiscal institutions are irrelevant.

For public-sector accounting scholarship, this negative result is useful because it separates classification from accountability performance. The categories 'locally generated income' and 'national support' make fiscal dependence calculable; they do not reveal who has voice over allocation, whether

audit recommendations are implemented, or whether citizens can connect revenue choices to service outcomes. In the relational view of accounting, the question is what reporting enables actors to know, contest and correct (Barbera, Sicilia and Steccolini 2024). Future tests of the fiscal channel should therefore combine revenue structure with audit-finding severity and follow-up, transfer predictability, budget execution, tax-base capacity and citizen-facing transparency.

5.3 Diversification quality, industrialisation and the SDGs

The SDG interpretation follows from the distinction between diversification quantity and diversification quality. SDG 8 is not achieved merely by a broader sector distribution if expanding activities are informal, insecure or low-productivity. SDG 9 requires industrial capability, infrastructure and innovation; the absence of a significant manufacturing response means that processing and supplier linkages cannot be inferred from the positive non-extractive result. SDG 10 requires territorial and household incidence to be measured rather than assumed. SDGs 12 and 13 additionally require attention to emissions, land and water impacts and transition risks that are entirely absent from a conventional HHI.

SDGs 16 and 17 are enabling conditions rather than peripheral governance add-ons. Transparent classifications, credible audit follow-up, realistic own-source assignments and predictable intergovernmental transfers determine whether resource-linked economic activity can be translated into local public goods. Yet maximising fiscal autonomy is not an appropriate universal target: equalisation is necessary precisely because tax bases differ across space. The relevant objective is accountable fiscal capacity—predictable transfers combined with feasible own-source mobilisation, administrative capability, auditability and performance information that citizens and oversight bodies can use.

This framing suggests that public accounting should trace diversification additionality rather than equate non-mining expenditure with structural change. A road, industrial park, market or training programme is developmentally meaningful only if it creates productive capacity that would not otherwise have existed, enables firms to enter higher-value supply chains, improves the durability and quality of employment, or reduces vulnerability without displacing environmental costs onto communities. Financial inputs should therefore be connected to output, outcome and distributional indicators. This is also consistent with the broader evidence that Zambia needs productivity-enhancing transformation rather than growth in activity alone (World Bank 2024).

The energy transition makes the trade-off more urgent. Copper and other transition minerals give Zambia a strategic opportunity, but a global 'green' demand shock can reproduce an extractive territorial model if domestic value addition, skills, local participation, fiscal management and environmental safeguards do not deepen simultaneously. Smith (2025) situates Zambia within a wider regional geopolitical contest over transition minerals, underscoring that minerals-based industrialisation cannot be treated as an automatic consequence of global decarbonisation. Zambia's recent energy-transition-minerals roadmap likewise places production expansion, fiscal value capture and downstream value addition within the same transformation agenda (World Bank 2025). The manuscript's results support that integrated view:

lowering a statistical HHI is a weak target unless diversification changes productive capabilities and resilience.

Table 7
SDG interpretation of the empirical findings

SDG	Relevant objective	What the evidence shows	Accountability extension
SDG 8	Decent work and inclusive growth	Non-extractive diversity can expand around mining, but job quality is not observed.	Add employment quality, wages and formal-sector employment by province.
SDG 9	Industry, innovation and infrastructure	No robust manufacturing deepening effect is detected.	Track manufacturing productivity, supplier localisation and infrastructure additionality.
SDG 10	Reduced inequalities	Strong territorial heterogeneity and equalisation architecture matter.	Measure within- and between-province distribution of mining benefits and public spending.
SDG 12/13	Responsible production / climate action	HHI diversification is environmentally neutral as constructed.	Integrate emissions, land/water impacts and transition-risk indicators.
SDG 16	Effective, accountable institutions	Transfer ratios do not capture answerability; audit data reveal implementation gaps.	Link audit findings, follow-up rates, budget transparency and citizen participation.
SDG 17	Partnerships and finance	Intergovernmental transfers spatially reconnect national mineral rents and local services.	Evaluate transfer predictability, formula equity and vertical coordination.

5.4 Policy implications for Zambia

First, diversification policy should be territorially differentiated. North-Western Province's unusually high mining concentration calls for supplier development, urban services, logistics and economic infrastructure that can retain more value locally. Copperbelt's older industrial base raises different priorities around upgrading, rehabilitation and linkage recovery. Provinces with little mining require strategies anchored in their own productive bases—such as agriculture, logistics, tourism and services—rather than imitation of mining-region policy. The broader objective should be productivity-enhancing transformation and better jobs, not convergence to a single sectoral template (World Bank 2024).

Second, fiscal decentralisation should not be evaluated by transfer reduction alone. Zambia's equalisation system performs a legitimate redistributive function. Reform should instead emphasise clear expenditure and revenue assignments, predictable transfer timing, updated valuation rolls, digital billing and collection, audit follow-up and transparent links between revenues and service outcomes. The 2023 National Decentralisation Policy's emphasis on own-source mobilisation is necessary, but it should be judged against the actual tax capacity of each locality rather than a uniform autonomy ratio.

Third, mining policy should move from local-content expenditure targets toward capability formation. Procurement shares can rise while local firms remain concentrated in low-value activities. Monitoring should therefore include supplier upgrading, certification, finance, technology absorption, local ownership, workforce skills and movement into tradable activities. Kragelund (2024) identifies supplier capacity and finance as central constraints on Zambia's local-content ambitions, while Cervantes Barron et al. (2024) show that downstream critical-mineral value addition does not automatically secure meaningful local participation. The positive non-extractive-diversification result is therefore best treated as an opportunity to upgrade activity, not as evidence that transformation has already occurred.

Fourth, provincial and local performance reporting should integrate financial and development metrics. Diversification programmes should disclose inputs and implementation milestones alongside firm-level additionality, productivity, job quality, distributional incidence and environmental effects. A compact territorial scorecard could link spending and transfers to supplier development, manufacturing productivity, formal employment, audit follow-up and environmental indicators. Such reporting would operationalise SDG-oriented accountability more effectively than stand-alone expenditure reports or aggregate HHI targets.

6. Robustness, limitations and research agenda

Several limitations constrain the strength of inference. The primary panel has only ten cross-sectional units and six years, so conventional cluster-robust inference is fragile and long-run structural effects cannot be identified. The wild-cluster bootstrap and influence exercises reduce the risk of over-interpreting asymptotic significance, but they cannot create variation that is absent from the data. Year effects absorb common national shocks but not exposure-specific responses to global copper-price movements, the COVID-19 shock or other province-specific time-varying disturbances.

Second, mining share is endogenous. A province can appear more mining dependent because mining expands or because other sectors contract. Reverse causality is also plausible: weak diversification may make mining mechanically more dominant. Without a defensible geological-instrument or quasi-experimental shock, the coefficients should remain associational. Future work could combine mine-level openings/closures, geological endowments and spatial buffers with district economic outcomes.

Third, the primary HHI is mathematically coupled to mining share. This is both a limitation and a substantive methodological finding. The paper mitigates the problem through non-extractive and market non-extractive indices, but these remain output-share measures. Future datasets should incorporate employment diversity, firm entry, export sophistication, productivity, wages and local procurement linkages.

Fourth, the fiscal panel is auxiliary and potentially selected. The Auditor-General reports do not provide an identical census of council Budget and Income tables every year, and the clean extraction sample changes from 42 councils in 2019 to 64 in 2020 and 43 in 2021. Province-year aggregation therefore mixes genuine fiscal change with changes in council coverage. A stronger design would obtain

administrative financial statements for all local authorities, construct a balanced council-year panel and explicitly model mine proximity, property tax bases, transfer timing and audit-selection processes before aggregating to province level.

Fifth, transfer dependence and fiscal autonomy are not direct accountability measures. They do not capture audit opinion, unresolved findings, procurement irregularities, citizen participation, council deliberation or enforcement. A stronger accounting study could code quantified audit findings and follow-up, link them to budget execution, and distinguish transparency from answerability and sanctioning capacity. That extension would test the accountability mechanism more directly.

Finally, the SDGs are used as a critical interpretive framework rather than as dependent variables. This avoids claiming sustainability effects from sector shares but means the paper cannot directly assess SDG progress. Provincial SDG dashboards combining employment, industrial productivity, inequality, emissions, environmental quality and institutional indicators would allow a genuinely multidimensional test.

7. Conclusion

This article tested whether resource dependence is associated with lower economic diversification across Zambia's provinces and whether fiscal dependence provides an observable accountability mechanism. The answer is conditional. Mining-intensive provinces are much more concentrated in cross-section, but the preferred within-province fixed-effects estimate is imprecise and the small-cluster bootstrap does not reject zero. The strong between-province relationship is also highly sensitive to North-Western Province. The most defensible conclusion is therefore one of territorial heterogeneity rather than a uniform subnational resource-curse dynamic over 2016–2021.

More importantly, the inference changes when the outcome is defined independently of mining's direct mathematical contribution. Mining dependence is positively associated with diversity inside the non-extractive economy, while manufacturing share shows no robust response. The formal HHI decomposition clarifies why these results can coexist: overall concentration, non-extractive variety and productive transformation are different estimands. A high mining share can mechanically depress an overall diversification index even while the composition of the remaining economy broadens.

The proposed fiscal mechanism is likewise unconfirmed. Transfer dependence does not mediate the mining-diversification association in the 2019–2021 audit-based panel. Zambia's intergovernmental architecture provides a plausible institutional reason: extraction, national tax collection, equalisation transfers and local tax bases are spatially decoupled. The proposed subnational fiscal accountability trap should therefore be reframed as a fiscal-accountability configuration whose operation depends on revenue assignment, transfer rules, administrative capacity and substantive answerability.

For accounting scholarship, the central lesson is that measurement is constitutive: sector classifications and fiscal categories shape what becomes visible as concentration, dependence and accountability. For

policy, the implication is equally demanding. Zambia's objective should not be simply to reduce mining's measured share, but to use mineral wealth to build productive capabilities, locally embedded value chains, accountable fiscal institutions and more resilient territorial economies. Linking SDGs 8 and 9 to SDGs 16 and 17—and testing distributional and environmental outcomes rather than assuming them—provides a stronger standard for judging whether diversification is developmentally meaningful.

Declarations

Competing Interests

The author declares that there are no competing interests.

Consent to Participate

Not applicable.

Consent for Publication

Not applicable.

Data Availability

The data supporting the findings of this study are available from the author upon reasonable request.

Author Contributions

The author conceived and designed the study, conducted the research and analysis, and wrote and approved the final manuscript.

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Figures

Integrated theoretical framework

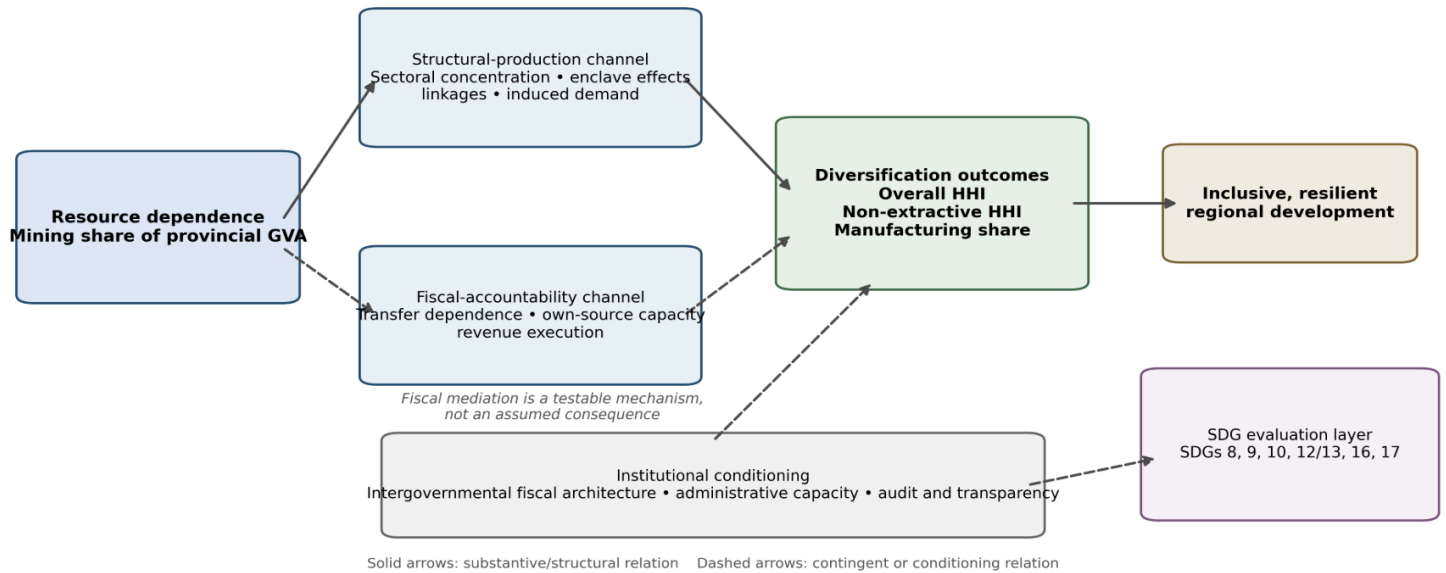
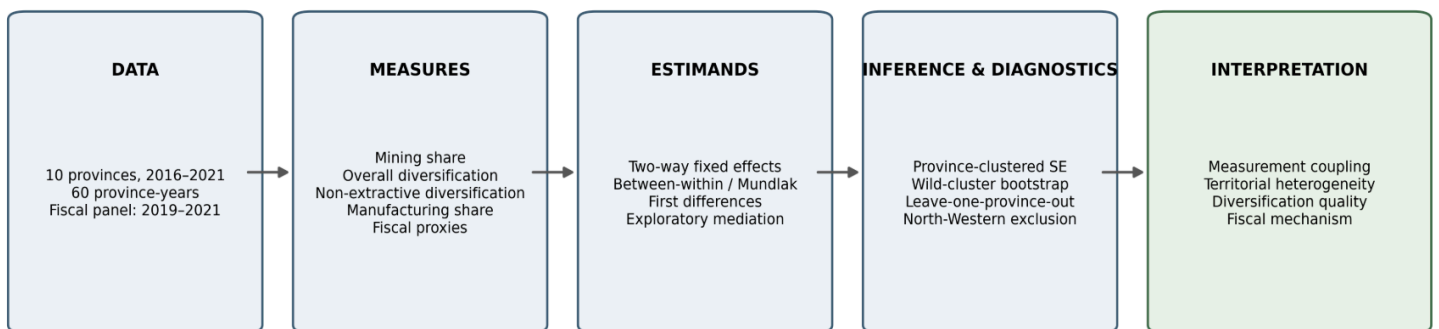


Figure 1

Integrated theoretical framework: resource dependence, fiscal accountability, diversification and SDG localisation.

Empirical strategy: from data construction to interpretation



The design separates persistent between-province structure from within-province change and tests whether conclusions survive alternative outcome definitions.

Figure 2

Conceptual and empirical framework

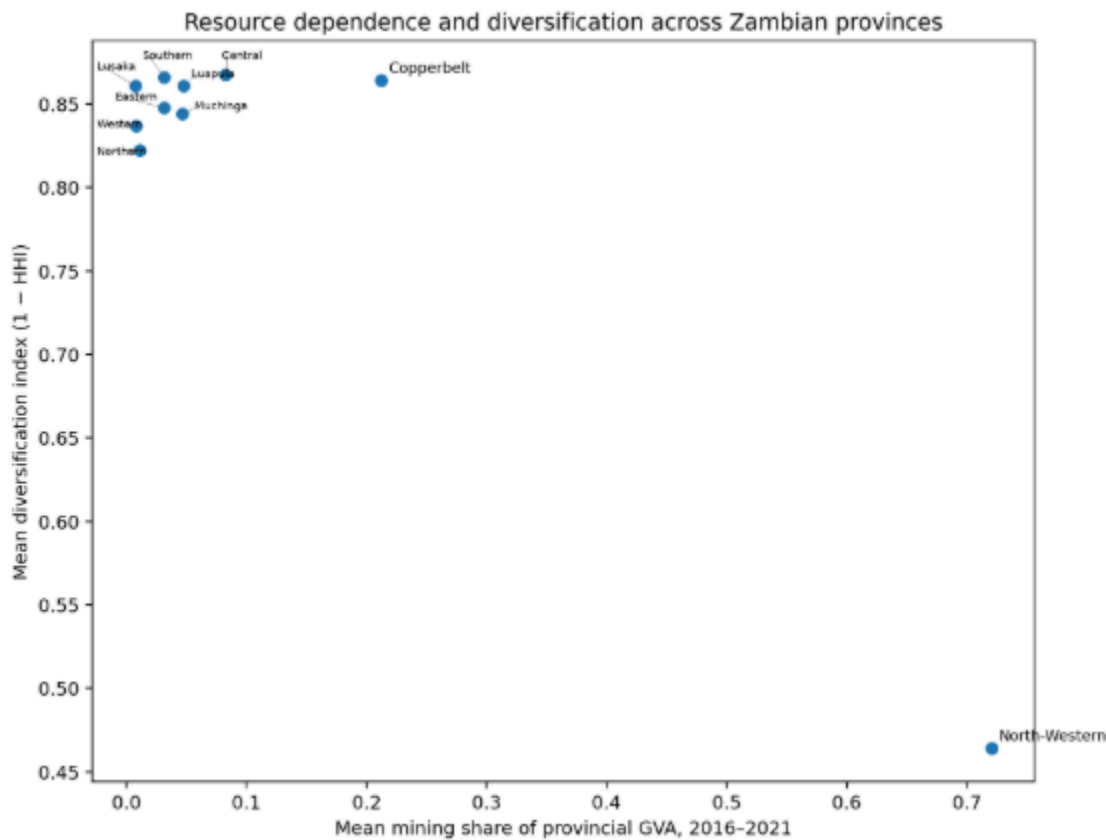


Figure 3

Mean mining dependence and overall diversification across Zambia's provinces 2016–2021. Province means are shown; North-Western Province is the principal high-leverage observation.

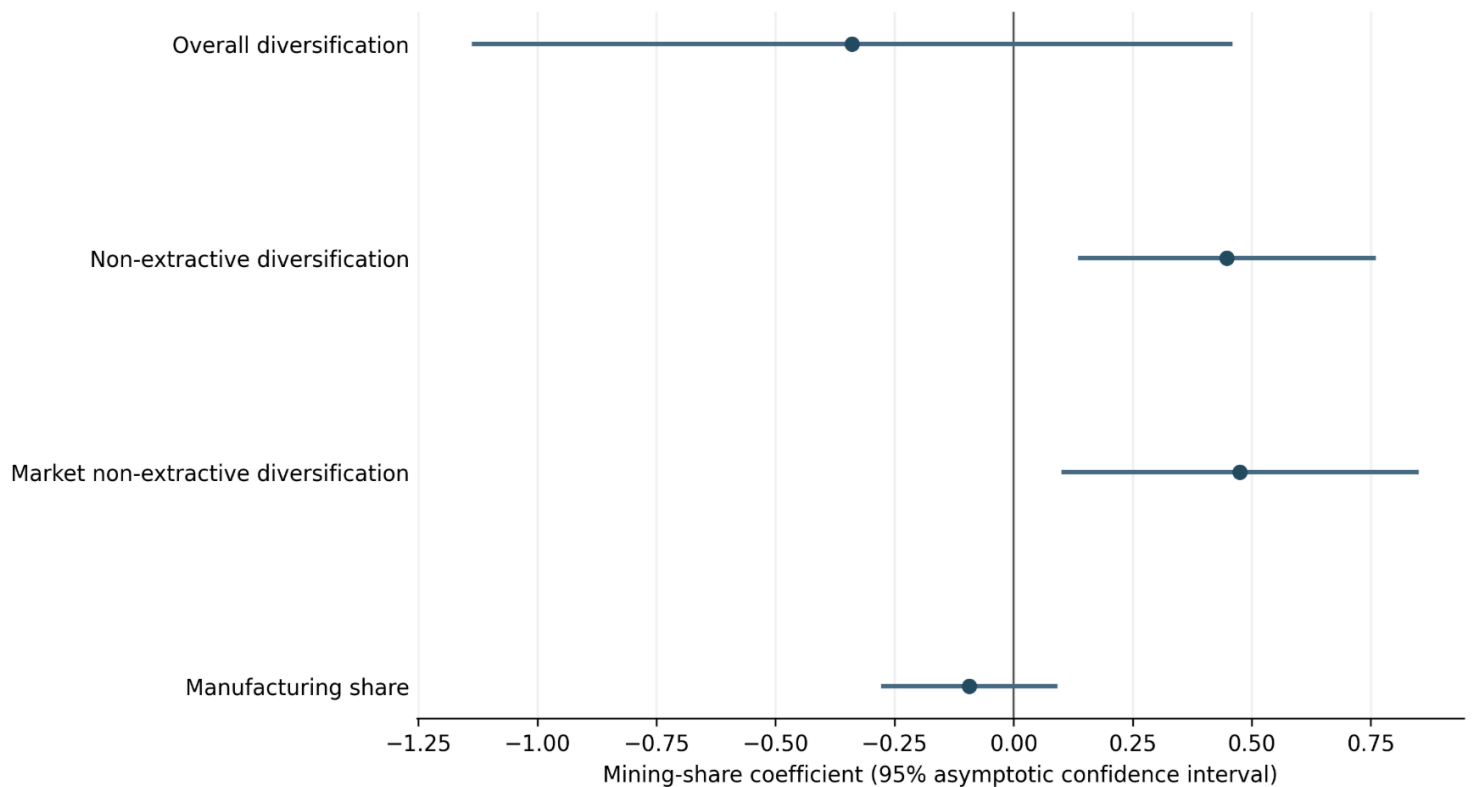


Figure 4

Sensitivity of the mining coefficient to diversification measurement. Points are fixed-effects estimates; bars are 95% asymptotic confidence intervals.