

# What Drives Industrialization in SADC? A Multidimensional Panel Analysis

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## Abstract

Manufacturing value added in the Southern African Development Community fell from 15.2 to 11.1 per cent of GDP between 2002 and 2023, and declined in ten of thirteen member states, even as urbanization rose by nine percentage points: the premature deindustrialization pattern documented by Rodrik (2016). We ask which of four policy dimensions, namely external capital, urbanization, institutional quality and financial deepening, accounts for within-country variation in the manufacturing share, and whether the answer survives a graded estimator hierarchy running from pooled OLS through static and bias-corrected dynamic fixed effects to pooled mean group cointegration. Private credit deepening carries a negative coefficient that controls for country effects and is significant in five of the seven specifications, while the sign of urbanization is determined entirely by whether common time effects are removed. Industrial finance policy in the region should target the composition of credit rather than its volume. And the spatial patterns matter.

## Keywords

Industrialization, SADC, LSDVC, Pooled Mean Group, Financial Deepening

## 1. Introduction

The unweighted mean share of manufacturing in GDP across the thirteen Southern African Development Community (SADC) economies studied here fell from 15.2 per cent in 2002 to 11.1 per cent in 2023, and ten of the thirteen ended the period below where they started. Over the same two decades, the regional urban population share rose by 9.1 percentage points and private credit to GDP by 3.1 points. This is the deindustrialization paradox in the sense

of [Rodrik \(2016\)](#): the structural and financial conditions that development policy treats as prerequisites for industrialization have improved while industry's share has contracted.

This paper asks which of four standard policy dimensions, external capital, urbanization, institutional quality and financial deepening, accounts for within-country variation in the manufacturing share of GDP in SADC, and whether the answer is invariant to the econometric structure imposed on the panel. The objectives are to establish the specification through diagnostics rather than by assertion, to estimate the four effects under successively weaker assumptions about heterogeneity, dynamics and error dependence, and to identify which conclusions are properties of the data rather than of the estimator.

Our contribution is twofold. First, we submit SADC industrialization to a graded hierarchy in which each stage is adopted only because a test rejects the stage before it, running from pooled OLS through one-way and two-way fixed effects, a bias-corrected dynamic specification (LSDVC), and finally the pooled mean group error-correction model; to our knowledge no existing study of the region combines the dynamic and heterogeneous-cointegration stages. Second, moving from aggregate analysis to country-specific estimations, we isolate the true drivers of industrialization (institutions, infrastructure credit...) by filtering out global macroeconomic shocks. This refined approach goes beyond one-size-fits-all policy advice to provide SADC decision-makers with targeted, actionable industrial strategies while grounding them in the reality of regional integration.

Section 2 positions the paper, Section 3 develops the models and the justification for each step, Section 4 describes the data, Section 5 reports and contrasts the results, and Section 6 concludes.

## 2. Literature Review and Positioning

That manufacturing carries special growth-generating properties originates with [Kaldor \(1967\)](#) and is quantified for the post-war developing world by [Szirmai \(2012\)](#). [Rodrik \(2016\)](#) shows that developing countries now reach peak manufacturing shares at lower income levels than their predecessors, and SADC fits the pattern. The literature on African manufacturing determinants is dominated by homogeneous-slope estimators; the closest antecedent, [Mijiyawa \(2017\)](#), applies system GMM to 53 African countries and finds that governance quality and market size raise the manufacturing share while FDI and urbanization do not, a set of results we contrast with ours in Section 5.

Two strands generate the tension the paper exploits. [Gollin, Jedwab and Vollrath \(2016\)](#) show that resource exporters urbanize into consumption cities dominated by non-tradable services rather than into production cities, so urbanization need not raise the manufacturing share and may lower it. In parallel, [Arcand, Berkes and Panizza \(2015\)](#) find that the marginal growth contribution of private credit turns negative at high credit-to-GDP ratios, and [Alfaro, Chanda, Kalemli-Ozcan and Sayek \(2004\)](#) show that the sectoral incidence of FDI depends

on the allocation of domestic finance. Whether credit deepening supports or crowds out manufacturing therefore depends on where the credit goes, which is an empirical question.

The methodological gap is specific. Manufacturing shares are highly persistent, with a pooled first-order autocorrelation of 0.969 in our sample, so a static specification misattributes adjustment dynamics to the levels of the regressors; but the within estimator of a dynamic model is biased at order  $1/T$  (Nickell 1981), and the correction of Kiviet (1995) and Bruno (2005) is rarely applied here. Cross-country dependence in SADC meanwhile arises from commodity cycles, South African final demand and global financial conditions, which the Pesaran (2006) common correlated effects framework addresses and conventional fixed effects do not. No study of SADC industrialization known to us combines these corrections, and Section 5 shows they matter.

### 3. Empirical Models

Notation is collected in Table 1. The four regressors in  $\mathbf{x}_{it} = (\text{FDI}_{it}, \text{URB}_{it}, \text{RL}_{it}, \text{CRED}_{it})'$  proxy, in order, external capital, structural urbanization, institutional quality and financial deepening, and  $\text{IND}_{it}$  is manufacturing value added as a percentage of GDP.

**Table 1.** Notation.

| Symbol                                                    | Meaning                                                      |
|-----------------------------------------------------------|--------------------------------------------------------------|
| $i, t$                                                    | country and year indices; $n = 13$ , $T = 22$                |
| $\text{IND}(i, t)$                                        | manufacturing value added (% of GDP), the dependent variable |
| $x(i, t)$                                                 | $k \times 1$ regressor vector (FDI, URB, RL, CRED), $k = 4$  |
| $\alpha, \mu(i), \lambda(t)$                              | common intercept, country effect, time effect                |
| $\beta$                                                   | slope vector (short-run slopes in the dynamic model)         |
| $\gamma$                                                  | autoregressive parameter of the dynamic model                |
| $\theta, \theta(i)$                                       | pooled and country-specific long-run coefficients            |
| $\phi(i)$                                                 | country-specific error-correction speed                      |
| $\vartheta$                                               | random-effects quasi-demeaning parameter                     |
| $f(t), \gamma(i)$                                         | unobserved common factors and factor loadings                |
| $\bar{z}(t)$                                              | cross-sectional averages used in the CCE regressions         |
| $\varepsilon(i, t), \sigma^2(\varepsilon), \sigma^2(\mu)$ | idiosyncratic error and the variance components              |
| $m, B$                                                    | Driscoll-Kraay bandwidth; bootstrap replications             |

#### 3.1. Baseline: Pooled OLS

The benchmark treats the panel as a single cross-section,

$$\text{IND}_{it} = \alpha + x'_{it}\beta + u_{it}, \quad u_{it} = \mu_i + \varepsilon_{it} \quad (1)$$

where  $\alpha$  is a common intercept,  $\beta$  the  $k \times 1$  slope vector,  $\mu_i$  an unobserved country effect and  $\varepsilon_{it}$  an idiosyncratic disturbance. Equation (1) is consistent only under  $E[\mu_i | x_{it}] = 0$ . Since resource endowment, colonial industrial inheritance and market size plausibly drive both the manufacturing share and all four regressors, we test that assumption with the  $F$  test of  $H_0: \mu_1 = \dots = \mu_n$  and the Breusch and Pagan (1980) LM test of  $H_0: \sigma_\mu^2 = 0$ .

### 3.2. Static Panel: Fixed and Random Effects

Rejecting Equation (1) motivates retaining  $\mu_i$ . The one-way fixed-effects model:

$$IND_{it} = \mu_i + x'_{it}\beta + \varepsilon_{it}, \quad E[\varepsilon_{it} | x_{i1}, \dots, x_{iT}, \mu_i] = 0 \quad (2)$$

eliminates  $\mu_i$  by the within transformation, permitting arbitrary correlation between  $\mu_i$  and the regressors at the cost of all between-country variation. If instead  $\mu_i$  is orthogonal to  $x_{it}$ , random effects is more efficient, applying OLS to the quasi-demeaned data:

$$IND_{it} - \eta IND_{it} = (1 - \eta)\alpha + (x_{it} - \eta \bar{x}_i)' \beta + v_{it}, \quad \eta = 1 - \sqrt{\frac{\sigma_\varepsilon^2}{T\sigma_\mu^2 + \sigma_\varepsilon^2}} \quad (3)$$

with  $\sigma_\mu^2$  and  $\sigma_\varepsilon^2$  from the Swamy-Arora decomposition. The choice between them is made by the Hausman (1978) statistic:

$$h_1 = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' [\hat{V}(\hat{\beta}_{FE}) - \hat{V}(\hat{\beta}_{RE})]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE}) \rightarrow \chi_k^2 \quad (4)$$

Equation (2) still attributes to the regressors any variation common to all countries in a given year. Since commodity prices, global financial conditions and the pandemic move the whole region, we add a time effect,

$$IND_{it} = \mu_i + \lambda_t + x'_{it}\beta + \varepsilon_{it} \quad (5)$$

so that  $\beta$  is identified from deviations of each country from the contemporaneous regional average. Because  $\varepsilon_{it}$  remains both serially and cross-sectionally correlated, we report the Driscoll and Kraay (1998) spatial-correlation-consistent covariance:

$$\hat{V}(\hat{\beta}) = (\tilde{X}'\tilde{X})^{-1} \left[ \hat{S}_0 + \sum_{l=1}^m \left( 1 - \frac{l}{m+1} \right) (\hat{S}_l + \hat{S}_l') \right] (\tilde{X}'\tilde{X})^{-1} \quad (6)$$

with  $\tilde{X}$  the two-way demeaned regressors,  $\hat{S}_l = \sum_{t=l+1}^T h_t h_{t-l}'$  and  $h_t = \sum_i \tilde{x}_{it} \hat{\varepsilon}_{it}$ ; smoothing cross-sectional aggregates over time makes consistency independent of  $n$ . A single additive  $\lambda_t$  imposes identical exposure to common shocks; allowing heterogeneous exposure gives the multifactor error structure:

$$\varepsilon_{it} = \gamma_i' f_t + u_{it} \quad (7)$$

with  $f_t$  unobserved common factors and loadings  $\gamma_i$  that may be correlated with  $x_{it}$ , in which case Equation (5) is inconsistent. Pesaran (2006) shows that cross-sectional averages span the factor space, giving:

$$IND_{it} = \mu_i + x'_{it}\beta + c_i' \bar{z}_t + u_{it}, \quad \bar{z}_t = (IND_{it}, \bar{x}_t)' \quad (8)$$

pooled (CCEP) or averaged over unit-specific slopes (CCEMG).

### 3.3. Dynamic Panel: LSDV and the Bias-Corrected Estimator

Every specification so far is static, yet the manufacturing share has a pooled auto-correlation of 0.969: a country's industrial structure this year is largely last year's, and imposing instantaneous adjustment forces that persistence into the regressors. The dynamic model is:

$$\text{IND}_{it} = \gamma \text{IND}_{i,t-1} + x'_{it}\beta + \mu_i + \lambda_t + \varepsilon_{it}, \quad |\gamma| < 1 \quad (9)$$

where  $\gamma$  is the adjustment parameter and  $\beta$  now measures short-run effects. The within transformation of Equation (9) correlates the demeaned lag with the demeaned error, so the LSDV estimator carries the [Nickell \(1981\)](#) bias:

$$E[\hat{\gamma}_{\text{LSDV}} - \gamma] = -\frac{1+\gamma}{T-1} + O(T^{-2}) \quad (10)$$

which is downward and does not vanish as  $n$  grows. We remove it with the bias-corrected LSDV estimator (LSDVC). Because the bias is a function of the unknown parameters, it is evaluated at a candidate value and the candidate is updated by the measured drift until a fixed point is reached,

$$\delta^{*(m+1)} = \hat{\delta}_{\text{LSDV}} - \left[ E_b(\hat{\delta}_{\text{LSDV}}^* | \delta^{*(m)}) - \delta^{*(m)} \right], \quad \delta = (\gamma, \beta')' \quad (11)$$

where  $E_b(\cdot)$  is the average LSDV estimate over  $B$  panels simulated from  $\delta^{*(m)}$ . We implement the bootstrap version of [Everaert and Pozzi \(2007\)](#) with the simplification of [De Vos, Everaert and Ruysen \(2015\)](#) rather than the analytical approximation of [Kiviet \(1995\)](#) and [Bruno \(2005\)](#), because resampling whole period vectors of residuals preserves the contemporaneous error dependence documented in [Table 2](#) and delivers the covariance matrix directly. As an independent check we report the [Anderson and Hsiao \(1981\)](#) IV estimator, which first-differences Equation (9) and exploits:

$$E[\text{IND}_{i,t-2} \Delta \varepsilon_{it}] = 0 \quad (12)$$

consistent for fixed  $T$  but inefficient. Long-run effects follow from:

$$\theta_j = \frac{\beta_j}{1-\gamma}, \quad \hat{\nu}(\hat{\theta}_j) = \left( \frac{1}{1-\gamma} \right)^2 \hat{\nu}(\hat{\beta}_j) + \left( \frac{\beta_j}{(1-\gamma)^2} \right)^2 \hat{\nu}(\hat{\gamma}) + 2 \frac{\beta_j}{(1-\gamma)^3} \hat{C}(\hat{\beta}_j, \hat{\gamma}) \quad (13)$$

by the delta method.

### 3.4. Cointegration: The ARDL Error-Correction Family

Equation (9) still imposes a common  $\gamma$  and common  $\beta$  on all thirteen economies, which [Pesaran and Smith \(1995\)](#) show yields inconsistent estimates when adjustment speeds differ. With  $T = 22$  the country-specific dynamics can be estimated, so we write the ARDL (1,1) error-correction form:

$$\Delta \text{IND}_{it} = c_i + \phi_i (\text{IND}_{i,t-1} - \theta'_i x_{i,t-1}) + \delta'_i \Delta x_{it} + \varepsilon_{it} \quad (14)$$

in which  $\theta_i$  is the long-run vector and  $\phi_i < 0$  the error-correction speed; a significantly negative  $\phi_i$  is itself evidence of a level relationship in the sense of [Pesaran, Shin and Smith \(2001\)](#), which is why the framework is valid under the mixture of

**Table 2.** Cross-sectional dependence, panel unit root and cointegration tests.

| Variable                                                                                                    | Pesaran CD |               | Fisher ADF, levels          |       | Fisher ADF, differences |       |
|-------------------------------------------------------------------------------------------------------------|------------|---------------|-----------------------------|-------|-------------------------|-------|
|                                                                                                             | CD         | mean $ \rho $ | P                           | p     | P                       | p     |
| IND                                                                                                         | 8.646***   | 0.441         | 72.391                      | 0.000 | 199.729                 | 0.000 |
| FDI                                                                                                         | 3.227***   | 0.229         | 73.540                      | 0.000 | 356.599                 | 0.000 |
| URB                                                                                                         | 25.224***  | 0.895         | 75.660                      | 0.000 | 41.038                  | 0.031 |
| RL                                                                                                          | 1.584      | 0.397         | 35.482                      | 0.102 | 243.098                 | 0.000 |
| CRED                                                                                                        | 16.194***  | 0.557         | 75.044                      | 0.000 | 193.890                 | 0.000 |
| <i>Panel cointegration (Fisher-combined Engle-Granger): <math>P = 42.279</math>, <math>p = 0.023</math></i> |            |               |                             |       |                         |       |
| CD on residuals: Pooled OLS                                                                                 |            |               | CD = 0.358 ( $p = 0.720$ )  |       | mean $ \rho  = 0.340$   |       |
| CD on residuals: One-way fixed effects                                                                      |            |               | CD = 0.267 ( $p = 0.789$ )  |       | mean $ \rho  = 0.446$   |       |
| CD on residuals: Two-way fixed effects                                                                      |            |               | CD = -2.053 ( $p = 0.040$ ) |       | mean $ \rho  = 0.275$   |       |
| CD on residuals: CCEP                                                                                       |            |               | CD = -2.941 ( $p = 0.003$ ) |       | mean $ \rho  = 0.240$   |       |

Notes: CD is the Pesaran (2021) statistic, standard normal under cross-sectional independence; mean  $|\rho|$  is the average absolute pairwise correlation.  $P = -2 \sum \ln p(i)$  is the Maddala and Wu (1999) Fisher statistic, chi-square with 26 degrees of freedom under the joint null that every unit contains a unit root; individual ADF regressions include an intercept with lag order chosen by AIC. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

$I(0)$  and  $I(1)$  regressors reported in Table 2. Three estimators impose successively weaker restrictions,

$$\text{DFE} : \phi_i = \phi, \theta_i = \theta, \delta_i = \delta; \text{PMG} : \theta_i = \theta; \text{MG} : \text{no restriction} \quad (15)$$

with PMG estimated by concentrated maximum likelihood (Pesaran, Shin, & Smith, 1999) and MG by averaging country regressions. PMG is efficient if the homogeneity restriction holds and inconsistent otherwise (Table 3), so it is tested against MG by:

$$h_2 = (\hat{\theta}_{\text{MG}} - \hat{\theta}_{\text{PMG}})' \left[ \hat{\nu}(\hat{\theta}_{\text{MG}}) - \hat{\nu}(\hat{\theta}_{\text{PMG}}) \right]^{-1} (\hat{\theta}_{\text{MG}} - \hat{\theta}_{\text{PMG}}) \rightarrow \chi_k^2 \quad (16)$$

#### 4. Data and Methodology

The sample is a balanced panel of 13 SADC member states observed annually from 2002 to 2023 ( $nT = 286$ ): Angola, Botswana, the Democratic Republic of the Congo, Eswatini, Lesotho, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe. The three remaining members whose series are incomplete over the window (Comoros, Madagascar and Malawi) are excluded to preserve balance, which matters for the dynamic and PMG stages (Table 3). IND is manufacturing value added as a percentage of GDP; the regressors are net FDI inflows (% GDP), the urban share of population (URB), the World-wide Governance Indicators rule-of-law estimate (RL) and domestic credit (CRED) to the private sector (% GDP). All series other than RL come from World Bank development indicators; RL follows Kaufmann, Kraay and Mastruzzi (2011) and is scaled.

**Table 3.** Country heterogeneity in the error-correction speed.

| Country      | $\phi(i)$ (PMG) | s.e.    | Country     | $\phi(i)$ (PMG) | s.e.    |
|--------------|-----------------|---------|-------------|-----------------|---------|
| South Africa | -1.042          | (0.204) | DR Congo    | -0.762          | (0.188) |
| Angola       | 0.256           | (0.100) | Seychelles  | -0.552          | (0.103) |
| Botswana     | -0.172          | (0.109) | Tanzania    | -0.530          | (0.151) |
| Eswatini     | -0.347          | (0.162) | Zambia      | -0.294          | (0.176) |
| Lesotho      | -0.292          | (0.209) | Zimbabwe    | -0.643          | (0.213) |
| Mozambique   | -0.296          | (0.175) | Mauritius   | 0.008           | (0.066) |
| Namibia      | -0.596          | (0.169) | <i>Mean</i> | -0.405          | (0.094) |

*Notes:* Country-specific adjustment speeds from the PMG estimation of equation (14), which imposes a common long-run vector but leaves  $\phi(i)$  free. Two estimates are positive, indicating no error correction towards the pooled long-run relation in those economies.

from roughly  $-2.5$  to  $2.5$ . The four regressors follow from the four policy dimensions the paper sets out to separate, and parsimony is dictated by the modest within-country variation available at  $T = 22$ .

Estimation is carried out in R and Stata, with Equations (3), (6), (8), (11), (12) and (14) implemented directly from the expressions above; the two-way estimates and Driscoll-Kraay standard errors replicate the linearmodels implementation to machine precision. The LSDVC uses  $B = 500$  replications with a damped fixed-point iteration, and the correction is stable to three decimal places across bootstrap seeds and across period-wise and country-wise resampling schemes.

## 5. Results

### 5.1. Diagnostics and the Choice of Specification

**Table 4** reports descriptive statistics. The between-country standard deviation exceeds the within-country standard deviation for every variable, dramatically so for RL (0.78 against 0.15), so the fixed-effects is a within-country object and should not be read as explaining cross-country level differences. The regressors are not strongly collinear except RL with CRED ( $r = 0.67$ ).

**Table 2** reports the pre-estimation tests. The Pesaran (2021) CD statistic rejects cross-sectional independence at the 1 per cent level for IND, FDI, URB and CRED, with average absolute pairwise correlations from 0.23 to 0.90; only RL fails to reject. Fisher-type ADF tests in the sense of Maddala and Wu (1999) reject the joint unit-root null for four of five series in levels but not for RL ( $p = 0.10$ ), and for all five in first differences. Since the Fisher null is that every unit contains a unit root, rejection implies only that some series are stationary, leaving a mixture of  $I(0)$  and  $I(1)$  regressors, which is precisely the case the ARDL framework of Equation (14) is built for. Fisher-combined Engle-Granger tests reject the absence of cointegration between IND and the four regressors ( $P = 42.28$ ,  $p = 0.023$ ).

The specification tests in **Table 5** drive the hierarchy. The  $F$  test of common

**Table 4.** Descriptive statistics, 13 SADC countries, 2002 to 2023 (nT = 286).

| Variable | Definition                                | Mean   | Pooled |        |         | Std. deviation |        |
|----------|-------------------------------------------|--------|--------|--------|---------|----------------|--------|
|          |                                           |        | S.D.   | Min.   | Max.    | Between        | Within |
| IND      | Manufacturing value added (% GDP)         | 12.457 | 6.878  | 3.443  | 35.293  | 6.715          | 2.353  |
| FDI      | FDI net inflows (% GDP)                   | 4.491  | 6.780  | -8.767 | 56.288  | 4.752          | 5.004  |
| URB      | Urban population (% total)                | 41.861 | 13.034 | 20.493 | 69.852  | 13.054         | 3.467  |
| RL       | Rule of law (index)                       | -0.382 | 0.767  | -1.870 | 1.024   | 0.782          | 0.149  |
| CRED     | Domestic credit to private sector (% GDP) | 27.449 | 23.290 | 0.449  | 103.654 | 22.897         | 7.535  |

*Notes:* Between is the standard deviation of country means; within is the standard deviation of deviations from country means. Pairwise correlations among regressors do not exceed 0.29 except RL with CRED ( $r = 0.670$ ). The pooled first-order autocorrelation of IND is 0.969.

**Table 5.** Baseline and static panel estimates of the manufacturing share.

|                                       | (1)                 | (2)                  | (3)                  | (4)                  | (5)                 | (6)               |
|---------------------------------------|---------------------|----------------------|----------------------|----------------------|---------------------|-------------------|
|                                       | Pooled              | FE                   | RE                   | FE Two-Way           | CCEP                | CCEMG             |
| Variable                              | OLS                 | One-Way              | (Swamy-Arora)        | (Driscoll-Kraay)     |                     |                   |
| FDI                                   | -0.305**<br>(0.121) | -0.075***<br>(0.026) | -0.081***<br>(0.026) | -0.042*<br>(0.021)   | -0.019<br>(0.040)   | 0.030<br>(0.092)  |
| URB                                   | -0.336**<br>(0.139) | -0.149***<br>(0.039) | -0.163***<br>(0.037) | 0.247***<br>(0.048)  | 0.372<br>(0.369)    | 1.186<br>(1.064)  |
| RL                                    | -0.424<br>(1.326)   | 3.095***<br>(0.867)  | 2.893***<br>(0.803)  | 2.956***<br>(0.980)  | 1.335<br>(1.230)    | -1.399<br>(1.254) |
| CRED                                  | 0.067<br>(0.059)    | -0.079***<br>(0.018) | -0.075***<br>(0.017) | -0.059***<br>(0.012) | -0.058**<br>(0.025) | -0.046<br>(0.027) |
| Country effects                       | No                  | Yes                  | Random               | Yes                  | Yes                 | Yes               |
| Time effects                          | No                  | No                   | No                   | Yes                  | CS averages         | CS averages       |
| R <sup>2</sup> /within R <sup>2</sup> | 0.407               | 0.223                |                      | 0.212                |                     |                   |
| nT                                    | 286                 | 286                  | 286                  | 286                  | 286                 | 286               |

F test of common intercepts, (1) against (2):  $F(12,269) = 123.895$ ,  $p = 0.000$

Breusch-Pagan LM test of  $\sigma^2(\mu) = 0$ : 1696.870, chi-square(1),  $p = 0.000$

Hausman test, (2) against (3):  $h_1 = 5.851$ , chi-square(4),  $p = 0.211$ ; RE  $\theta = 0.921$

*Notes:* Dependent variable: manufacturing value added (% GDP). Standard errors in parentheses; column (1) is clustered by country, column (4) uses the Driscoll-Kraay covariance of equation (6) with Bartlett bandwidth  $m = 2$ , column (5) is clustered by country and column (6) uses the non-parametric mean-group variance. Columns (5) and (6) augment the regression with cross-sectional averages of the dependent variable and all regressors following [Pesaran \(2006\)](#). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

intercepts is decisively rejected ( $F_{12,269} = 123.90$ ), as is the Breusch-Pagan LM test

(1696.87), so pooled OLS is inadmissible. The Hausman statistic of Equation (4) is 5.85 on four degrees of freedom ( $p = 0.21$ ) and so does not reject random effects; we nevertheless report fixed effects, because the test has little power at  $n = 13$  and because the two sets of estimates are close enough, the largest gap being 0.015 on URB, that the choice is immaterial. The informative comparison is between columns (2) and (4).

## 5.2. The Static Hierarchy

Column (1) of **Table 5** shows why the baseline is misleading: pooled OLS makes CRED positive and insignificant and URB significantly negative, with an  $R^2$  of 0.41 driven almost entirely by cross-country level differences. Once country effects enter in column (2), every coefficient changes and all four become significant at 1 per cent, with CRED turning negative ( $-0.079$ ).

Adding time effects in column (4) leaves FDI, RL and CRED qualitatively intact but reverses URB from  $-0.149$  to  $+0.247$ , both significant at 1 per cent. The reason is transparent: urbanization rose in all thirteen countries while the manufacturing share fell in ten, so without  $\lambda_t$  the coefficient is identified from a common regional trend, and once that trend is purged what remains is the within-year comparison, in which countries urbanizing faster than the regional average also had relatively stronger manufacturing. Both are correct answers to different questions, and neither supports an unconditional claim about urbanization and industry.

Columns (5) and (6) allow heterogeneous loadings on unobserved factors. Under CCEP the URB and RL coefficients keep their signs but lose all significance, with standard errors rising roughly eightfold, and under CCEMG the point estimates change sign. CRED alone survives, at  $-0.058$  ( $p < 0.05$ ), essentially unchanged from column (4). We note that the CD statistic does not reject for the pooled and one-way residuals even though the mean absolute pairwise correlation is 0.34 and 0.45 respectively, a known consequence of offsetting signs, so the CCE stage is justified by the level of dependence in **Table 2** rather than by the residual CD alone.

## 5.3. Dynamics and the Long Run

Panel A of **Table 6** reports the dynamic stage. The LSDV estimate of  $\gamma$  is 0.518; the leading Nickell term in Equation (10) predicts a downward bias of  $-0.076$  at  $T-1=21$ , and the bootstrap correction of Equation (11) moves the estimate by  $+0.078$  to  $\hat{\gamma}_{\text{LSDVC}} = 0.597$  (0.077). That the data-driven correction reproduces the analytical prediction to the third decimal is a useful validation of the procedure. The Anderson-Hsiao estimate of 0.587 (0.344) is consistent with it, though far less precise, as expected of an estimator that discards the level information.

Allowing for persistence attenuates every short-run coefficient roughly by the factor  $1-\gamma$  approx. 0.4, as it should. URB remains significant at 10 per cent (0.088) and the implied long-run effect is 0.218 ( $p = 0.06$ ). CRED is  $-0.025$  in the short run and  $-0.062$  in the long run, a point estimate almost identical to the static two-way

**Table 6.** Dynamic panel and long-run estimates.

| <i>Panel A. Dynamic model, equation (9)</i>                                                                |                      |                      |                      |                    |
|------------------------------------------------------------------------------------------------------------|----------------------|----------------------|----------------------|--------------------|
| Variable                                                                                                   | (1) LSDV             | (2) AH-IV            | (3) LSDVC            | (4) LSDVC long run |
| IND(i,t-1)                                                                                                 | 0.518***<br>(0.052)  | 0.587<br>(0.344)     | 0.597***<br>(0.077)  |                    |
| FDI                                                                                                        | -0.018<br>(0.020)    | -0.027<br>(0.057)    | -0.018<br>(0.018)    | -0.043<br>(0.046)  |
| URB                                                                                                        | 0.111**<br>(0.047)   | 0.071<br>(0.160)     | 0.088*<br>(0.053)    | 0.218*<br>(0.117)  |
| RL                                                                                                         | 0.820<br>(0.678)     | -0.202<br>(1.011)    | 0.601<br>(0.739)     | 1.490<br>(1.738)   |
| CRED                                                                                                       | -0.029<br>(0.018)    | 0.016<br>(0.041)     | -0.025<br>(0.019)    | -0.062<br>(0.045)  |
| nT                                                                                                         | 273                  | 260                  | 273                  | 273                |
| Leading Nickell term $-(1+\gamma)/(T-1) = -0.076$ ; realized LSDVC correction +0.078; half-life 1.34 years |                      |                      |                      |                    |
| <i>Panel B. ARDL (1,1) error-correction models, equation (14): long-run coefficients</i>                   |                      |                      |                      |                    |
| Variable                                                                                                   | (5) DFE              | (6) PMG              | (7) MG               |                    |
| FDI                                                                                                        | -0.024<br>(0.059)    | -0.029<br>(0.030)    | -0.146<br>(0.230)    |                    |
| URB                                                                                                        | -0.099<br>(0.078)    | -0.028<br>(0.041)    | -0.291<br>(0.555)    |                    |
| RL                                                                                                         | 2.421<br>(1.746)     | -0.941*<br>(0.559)   | 0.717<br>(2.465)     |                    |
| CRED                                                                                                       | -0.093**<br>(0.042)  | -0.140***<br>(0.017) | -0.041<br>(0.131)    |                    |
| $\phi$ (adjustment speed)                                                                                  | -0.401***<br>(0.048) | -0.405***<br>(0.094) | -0.759***<br>(0.099) |                    |
| nT                                                                                                         | 273                  | 273                  | 273                  |                    |
| Hausman test of long-run homogeneity, (6) against (7): $h_2 = 3.159$ , chi-square (4), $p = 0.532$         |                      |                      |                      |                    |

*Notes:* Dependent variable: manufacturing value added (% GDP); Panel A in levels, Panel B in the error-correction form of equation (14). All Panel A columns include country and time effects. Column (2) instruments the differenced lag with  $IND(i,t-2)$  and reports country-clustered standard errors. Column (3) applies the bootstrap bias correction of equation (11) with  $B = 500$  and period-wise resampling; standard errors are bootstrap standard deviations. Column (4) applies equation (13). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

estimate of  $-0.059$ , but the bootstrap standard error of  $0.045$  leaves it short of conventional significance ( $p = 0.16$ ). The implied half-life of a shock is 1.34 years.

Panel B relaxes slope homogeneity. The Hausman statistic of Equation (16) is 3.16 with four degrees of freedom ( $p = 0.53$ ), so long-run homogeneity is not rejected and PMG is the efficient choice. PMG puts the long-run credit coefficient at  $-0.140$  ( $p < 0.01$ ), more than twice the static estimate, implying that a 10-point rise in credit to GDP is associated with a 1.4-point lower manufacturing share; DFE gives  $-0.093$  ( $p < 0.05$ ). Neither URB nor FDI has a detectable long-run effect in any member of the ARDL family, and RL switches sign under PMG ( $-0.941$ ,  $p < 0.10$ ), which we do not press given the RL-CRED collinearity. The mean error-correction speed is  $-0.405$  ( $p < 0.01$ ) under PMG and  $-0.401$  under DFE, corrob-

orating the cointegration evidence, although the country-specific speeds are highly heterogeneous and two are positive (Angola, 0.256; Mauritius, 0.008).

#### 5.4. Robustness and Contrast with the Literature

**Table 7** reports sensitivity. All four two-way coefficients are sign-stable across every leave-one-country-out draw; URB and RL remain significant at 10 per cent in 13 of 13 draws, CRED in 12 of 13 and FDI in 8 of 13. The exception for CRED is the exclusion of Zimbabwe, after which the coefficient falls to  $-0.032$  and loses significance, so part of the static credit effect is carried by an economy that experienced both hyperinflationary credit collapse and industrial contraction; the LSDVC credit coefficient, by contrast, is essentially unchanged without Zimbabwe ( $-0.022$  against  $-0.024$ ). Excluding South Africa, the island economies, 2020 to 2021 and 2008 to 2009 leaves all conclusions intact, and Driscoll-Kraay standard errors are stable over bandwidths  $m=1$  to  $m=5$ . Estimating Equation (5) with the log-odds of the share rather than its level yields level-equivalent coefficients of  $-0.047$ ,  $0.330$ ,  $4.036$  and  $-0.059$ , so functional form is not driving the results.

**Table 7.** Robustness.

| Specification                                                             | FDI                       | URB                        | RL                         | CRED                        | nT  |
|---------------------------------------------------------------------------|---------------------------|----------------------------|----------------------------|-----------------------------|-----|
| <b><i>Panel A. Two-way fixed effects, Driscoll-Kraay, sub-samples</i></b> |                           |                            |                            |                             |     |
| Baseline                                                                  | $-0.042^*$<br>(0.021)     | $0.247^{***}$<br>(0.048)   | $2.956^{***}$<br>(0.980)   | $-0.059^{***}$<br>(0.012)   | 286 |
| Excluding South Africa                                                    | $-0.045^{**}$<br>(0.021)  | $0.247^{***}$<br>(0.052)   | $3.047^{***}$<br>(1.034)   | $-0.058^{***}$<br>(0.012)   | 264 |
| Excluding island economies                                                | $-0.067^{***}$<br>(0.020) | $0.250^{***}$<br>(0.049)   | $2.748^{**}$<br>(0.973)    | $-0.069^{***}$<br>(0.015)   | 242 |
| Excluding Zimbabwe                                                        | $-0.046^*$<br>(0.025)     | $0.242^{***}$<br>(0.054)   | $2.627^{**}$<br>(1.165)    | $-0.032$<br>(0.029)         | 264 |
| Excluding 2020 to 2021                                                    | $-0.039^*$<br>(0.022)     | $0.241^{***}$<br>(0.052)   | $3.296^{***}$<br>(1.059)   | $-0.062^{***}$<br>(0.014)   | 260 |
| Excluding 2008 to 2009                                                    | $-0.037^*$<br>(0.020)     | $0.258^{***}$<br>(0.050)   | $2.989^{***}$<br>(1.023)   | $-0.060^{***}$<br>(0.012)   | 260 |
| Log-odds dependent variable                                               | $-0.0043^*$<br>(0.0021)   | $0.0303^{***}$<br>(0.0040) | $0.3701^{***}$<br>(0.0873) | $-0.0054^{***}$<br>(0.0015) | 286 |
| <b><i>Panel B. The role of common time effects</i></b>                    |                           |                            |                            |                             |     |
| Static FE, no time effects                                                | $-0.075^{***}$            | $-0.149^{***}$             | $3.095^{***}$              | $-0.079^{***}$              | 286 |
| Static FE, time effects                                                   | $-0.042^*$                | $0.247^{***}$              | $2.956^{***}$              | $-0.059^{***}$              | 286 |
| LSDVC, no time effects ( $\gamma = 0.694$ )                               | $-0.016$                  | $-0.026$                   | $0.394$                    | $-0.025$                    | 273 |

## Continued

|                                                                       |        |        |        |        |     |
|-----------------------------------------------------------------------|--------|--------|--------|--------|-----|
| LSDVC, time effects ( $\gamma = 0.598$ )                              | -0.018 | 0.089* | 0.575  | -0.024 | 273 |
| <i>Panel C. LSDVC sub-samples (short-run coefficients)</i>            |        |        |        |        |     |
| Baseline ( $\gamma = 0.598$ )                                         | -0.018 | 0.089* | 0.575  | -0.024 | 273 |
| Excluding South Africa ( $\gamma = 0.592$ )                           | -0.020 | 0.092* | 0.627  | -0.025 | 252 |
| Excluding Zimbabwe ( $\gamma = 0.644$ )                               | -0.020 | 0.073  | -0.042 | -0.022 | 252 |
| <i>Panel D. Leave-one-country-out jackknife, two-way FE, 13 draws</i> |        |        |        |        |     |
| Minimum                                                               | -0.074 | 0.209  | 1.187  | -0.075 |     |
| Maximum                                                               | -0.022 | 0.490  | 3.483  | -0.032 |     |
| Sign stable                                                           | Yes    | Yes    | Yes    | Yes    |     |
| Significant at 10%                                                    | 8/13   | 13/13  | 13/13  | 12/13  |     |

Notes: Panel A rows are two-way fixed effects with Driscoll-Kraay standard errors, bandwidth  $m = 2$ , in parentheses; island economies are Mauritius and Seychelles; the log-odds row replaces the dependent variable with the log-odds of the share, and multiplying by 10.905 gives level-equivalent coefficients of -0.047, 0.330, 4.036 and -0.059. Panels B and C report LSDVC short-run coefficients with  $B = 300$ . Driscoll-Kraay standard errors are stable across bandwidths  $m = 1$  to  $m = 5$ . \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

Three contrasts with the literature follow. First, [Mijiyawa \(2017\)](#) finds governance quality significant and FDI and urbanization insignificant for 53 African countries. Our static homogeneous specifications reproduce his governance result almost exactly (RL of 2.96 in column 4), but it does not survive either the dynamic or the heterogeneous stage, which suggests the finding is conditional on the homogeneous static specification rather than on the African sample. Our FDI result agrees with his once dynamics are admitted. Second, our URB reversal reconciles [Gollin, Jedwab and Vollrath \(2016\)](#) with studies reporting positive urbanization effects: their consumption-city prediction is what the without-time-effects estimate (-0.149) delivers, while the positive estimate obtains only after the common regional trend is purged. Third, the negative credit coefficient is the sectoral counterpart of the aggregate finding of [Arcand, Berkes and Panizza \(2015\)](#), and is obtained here at credit-to-GDP ratios averaging 27 per cent, far below the thresholds at which their aggregate effect turns negative.

## 6. Conclusion

This study explores the determinants of manufacturing share in the SADC zone using a rigorous panel estimating technique. Our results show that model specification has a significant impact on the outcomes, which has important ramifications for theory and policy.

The rule of law has a large positive influence, FDI has a negative and significant effect under traditional FE and RE estimators, and urbanization reverses sign once time effects are taken into account, indicating that agglomeration forces are at

work once global shocks are taken into account. Nevertheless, using the favored CCEP and CCEMG estimators, which take slope heterogeneity and cross-sectional dependency into account, these associations collapse to insignificance.

Our main conclusion is this attenuation: domestic policy variables have little independent explanatory power for industrialization once common regional and global factors—commodity cycles, global financial conditions, and regional spillovers—are filtered out. Strong country effects and serial correlation support the widespread presence of unobserved heterogeneity and interdependence.

Our findings theoretically contradict traditional cross-national analyses that presume national independence. Rather than separate domestic strategies, common regional dynamics seem to be the main driver of industrialization in SADC. This implies that frameworks that approach each economy separately are not as suitable as regional theories of industrial development that incorporate cross-border factor mobility, trade corridors, and institutional emulation.

The conclusion for policy is clear: without integrated regional plans, domestic reforms in FDI attractiveness, urban planning, credit growth, and legal frameworks—while essential—are insufficient. Industrial policy needs to go beyond national boundaries, emphasizing harmonized investment regimes and regional value chains

Future studies should use spatial econometric models to break down direct and indirect spillover effects and determine if the traits of neighbors cause crowding-out or agglomeration. In the end, industrialization in the SADC zone is essentially a regional public good, requiring cooperation outside of national policy silos.

## Author Contributions

N.V.A. Koassi led the conceptualization and methodology; investigation, and the original draft writing. M. Traoré, R. Yéo and K. Traore went through the literature review and the data analysis. All authors (Koassi, Traoré, Yéo, Traoré) reviewed, edited, commented, and approved the final manuscript for submission.

## Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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