Enforcement of environmental protection protocols and compliance among micro, small, and medium enterprises in Zimbabwe: is institutional credibility effective in the presence of corruption tendencies?

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ONLINE APPENDIX

Appendices

Appendix A1. Data generation process

Technological and Commercial Information Promotion System (TIPS), a division of the Scientific and Industrial Research and Development Centre operating under the Office of the President and Cabinet, conducted a nationwide survey of manufacturing MSMEs in Zimbabwe in November/December 2021. The survey aimed to identify challenges faced by MSMEs and develop targeted intervention strategies to support industrial development.

Prior to the survey, TIPS engaged in multi-stakeholder consultations with government agencies, aid organizations, academic institutions, and the private sector in September 2021 to establish clear objectives for the study. These consultations informed the development of the survey instrument.to

The survey classified MSMEs based on the number of employees: micro enterprises (≤5 employees), small enterprises (6–30 employees), and medium enterprises (31–75 employees). This classification aligns with the definition used in the 2012 survey of MSMEs in Zimbabwe (Research Continental-Fonkom and Finmark Trust, 2012). The survey sought to understand the scope, composition, and challenges faced by manufacturing MSMEs in Zimbabwe, including regulatory compliance.

The Manufacturing MSME survey covered each of the country's 10 provinces. Twenty enumerators were employed in Harare province, which has the highest concentration of MSMEs in the nation, and 15 enumerators were hired in each of the remaining nine provinces. Enumerators were either university students or graduates who underwent a two-week training program to enable them to address every aspect of the questionnaire. To achieve balanced sample representation across the country in terms of regional representation, manufacturing subsector, enterprise formality, and operational space occupied, we employed the following stratification strategy: (a) Geospatial stratification was achieved by subdividing the country

into 10 provincial subdivisions following the political boundaries established by the government of Zimbabwe. All provinces were surveyed, and further stratification was done in each province using the other stratification criteria detailed below. (b) The manufacturing sector was divided into eight major subsectors, as identified and targeted by the Ministry of Industry and Commerce, namely: arts and crafts, building and construction materials, food production, furniture and fixtures, metal fabrication, oil chemicals and plastics, paper printing and publishing, textiles and leather, and other. The "other" category was created by combining several smaller subsectors that were too small to identify individually. (c) The survey visited both registered (formal) and unregistered (informal) manufacturing MSMEs of various sizes (micro, small, and medium) for interviewing. (d) Balance between formal and informal enterprises was achieved mostly by visiting enterprises located in both informal spaces (homes, open spaces, and mobile workshops) and formal spaces (private, government, and council premises).

Representatives from the Ministry of Women Affairs, Community, Small and Medium Businesses would direct enumerators toward industrial clusters or areas where they could identify enterprises working in various manufacturing subsectors. Enumerators conducted interviews with entrepreneurs who consented to participate after being randomly selected upon arrival. Later, they employed the "snowball" strategy to gather data on other firms, especially those located in unapproved locations. Each interview lasted between 30 and 45 minutes and was conducted in November and December 2021. In-person interviews were conducted using digital tablets equipped with Census and Survey Processing System questionnaires. Each interview was conducted in the local language on the company's premises. Respondents were owners or top managers with an extensive understanding of the company's operations. Overall, 4,776 valid interviews were conducted.

Appendix B. Balance diagnostics and overlap plots

Table A1. Balance of covariates after weighting

	Means		Variances		Difference in means	p-value for difference in means
	Control	Treated	Control	Treated		
Owner is female	0.144	0.140	0.123	0.121	0.004	0.997
Age of entrepreneur						
36 ≤ Age [Years] ≥55	0.519	0.584	0.250	0.243	-0.065	0.948
56 ≤ Age [Years]	0.056	0.057	0.053	0.054	-0.001	0.999
Education of entrepreneur						
Primary level	0.061	0.041	0.057	0.040	0.020	0.984
Ordinary level	0.663	0.550	0.224	0.248	0.113	0.910
Advanced level	0.066	0.119	0.062	0.105	-0.052	0.958
Vocational	0.045	0.086	0.043	0.079	-0.041	0.967
Artisan	0.067	0.102	0.063	0.092	-0.035	0.972
University Degree	0.070	0.078	0.065	0.072	-0.009	0.993
Source of knowledge about the business						
Through Training	0.274	0.259	0.199	0.192	0.015	0.988
Outsourced Expertise	0.068	0.067	0.064	0.062	0.002	0.999
Prior industry experience						
Not related	0.391	0.279	0.238	0.201	0.111	0.911
No previous work experience	0.090	0.127	0.082	0.111	-0.038	0.970
Attended a management training	0.083	0.127	0.076	0.111	-0.044	0.965
Enterprise age	7.478	7.262	50.517	47.902	0.215	0.829
Number of workers at establishment	1.055	1.103	0.063	0.106	-0.048	0.962
Operating space						
Home	0.157	0.105	0.132	0.094	0.052	0.959
Council	0.282	0.260	0.203	0.192	0.022	0.982
Government	0.018	0.015	0.017	0.015	0.002	0.998
Open space	0.227	0.222	0.176	0.173	0.005	0.996
Mobile workshop	0.032	0.021	0.031	0.020	0.012	0.991
Sub-sector						
Food Production	0.108	0.077	0.097	0.071	0.031	0.975
Textiles and Leather	0.091	0.106	0.083	0.095	-0.015	0.988
Furniture and Fixtures	0.276	0.282	0.200	0.203	-0.007	0.995
Paper Printing and Publishing	0.032	0.041	0.031	0.040	-0.009	0.993
Oil Chemicals and Plastics	0.019	0.030	0.018	0.029	-0.012	0.991
Metal manufacturing	0.268	0.256	0.196	0.191	0.012	0.991
Construction and Building materials	0.110	0.114	0.098	0.101	-0.003	0.997

Province						
Bulawayo	0.066	0.081	0.062	0.075	-0.015	0.988
Manicaland	0.114	0.116	0.101	0.103	-0.002	0.999
Mashonaland Central	0.068	0.066	0.063	0.061	0.002	0.998
Mashonaland East	0.128	0.105	0.112	0.094	0.023	0.982
Mashonaland West	0.109	0.116	0.097	0.103	-0.007	0.995
Matabeleland North	0.015	0.026	0.014	0.025	-0.011	0.991
Matabeleland South	0.020	0.024	0.020	0.024	-0.004	0.997
Midlands	0.122	0.093	0.107	0.084	0.029	0.977
Masvingo	0.082	0.082	0.076	0.075	0.000	1.000

Table A2. Overidentification test for covariate balance

H0: Covariates are balanced	
chi2(40)	59.516
Prob > chi2	0.024

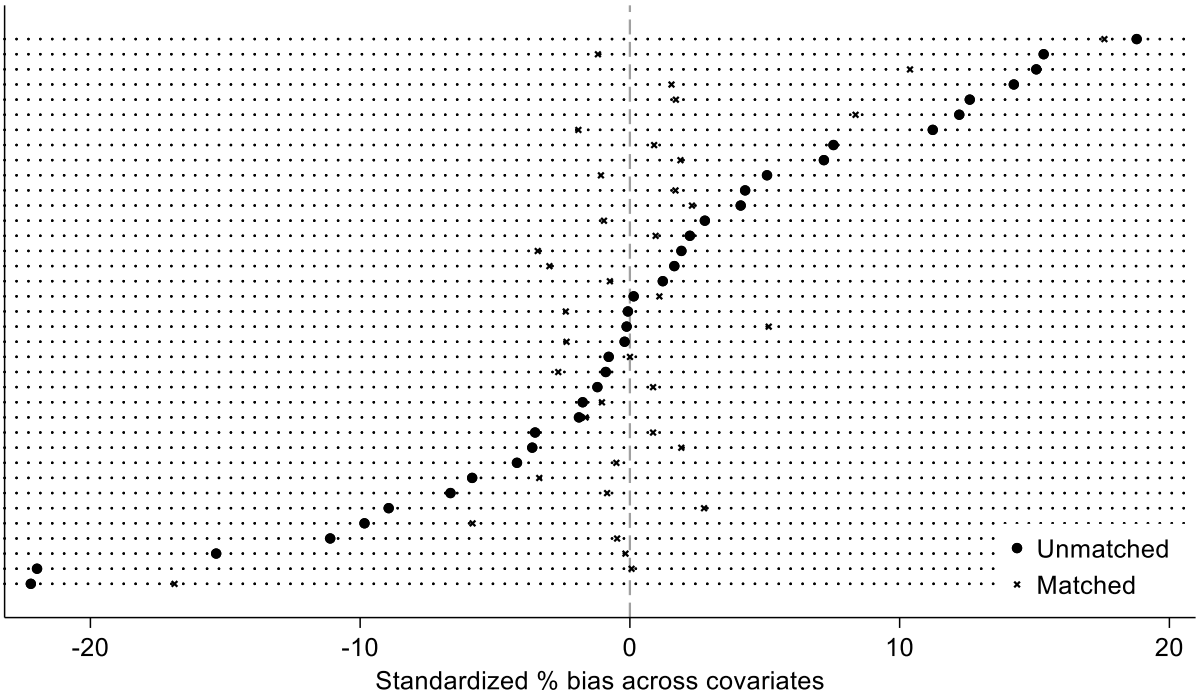

Figure A1. Absolute standardised mean differences before and after weighting.

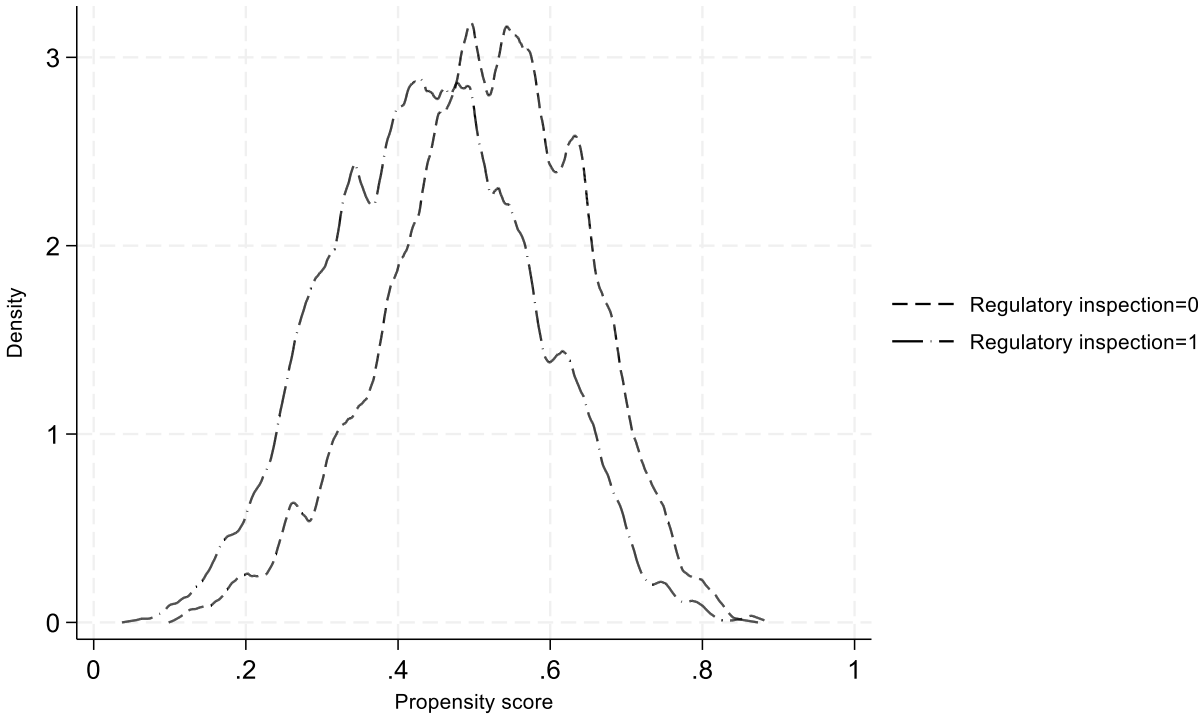

Figure A2. Kernel density plot of propensity scores for treated and control groups.

Appendix C. Endogenous Switching Probit model specification

C1. Model specification

The Endogenous Switching Probit (ESP) model accounts for potential selection on unobservables by jointly modelling the treatment assignment process (receiving a regulatory inspection) and the outcome process (compliance). The model consists of a selection equation and two outcome equations as shown below.

Selection equation

$$T_i^* = Z_i'\gamma + u_i$$

$$T_i = \begin{cases} 1 & \text{if } T_i^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

where T_i^* is the latent propensity for firm i to receive regulatory inspections, Z_i is a vector of covariates that influence inspection assignment (which include all covariates from X_i in the main IPWRA model), γ is a parameter vector, and u_i is the error term.

Outcome equations

For firms that receive inspections ($T_i = 1$),

$$Y_i^*(1) = X_i'\beta_1 + \epsilon_{1i}$$

$$Y_i(1) = \begin{cases} 1 & \text{if } Y_i^*(1) > 0 \\ 0 & \text{otherwise} \end{cases}.$$

For firms that do not receive inspections ($T_i = 0$),

$$Y_i^*(0) = X_i'\beta_0 + \epsilon_{0i}$$

$$Y_i(0) = \begin{cases} 1 & \text{if } Y_i^*(0) > 0 \\ 0 & \text{otherwise} \end{cases}.$$

Error structure

The error terms $(u_i, \epsilon_{1i}, \epsilon_{0i})$ are assumed to follow a trivariate normal distribution with mean zero and covariance matrix:

$$\Sigma = \begin{bmatrix} 1 & \rho_1\sigma_1 & \rho_0\sigma_0 \\ \rho_1\sigma_1 & \sigma_1^2 & \rho_{10}\sigma_1\sigma_0 \\ \rho_0\sigma_0 & \rho_{10}\sigma_1\sigma_0 & \sigma_0^2 \end{bmatrix},$$

where $\rho_1 = \text{corr}(u_i, \epsilon_{1i})$ and $\rho_0 = \text{corr}(u_i, \epsilon_{0i})$ capture the correlation between unobservables affecting treatment assignment and outcomes in each regime. For identification, we set $\text{var}(u_i) = 1$ (probit normalization) and $\sigma_1^2 = \sigma_0^2 = 1$ (probit outcome equations).

Average Treatment Effect on the Treated (ATT)

The ESP-derived ATT is calculated as

$$ATT_{ESP} = \frac{1}{N_1} \sum_{i:T_i=1} \left[\Phi(X_i'\hat{\beta}_1) - \Phi(X_i'\hat{\beta}_0 + \hat{\rho}_0\hat{\lambda}_i)\right],$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function, and $\hat{\lambda}_i = \phi(Z_i'\hat{\gamma})/\Phi(Z_i'\hat{\gamma})$ is the inverse Mills ratio for the treated firms, with $\phi(\cdot)$ being the standard normal probability density function. The model is estimated via full information maximum likelihood. Note that identification relies on distributional assumptions (joint normality) and functional form, as we lack a credible exclusion restriction (an instrument that affects inspections but not compliance directly). The ESP results are only meant to be confirmatory.

Appendix D. Placebo test results

Table A3. Placebo tests: treatment effects of enforcement on exogenous entrepreneur characteristics

Exogenous entrepreneur characteristic	Treatment effect of enforcement
Owner is female	0.002 (0.010)
56 ≤ Age [Years]	0.004 (0.007)
University Degree (Bachelors/Masters/PhD)	0.006 (0.008)

Note: Standard errors in parentheses.

References

Research Continental-Fonkom and Finmark Trust (2012) *FinScope MSME Survey Zimbabwe 2012*. Available at https://documents1.worldbank.org/curated/en/780081468137402417/pdf/945050WP0Box385442B0P12644800PUBLIC00ACS.pdf.