WEST BENGAL STATE UNIVERSIRY

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SEMISTER: III

SUBJECT: **Development economics**

TOPIC: Manufacturing value added (MVA)

Introduction

Access to electricity and capital investment are pivotal factors influencing the growth and performance of the manufacturing sector, which serves as a cornerstone of economic development in many countries. The manufacturing sector not only contributes significantly to gross domestic product (GDP) but also plays a crucial role in job creation, technological innovation, and export competitiveness. Understanding the interplay between access to electricity, capital investment, and Manufacturing Value Added (MVA) is essential for policymakers, investors, and industry stakeholders seeking to promote sustainable industrial growth and economic prosperity.

Access to reliable and affordable electricity is fundamental for modern manufacturing processes, powering machinery, lighting facilities, and supporting essential operations. Electricity access facilitates the adoption of advanced manufacturing technologies, enhances productivity, and enables firms to remain competitive in global markets. Similarly, capital investment in machinery, equipment, infrastructure, and human capital drives innovation, productivity gains, and expansion within the manufacturing sector. Investments in research and development (R&D) foster technological advancements, leading to the development of new products and processes that drive economic growth and competitiveness.

Despite their importance, the relationship between access to electricity, capital investment, and MVA remains complex and multifaceted. While access to electricity is widely recognized as a critical enabler of manufacturing activities, the extent to which it directly contributes to MVA may vary depending on factors such as infrastructure quality, regulatory frameworks, and technological capabilities. Likewise, the impact of capital investment on MVA may be influenced by factors such as financing constraints, market conditions, and policy environments.

This paper aims to examine the relationship between access to electricity, capital investment, and MVA in the manufacturing sector using panel data regression analysis. By analyzing data from a sample of countries or regions over a specified time period, we seek to empirically assess the extent to which access to electricity and capital investment influence MVA and identify potential policy implications for fostering sustainable industrial growth.

1) Research Questions

a) What is the relationship between access to electricity and manufacturing value added?
b) How does capital investment influence manufacturing value added?
c) Are there statistically significant associations between these variables and manufacturing value added?
d) Which factor, access to electricity or capital investment, has a stronger impact on manufacturing value added?
e) Do the effects of access to electricity and capital investment on manufacturing value added differ across different countries or regions?

2) Objectives

3) Understanding the Relationship: Investigate the relationship between access to electricity and manufacturing value added, as well as the relationship between capital investment and manufacturing value added.
4) Quantifying Impact: Determine the extent to which access to electricity and capital investment influence manufacturing value added. This could involve assessing the magnitude of the coefficients associated with these variables in the regression model.
5) Policy Implications: Evaluate the policy implications of improving access to electricity and increasing capital investment for the manufacturing sector. This could include recommendations for policymakers on how to stimulate manufacturing growth through infrastructure development and investment promotion.
6) Comparative Analysis: Compare the relative importance of access to electricity and capital investment in driving manufacturing value added. This could

involve assessing which factor has a larger impact or whether their effects are complementary or substitutable.

7) Temporal Analysis: Analyze how the impact of access to electricity and capital investment on manufacturing value added may have evolved over time. This could involve examining trends and changes in the coefficients of these variables over different time periods.
8) Sectoral Differences: Explore whether the impact of access to electricity and capital investment varies across different segments of the manufacturing sector. This could involve conducting subgroup analyses to identify specific industries or regions where these factors are particularly important.
9) Robustness Checks: Conduct sensitivity analyses and robustness checks to ensure the stability and reliability of the results. This could involve testing alternative specifications of the regression model or using different estimation techniques to verify the robustness of the findings.

Overall, the research objective would be to provide empirical evidence on the drivers of manufacturing value added, with a focus on understanding the role of access to electricity and capital investment in shaping the performance of the manufacturing sector.

C) Hypothesis

Null Hypothesis (H0): There is no significant relationship between access to electricity, capital investment and manufacturing value added.

Review of literature

Manufacturing contributes significantly to gross domestic product (GDP) in many countries. MVA represents the value added by the manufacturing sector to the economy after accounting for the cost of intermediate goods and services. As such, it serves as a key component of GDP and contributes to overall economic output. Manufacturing industries are often labor-intensive, providing employment opportunities to a large segment of the population. The creation of jobs in manufacturing not only reduces unemployment but also improves living standards by offering stable income sources and access to benefits such as healthcare and education. Manufacturing sectors are hubs of technological innovation and productivity enhancement. Investments in research and development (R&D), technology adoption, and process improvements in manufacturing lead to productivity gains, which drive economic growth and competitiveness on a global scale. Overall, manufacturing value added serves as a critical driver of economic growth, employment generation, technological progress, and structural transformation in economies around the world. Policies that support the development and competitiveness of the manufacturing sector are essential for fostering sustainable and inclusive economic development.

Access to reliable and affordable electricity is fundamental for the functioning of modern manufacturing processes. Electricity is a primary energy input used in various stages of production, including powering machinery, lighting facilities, and supporting heating and cooling systems. Without adequate access to electricity, manufacturing firms face operational constraints, reduced production capacity, and increased costs. Moreover, electricity access enables the adoption of advanced manufacturing technologies, such as automation, robotics, and digitalization, which are essential for enhancing productivity, quality, and competitiveness in today's global market. Capital investment, including investments in machinery, equipment, infrastructure, and human capital, plays a pivotal role in driving innovation, productivity growth, and expansion within the manufacturing sector. Capital investment enables firms to modernize production processes, upgrade technologies, and improve efficiency, leading to higher output levels and improved product quality. Additionally, investment in research and development (R&D) fosters innovation, driving the development of new products, processes, and market opportunities. Capital investment also facilitates the integration of manufacturing activities into global value chains, enabling firms to access new markets and compete effectively on a global scale.

Energy input appears to be closely related to production. The development of manufacturing sector stimulates greater demand for electricity. Access to electricity for mass people in developing countries to increase productivity and thus to improve the living standards of their citizens.

Effective use of capital is an important strategic tool for any manufacturing company operating in today's high technology and capital intensive environment. Capital budgeting processes based on discounted cash flow served as the principal tools for evaluating capital investment proposals for American firms as early as the 1950s. The relationship between intellectual capital and firm value has been researched by researchers from various countries.

Research gap

The research gap in Ugur Soytas, Ramazan Sari (2007) is the need for further research on specific energy saving technologies and strategies for increasing energy efficiency in the Turkish manufacturing industry. The research gap in D. H. Husaini, H. Lean (2015) is the lack of focus on the micro level, particularly in the manufacturing sector, in terms of the relationship between energy consumption and economic growth. The paper extends the current literature by examining the specific relationship between electricity consumption and economic growth in the Malaysian manufacturing sector. The research gap is not explicitly stated, but it may lie in the specific policy initiatives related to individual control variables and their impact on ensuring access to electricity for productivity growth in developing countries.

The research gap in Preatmi Nurastuti, Surachman, Rofiaty, S. Aisjah (2020) is the lack of consensus in empirical studies on the relationship between intellectual capital and firm value, highlighting the need for further research to clarify this relationship. The research gap in R. Tiwari, B. Kumar (2015) is the lack of consensus and uniform approach towards value drivers and their classification, especially in the context of developing economies like India. The paper also emphasizes the scarcity of empirical literature on developing economies and encourages further research in this area to address the dynamics of value drivers in emerging nations.

Methodology

1. **Data Collection**:
    - Gather panel data containing information on Manufacturing Value Added (MVA), access to electricity, capital investment, and other relevant variables for a sample of countries or regions over a specified time period. Ensure that the data is reliable, consistent, and covers a sufficiently long time span to capture meaningful relationships.
2. **Variable Definition**:
    - Define the variables to be used in the regression analysis:
        - Dependent Variable: Manufacturing Value Added (MVA)
        - Independent Variables: Access to Electricity, Capital Investment, and potentially other control variables such as GDP per capita, labor force participation, trade openness, and technological advancement.
        - Time and Country/Region Fixed Effects: Include fixed effects for time and country/region to account for unobserved heterogeneity and time-specific shocks.
3. **Regression Model Specification**:
    - Specify the regression model based on the research objective and theoretical framework:

- $MVA_{it}=\beta_0+\beta_1\times AccessToElectricity_{it}+\beta_2\times CapitalInvestment_{it}+\beta_3\times ControlVariables_{it}+\alpha_i+\gamma_t+\epsilon_{it}$

Where:

- MVA_{it} is the Manufacturing Value Added for country/region i at time t.
- $AccessToElectricity_{it}$ and $CapitalInvestment_{it}$ are the variables representing access to electricity and capital investment for country/region i at time t.
- $ControlVariables_{it}$ represents other control variables.
- α_i and γ_t are country/region and time fixed effects, respectively.
- ϵ_{it} is the error term.

4. **Estimation Technique**:
   - Utilize panel data regression techniques such as Fixed Effects (FE) or Random Effects (RE) models to estimate the parameters of the regression equation. Given the focus on understanding the impact of access to electricity and capital investment, a Fixed Effects model may be preferred to control for unobserved heterogeneity across countries/regions. We use
     Hausman Test for choosing between fixed effect or random effect model.

Result

The fixed effect model result are below

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. xtreg MVA Accesstoelectricity capitalinvestmentusd,fe robust

Fixed-effects (within) regression               Number of obs     =         72
Group variable: j2                              Number of groups  =          3

R-squared:                                      Obs per group:
     Within  = 0.9613                                         min =         24
     Between = 0.9912                                         avg =       24.0
     Overall = 0.9622                                         max =         24

                                                F(2,2)            =  121861.55
corr(u_i, Xb) = 0.6850                          Prob > F          =     0.0000

                                       (Std. err. adjusted for 3 clusters in j2)
--------------------------------------------------------------------------------
                     |               Robust
                 MVA | Coefficient  std. err.      t    P>|t|     [95% conf. interval]
---------------------+----------------------------------------------------------
 Accesstoelectricity |   4.26e+08   1.85e+08     2.30   0.148    -3.72e+08    1.22e+09
capitalinvestmentusd |   .4699054   .0099325    47.31   0.000     .4271694    .5126413
               _cons |  -3.49e+09   1.22e+10    -0.29   0.802    -5.61e+10    4.92e+10
---------------------+----------------------------------------------------------
             sigma_u |  3.341e+10
             sigma_e |  1.486e+10
                 rho |  .83494406   (fraction of variance due to u_i)
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in the fixed effect model we get good rho value . and there is correlation between u_i and XB . so fixed effect model is appropriate. Furthermore we calculate Hausman test for model selection. To do that we need to get random effect model and run the Husman test.

Random Effect model results

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Random-effects GLS regression                   Number of obs     =         72
Group variable: j2                              Number of groups  =          3

R-squared:                                      Obs per group:
     Within  = 0.9514                                         min =         24
     Between = 0.9997                                         avg =       24.0
     Overall = 0.9708                                         max =         24

                                                Wald chi2(2)      =    2293.04
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =     0.0000
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MVA	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Accesstoelectricity	-1.86e+08	1.53e+08	-1.21	0.225	-4.85e+08	1.14e+08
capitalinvestmentusd	.5815762	.0131698	44.16	0.000	.5557638	.6073885
_cons	2.62e+10	1.09e+10	2.40	0.016	4.78e+09	4.75e+10
sigma_u	0					
sigma_e	1.486e+10					
rho	0	(fraction of variance due to u_i)				

And Hasuman Test

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    Note: the rank of the differenced variance matrix (1) does not equal the number of
          coefficients being tested (2); be sure this is what you expect, or there may be
          problems computing the test.  Examine the output of your estimators for anything
          unexpected and possibly consider scaling your variables so that the coefficients
          are on a similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       re           fe         Difference       Std. err.
-------------+----------------------------------------------------------------
Accesstoel~y |  -1.86e+08     4.26e+08       -6.12e+08        5.77e+07
capitalinv~d |   .5815762     .4699054        .1116708               .
------------------------------------------------------------------------------
                          b = Consistent under H0 and Ha; obtained from xtreg.
           B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

    chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            = 112.40
Prob > chi2 = 0.0000
(V_b-V_B is not positive definite)
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Here we can see Prob>chi2 so fixed effect model is appropriate.

Conclusion

- Capital investment appears to be a significant driver of Manufacturing Value Added (MVA) in the manufacturing sector. Higher levels of capital investment are associated with increased MVA, suggesting that investment in machinery, equipment, and infrastructure plays a crucial role in driving economic output within the manufacturing industry.

- The relationship between access to electricity and MVA, however, does not appear to be statistically significant in this model. This result may indicate that while access to electricity is important for manufacturing activities, its direct impact on MVA may be less pronounced or may vary depending on other factors not captured in the model.

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