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Quantifying The Contribution Of Knowledge To Indian Economic Growth

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Abstract:
This paper investigates the role of knowledge in driving economic growth in the context of 18 Indian states over the period of 2013-2020. Using the Knowledge Assessment Methodology (KAM) as a conceptual base, a composite Knowledge Index is constructed from seven indicators spanning three core pillars: education (pupil-teacher ratio, education expenditure and pass-out percentage), information and communication technology (ICT) (teledensity and internet subscriptions), and research & development (R&D) (patents granted). Panel data regression techniques are employed to evaluate the impact of this index on Gross Domestic Product (GDP), controlling for variables such as credit availability, direct taxes, power generation, capital expenditure, and population growth. The results show that knowledge has a significant and positive effect on economic growth only in the short-run and not in the long-run. This research emphasizes on the urgent need to invest in knowledge-related sectors to promote growth of the economy especially in developing countries.

Keywords: *knowledge economy, KAM, Pooled Mean Group-Error Correction Model*

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I. Introduction:

Knowledge has always underpinned human progress, but its formal recognition as an economic driver emerged in twentieth-century economic theories. Moving beyond classical models of land and labor, economists like Romer and Lucas placed ideas, innovation, and human capital at the heart of growth. This defines the modern "knowledge economy," where creating and applying knowledge is the primary engine of productivity and competitiveness.

This transformation has been accelerated by the ICT revolution, which has reshaped how knowledge is accessed and shared. However, the benefits remain uneven, with developing nations facing significant structural challenges.

India presents a compelling case study. Its historical legacy as a knowledge-rich civilization is now coupled with a modern trajectory supercharged by the IT revolution. Cities like Bangalore have become global innovation hubs, and the number of knowledge workers has surged. This study builds on these insights to examine the impact of knowledge—through education, R&D, and ICT—on economic growth, with a particular focus on India's dynamic and complex transition.

II. Review Of The Literature:

The conceptual history of knowledge in economics begins with classical thinkers like Adam Smith, who highlighted specialization's role in enhancing skill and creativity. A significant shift occurred when Theodore Schultz formally introduced 'human capital' into economic analysis, arguing that investments in education and skills were key to productivity (Schultz, 1961).

Neoclassical growth theory, exemplified by Solow (1956), identified a major unexplained 'residual' in growth accounting, attributed to exogenous technological progress. This led to efforts to quantify improvements in labour and capital quality, with Schultz's human capital theory providing a partial explanation.

Dissatisfaction with exogenous technology spurred the Endogenous Growth Theory of the 1980s/90s. Economists like Romer (1986, 1990) and Lucas (1988) re-framed knowledge and human capital as internal drivers of long-term growth, avoiding diminishing returns. Romer emphasized the non-rivalrous nature of knowledge

and the incentives for R&D, while Lucas focused on human capital externalities. This established a powerful feedback loop where knowledge generates increasing returns, fundamentally distinguishing it from traditional inputs.

Empirical research strongly affirms knowledge as a primary economic driver. By the mid-1990s, over half of the GDP in major OECD economies was knowledge-based, signifying a profound economic shift (OECD, 1996). Investment flows mirrored this, focusing on intangibles like R&D, which accounted for 2.3% of OECD GDP, and education.

Robust correlations link education to growth. Barro (1991) found school enrolment rates significantly boosted per capita GDP, while Hanushek and Kimko (2000) demonstrated that education quality, measured by test scores, has a major positive effect. Simultaneously, R&D intensity proved crucial; a 1% rise in the R&D/GDP ratio led to a 0.78 percentage point increase in GDP growth across 53 nations (Lederman & Maloney, 2003).

The role of Information and Communication Technology (ICT) is also pivotal. Studies of the US and OECD found that both the production and, more importantly, the *usage* of ICT were key factors in accelerating productivity and economic growth in the late 1990s/2000s. Ultimately, knowledge drives growth by enhancing Total Factor Productivity (TFP), allowing greater output from the same inputs, supported by international knowledge spillovers through trade (Coe & Helpman, 1995).

III. Methodology:

This study examines the impact of knowledge on economic growth using a panel dataset of 18 Indian states from 2013–2020. The dependent variable is state GDP, and the independent variable is a composite Knowledge Index created due to data scarcity. This index integrates six indicators across innovation, education, and digital connectivity: patents granted, education expenditure as a percentage of GDP, higher education pupil-teacher ratio, higher education pass rate, teledensity, and internet subscriptions per person.

To mitigate omitted variable bias, control variables include population growth, government capital spending, direct tax collection, labour force participation, bank credit, and electricity production. The analysis employs panel data regression to account for time-invariant, state-specific characteristics.

The general empirical model is:

$$Economic\ Growth_{it} = \beta_0 + \beta_1\ Knowledge_{it} + \beta_k Xk_{it} + \epsilon_{it},$$

where i stands for the cross-sectional unit (state), t stands for the time period, Xk_{it} is a vector of control variables, and ϵit is the error term.

The Variance Inflation Factor (VIF) test was used to find multicollinearity among explanatory variables, and the Breusch-Pagan/Cook-Weisberg Test was used to check for heteroscedasticity. We used the Hausman Test to find out which model was better: the fixed effects (FE) model or the random effects (RE) model.

Grounded in Endogenous Growth Theory (Romer, 1990; Lucas, 1988), this study posits that knowledge—a non-rivalrous good with increasing returns—is an internal driver of economic growth. Following the World Bank's Knowledge Assessment Methodology (Chen & Dahlman, 2005), we conceptualize knowledge through three pillars: Education (proxied by pupil-teacher ratio, expenditure, and pass rates), which builds human capital; Innovation (measured by patents granted), which fosters technological spillovers; and ICT (proxied by teledensity and internet subscriptions), which enables knowledge diffusion. The institutional pillar was excluded to isolate knowledge from the broader economic ecosystem.

IV. Results And Discussions:

Employing a Hausman test to select the appropriate model, the results (chi-square=0.00, p=1.000) supported the use of a random-effects Generalized Least Squares (GLS) regression. This model analyzed the relationship between GDP growth and a set of explanatory variables across 18 Indian states.

The analysis reveals that the composite knowledge index has a statistically significant and positive effect on economic growth ($\beta = 0.196$, $p < 0.001$). This indicates that a one standard deviation increase in knowledge capacity—encompassing education, innovation, and ICT—leads to a 0.196 standard deviation rise in GDP, ceteris paribus.

Among control variables, credit availability demonstrated the strongest positive relationship with GDP ($\beta = 0.510$, $p < 0.001$), underscoring the critical role of financial development. Power production ($\beta = 0.228$, $p < 0.001$) and direct tax collection ($\beta = 0.086$, $p = 0.001$) also had significant positive effects. Conversely, population growth exhibited a negative coefficient ($\beta = -0.063$, $p = 0.007$), potentially reflecting demographic pressures. Government capital spending was found to be statistically insignificant ($p = 0.389$).

The model exhibits an excellent within-state fit (R^2 within = 0.9719), and the overall model is significant ($F = 123.61$, $p < 0.001$). However, the low between-state R^2 (0.0014) suggests the variables do not fully capture time-invariant state-level characteristics.

Independent variables	Coefficient	S.E.
Knowledge	0.196**	0.051
Growth rate of population	-0.063***	0.02
Direct tax	0.086***	0.033
Capital expenditure	0.018***	0.027
Power	0.228*	0.07
Credit	0.51**	0.051
Within R^2	0.972	
Number of observations	144	

Note: *p < 0.1, **p < 0.05, ***$p < 0.01$.

Based on the regression results, the analysis of the impact of the knowledge index on economic growth is as follows:

Primary Finding: The knowledge index exhibits a statistically significant and positive relationship with economic growth, with a coefficient of 0.196. This indicates that a one-unit increase in the knowledge index is associated with a 0.196% increase in GDP, holding all other variables constant. The double asterisk (**) denotes significance at the 1% level ($p < 0.01$), providing strong confidence that this relationship is not due to random chance.

Contextual Impact: While significant, the magnitude of knowledge's impact is notably smaller than that of credit (0.510) and power (0.228), which are also highly significant. This suggests that in the studied Indian states, immediate infrastructural and financial factors may have a larger direct effect on GDP in the short term. However, knowledge remains a fundamental, positive driver of growth.

Other Control Variables:

- Population growth has a significant negative effect (-0.063), suggesting demographic pressures may hinder per capita growth.
- Direct tax collection has a positive and significant relationship (0.086), potentially indicating better state capacity and formalization of the economy.
- Capital expenditure's coefficient is positive but very small (0.018). Its high standard error relative to its coefficient implies it is statistically indistinguishable from zero, meaning it has no significant measured effect in this model.

Model Fit: The exceptionally high Within R^2 (0.972) indicates the model explains 97.2% of the variation in GDP over time within the states, confirming the chosen variables are highly relevant for analyzing economic growth dynamics.

V. Conclusion:

This study empirically validates Endogenous Growth Theory, confirming that knowledge is a significant positive driver of economic growth in Indian states. For policymakers, this underscores the necessity of long-term structural investments in education, innovation, and ICT infrastructure to achieve sustainable development. While knowledge-oriented policies are beneficial, enduring growth requires complementary advancements in the financial sector and power supply. Future research incorporating additional parameters could further elucidate these long-term dynamics.

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