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HERFINDAHL-HIRSCHMAN INDEX (HHI), VALUE CO-CREATORS AND COMPETITIVENESS OF THE INDUSTRY IN INDIA

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ABSTRACT
The Herfindahl-Hirschman Index (HHI) measures the competitive intensity in an industry. Literature review of the HHI in the context of telecommunications demonstrates that greater the efficiency of markets, greater the opportunities for pricing and profitability (Sung 2014). These need to be associated with value co-creators (Gopalan 2017). Effectiveness of innovation for products and services across industry sectors for studying HHI requires empirical analysis. Time series data on these value co-creators from the International Telecommunications Union and World Bank Database across India are associated to Labour Force (Total), Business and Innovation Environment, Electricity Production, Mobile Cellular Subscriptions, Purchasing Power Parity, Secondary Enrollment Tertiary, Households with a Computer, Annual Investment in Telecommunications and Services - Value Added. Industries thrive on concept development, growth in small and medium businesses that create innovations by integrating disciplines. They are improved by regulating the industry and encouraging development in innovations, financing of research and development, investments, enabling product and service differentiations and ownership in patents.

KEYWORDS
Herfindahl-Hirschman index, innovation, value co-creators.

INTRODUCTION AND THRESHOLD OF HHI
Despite the high level of popularity of the HHI in measuring industry and business concentration, there is a threshold of applicability of the index. The relevance of the index becomes null and void beyond that threshold. Decision makers use this index to rely on the corrections of atypical monetary decision. The money demand function plays a very crucial role in estimating Gross Domestic Product (GDP) rates in an economy. Structurally coefficient regression models speak only on the macro money demand function while ignoring the bias that creeps in while the elasticity of money demand supply that rule industry concentrations cannot be ruled out. There is an opportunity cost variable that speaks on the money market rate and deposits rates based on how the industry pointers work (Borenstein et al. 1999). Maximum likelihood estimates have demonstrated a statistically highly significant positive coefficient for the H variable besides equally highly significant scale and opportunity cost variables with their expected respective signs. This empirical evidence suggests that the conventional specification contains a serious specification error. The implication of the result is that as the sector GDP concentratiocn increases, the demand for real money balances also increases though quite less proportionately, indicating the absence of any economies of GDP concentration.

When paradigm shifts happen it is seen that *value co-creators* work best when applied in the broader spectrum of industry intensity and competition guided by the HHI.

Emerging industry patterns can be looked at within the boundaries of competition only if there is a guideline formulated by the HHI. This index can well be a guiding factor where economies and planners need to know where the Hirschman index if applied can bring out the real information of the market demand and pull sections. It is generally observed that the Hirschman index is applied to broad infrastructural industry requirements and is notated in the form of a whole number. Less than a whole number can be taken as being unfavorable where opportunity costs are relatively very high and industry players are unable to assimilate these costs.

The HHI surmises the income demand and supply elasticities as opposed to its intent towards tilting of the GDP rates. Both together form the basis of economic decision making. How best innovation can be supported at the macro level through government interventions (Cowling and Waterson, 1976)? Questions arise on concerns such as:

a. What kind of market structure could arise from the intermodal nature of transition of economies?
b. Will this encourage or discourage new firms from competing in the market or will ease out disturbances from the already existing structure.
c. One of the most frequently used indicators of anticompetitive behavior among firms in an industry is the HHI. There are, however, cases when it may be inappropriate. Two such cases were shown for N-firm oligopolies with partially cooperative firms. The co-operation of all firms cannot be detected since the value of the HHI index does not depend on the cooperation level in the case of symmetric oligopolies, that is, the index always shows no cooperation. In the semi symmetric case there is the possibility that cooperation has a decreasing effect on the index.
d. Would the nature of co-operation sustain in the long run or would there be diversified structure of the competition based on studies of this Index?
e. Could certain firms and industry be structured as oligopolies and would the nature of competition eliminate a perfectly competitive market structure and the revolutions that would happen inside the structure to pave way from an ultimate competitive structure can be effectively studied using this index. Hence this index is a guide for better structured growth.
f. The telecommunications sector is a highly dynamic and ever evolving one and it is a matter of concern as to the kind of market structure that would be desirous of this highly competitive one.

Economics for businesses across industry sectors depends on various enablers and this need to be audited and verified by empirical analysis. Hypotheses of these enablers were identified and need statistical analysis (Gopalan and Natarajan 2015). The *value co-creators* that justify the usefulness of the HHI for various industry sectors and the economic success must be audited and verified by extensive time series studies. In this manuscript we have considered a study on telecommunications usage and development data across India for the timeline between 1960 and 2013 (Gopalan 2017). The efficiency of the HHI may vary according to the *value co-creators* in terms of the social, economic and intellectual motivation during innovativeness requiring interaction that is inclusive, creative and engaging. Studies on the HHI have discussed about its credibility and ineffectiveness as a measure of containing corruption because of its inability in detecting anticompetitive behavior, non-cooperation and any collusion (Matsumoto et al. 2012). This may result in double standards. Audits and verification on the intensity of *services value added* in an industry qualified by substantial empirical research for that sector in terms of interactivity between productivity, employability, development and pay scales and earnings for a country and associating it with a country's economic success is justified and required. Empirical and conceptual research and the role played by *value co-creators* and the timeline on the use of the Internet in India for development of the country and use of telecommunications during 1960 and 2013 have demonstrated numerous variables that are directly associated with development and innovativeness in sectors such as Information and Communication Technologies (ICT), Energy and Utilities, Business and Financial Services and Media (Gopalan 2017). These are discussed in the subsequent sections.

TABLE 1: STATISTICS SUBSETS FOR INTENSITY IN INNOVATIONS

Sector	Enablers	Null Hypotheses
ICT	x_1 = Growth rate of start ups (last five years)	$b_1 > 0$
	x_2 = Number of new disruptive technologies (last five years)	$b_2 > 0$
	x_3 = Index of mobile computing use	$b_3 > 0$
Pharmaceutical	x_1 = Number of regulations that affect growth (last five years)	$b_1 > 0$
	x_2 = Number of new drugs introduced in the market (industry average for last five years)	$b_2 > 0$
	x_3 = Cost index (industry average for last five years)	$b_3 > 0$
Advanced Manufacturing	x_1 = R&D cost index (industry average)	$b_1 > 0$
	x_2 = Public sector budgets	$b_2 < 0$
	x_3 = Competition in industry (measured by Herfindahl-Hirschman index)	$b_3 < 0$
FMCG	x_1 = Competition in industry (measured by Herfindahl-Hirschman index)	$b_1 < 0$
	x_2 = Shelf life of products (industry average)	$b_2 < 0$
Energy and Utilities	x_1 = Energy demand	$b_1 > 0$
	x_2 = Number of carbon related regulations	$b_2 > 0$
	x_3 = Number of new energy technologies	$b_3 > 0$
	x_4 = Kwh of energy used from renewable and sustainable sources	$b_4 > 0$
Business and Financial Services	x_1 = Mobile technology advances	$b_1 > 0$
	x_2 = Number of customers from new markets	$b_2 > 0$
Media	x_1 = Penetration of mobile technology (measured by readership via mobile technology)	$b_1 > 0$
	x_2 = Number of new players in industry (measured by Herfindahl-Hirschman index	$b_2 > 0$
	x_3 = Number of new business models	$b_3 > 0$

The Table 1 shows the enablers of intensity in innovations for different sectors and these models are useful in sectors for comprehending the sophistication of innovation (Gopalan and Natarajan 2015). They can be standardised for a firm based on qualifications of recruitments, productivity in research and development, incentives, audits and market share of the industry.

Considering *Services Value Added (constant 2005 US$)* shown in equation (1) across India as a measure of adding to the productivity during innovation in products and services, the *ICT* industry for India considering the timeline between 1960 and 2013 has benefitted significantly from *growth rate of start-ups*, *advanced technologies* and the use of computers and *mobile technologies.* The equations (1) (2) (3) (4) shown are all derived based on time series statistics and multivariate study for telecommunications and development data across India for the timeline between 1960 and 2013 (Gopalan 2017).

Log_{10} (*Services – value added (constant 2005 US$)*) = 2.984 + 0.02535 Log_{10} (*Mobile Cellular Subscriptions*) + 0.7104 Log_{10} (*Electricity production (kWh)*) (1)

The *Fast Moving Consumer Goods* (FMCG) segment in India similar to that seen in other countries has demonstrated customer productivity on the Internet as a facilitator of interactivity between businesses and customers and also in facilitating *electronic commerce* and redefining ways of innovating in products and services. The efficiency of the telecommunications industry for the *Labour Force (total)* across India depends on enablers shown in equation (2) and (3) such as *Electricity Production (kWh)* and the *Energy and Utilities industry* and is associated with the economies of scale such as *Mobile Cellular Subscriptions* and *Purchasing Power Parity or affordability* in subscriptions and *ICT* and facilitation of *Net Neutrality* from the government and industry.

Log_{10} (*Labour Force (total)*) = 8.4212 + 0.01887 *Purchasing Power Parity Conversion Factor, GDP (LCU per international US$)* (2)

Log_{10} (*Labour Force (total)*) = 4.884 + 0.3174 Log_{10} (*Electricity Production (kWh)*) (3)

Advanced manufacturing has benefited from facilitation of *value co-creators* in the logistics industry by developing the *Information Technologies (IT)* capability profiles between businesses in the industry and the infrastructure required for communication during procurement and shipping of products and services and diversification of areas of specialization (Rai et al. 2012).

Business and Financial services have benefited existing industries for customers in new markets when facilitated by successful *smart phone services* such as bank services developed and deployed successfully in other markets. Media businesses have also benefited from increase in readers and greater audience across the Internet along with delivery of quality content due to the increase in competitiveness of participating firms and new revenue models. Development data for India demonstrates that the merits of *School Enrollment, Tertiary (% gross)* and affordability of education along with *Electricity Production (kWh)* for households across India adds to the effectiveness of the *Business and Innovation Environment* in terms of *Services Value Added* by providing towards *Labour Force (total). Usage of ICT by people* across India in terms of *Households with a Computer* adds to *School Enrollment, Tertiary (% gross).*

School Enrollment, Tertiary (% gross) = 8.814 + 1.4662 Percentage of Households with a Computer. (4)

School Enrollment, Tertiary (% gross) across India adds to the *Services Value Added* to a country from generating employment for the *Labour Force (total)* and also bringing in earnings to the household. Table 2 shows the different *value co-creators* of development from investments in telecommunications across India (Gopalan 2017).

TABLE 2: VALUE CO-CREATORS OF DEVELOPMENT FROM TELECOMMUNICATIONS ACROSS INDIA

People Usage of ICT	Values Added - Economic	Values Added - Social
Mobile phone subscriptions	Values added from ICT for new services and products	Values added from ICT on access to basic services
People using the internet	Values added from ICT for new businesses	Participation index
Households with a personal computer and Internet access	**Government Use of ICT:**	**Affordability:**
	Government prioritization of ICT as an indication of investment in telecommunications	Purchasing Power Parity (PPP) conversion factor, GDP (Local currency unit (LCU) per international US$)
Broadband internet and Mobile broadband subscriptions	**Environments for Business and Innovation:**	**Infrastructure:**
	Secondary education gross enrollment rate (%)	Electricity Production (kWh)

CONCLUSION

The United States Department of Justice describes how the HHI used to measure market concentration is calculated by squaring the market share of each firm competing in a market and then adding the numbers (United States Department of Justice 2015). When there is a greater concentration of firms in a market competing for the market share, the HHI tends to zero and can reach a maximum value of 10,000 points when there is domination of the market controlled by one firm. Industry sector performances may be studied by multivariate statistics taking into consideration the different variables that are relevant. These need to be associated with the HHI to discuss conclusions or inferences for decision making, investments or studies. Table 2 is a demonstration from a study on telecommunications usage across India and its relevance to development in India for the time between 1960 and 2013 (Gopalan 2017). It identifies the *units of concept* bringing together telecommunications and development data across India in terms of response variables and were categorised according to the *People Usage of ICT; Values Added – Economic; Values Added – Social; Government Use of ICT; Environments for Business and Innovation; Affordability and Infrastructure.* Revenue generated for businesses benefit from *mobile phone subscriptions; Internet subscriptions; values added by information and communications technologies (ICT)* for products and services and new businesses*; government investment in telecommunications; secondary education gross enrollment rate (%); values added from ICT on access to basic services; participation index of labour force (total), affordability and electricity production.* This is relevant in terms of improving the quality of competitiveness among participating members across industry sectors and between *value co-creators*. What needs to be verified is the accuracy of the HHI.

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