

Regional Drivers of Pharmaceutical Start-ups in India: The Role of Agglomeration, Innovation and Infrastructure

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Abstract

This study examines the impact of various critical regional factors on start-ups in Indian pharmaceutical industry across Indian states. Based on various interlocked theoretical frameworks like industrial district, new economic geography, cluster, regional innovation system etc.; agglomeration, innovation and infrastructure have been identified as few of the decisive factors affecting the establishment of new firms at regional level. Using unit-level data of annual survey of industry, this study reveals that Indian pharmaceutical industry has undergone some regional transformation in terms of establishment of new pharmaceutical firms, since 1981 and especially in the last period of 2011-18. The negative binomial regression analysis highlights the significance of regional innovation, infrastructure and agglomeration-based factors like local demand, skilled labour and vertically-related firms. The findings suggest that agglomeration and innovation play positive and significant role in the start-ups of new pharmaceutical firms in Indian states. Whereas, among the infrastructural factors, energy has been found positively and significantly related to the start-ups of new pharmaceutical firms.

JEL Classification: M13, O31, O18, L6

KeyWords: Start-ups, Pharmaceutical Industry, Agglomeration, Innovation, Infrastructure.

Introduction

Start-ups have generally been explained as one of the decisive factors for the development of an economy, as it brings in the new opportunities of employment and income. From the regional perspective, start-up of new firms plays more vital role in determining the regional income, employment and standard of living (Baptista and Preto, 2011; Mueller et al., 2008). In this regard, the policy makers always face the challenge of removing regional imbalances in terms of industrialisation, through the establishment of new firms in the backward regions. But despite the various acute policy measures for balance regional development, concentration of firms in few regions of a country is inevitable (Scott, 1988; Becattini, 1992). This concentration of firms in few regions occurs due to transportation cost (Ohlin, 1933), backward and forward linkages (Hirschman, 1963), skilled labour (Romer, 1990; Lucas, 1988), increasing returns and transportation (Krugman, 1991), regional innovation system (Cooke et al., 1997; 2001; 2004; Asheim and Isaksen, 2002) and other region-specific factors.

The impact of agglomeration of economic activities on firms' competitive and comparative advantage is the prime concern of new economic geography (Krugman, 1991). The agglomeration of various economic activities like market, labour and vertically related firms in a region lead to the increasing returns to scale due to the low transportation cost and external economies of scale. These increasing returns to scale and external economies make a region as the first choice for entrepreneurs to start a business in the agglomerated region. Similarly, regional innovation and infrastructure lead to the external economies of scale for the firms located in that region. As pharmaceutical industry is a knowledge-based industry, innovation

is certain to have an impact on the performance pharmaceutical firms. As a result, the level of regional innovation becomes one of the main factors to be considered by the entrepreneurs, while establishing a business in a region.

Pharmaceutical industry is a technology-intensive industry, holding a significance stake in Indian industrial sector. Indian pharmaceutical industry has emerged considerably under the old patent regime of 1970. The year of 1970 is recognised as the turning year for the Indian pharmaceutical industry in terms of establishment of new firms producing not only formulations but also bulk drugs (Lalitha, 2002; Chaudhuri, 2002). Further, the introduction of new economic reforms in the early 1990s intensified the rate of establishment of new firms. As the economic reforms opened up Indian economy at international level as well as liberalised the rules and regulation of establishing new businesses in India, establishment of new firms has increased drastically in the Indian pharmaceutical industry (Kumar and Pradhan, 2003; Joseph, 2012). Simultaneously, the introduction of trade-related intellectual property rights (TRIPS) in the starting of 21st century has also played a decisive role in the rising number of new pharmaceutical firms in India (Jha, 2007).

India as an economy consists of various sub-national entities which are contributing it unequally in terms of various economic attributes such as industrialisation, employment and income. Similarly, Indian pharmaceutical industry has also been concentrated in few Indian regions and states of India (Neogi, et al., 2014). Concentration of pharmaceutical firms in few Indian states has been increasing continuously over the last four decades because of establishment of new pharmaceutical firms. The present study is an attempt in the same context, i.e. revealing the patterns and determinants of start-ups of new pharmaceutical firms across Indian states.

The next section of the study explains the theoretical framework of the study, while the third section deals with the trends and patterns of start-ups of new firms in the pharmaceutical sector since 1981. Fourth section explains the methodological part of the study. Fifth section reveals the estimation and results, whereas the last section concludes the study.

Determinants of Firms Start-ups

Establishment of new firms is theoretically believed to be determined by the availability of various critical regional factors which are favourable for doing business in a region. These critical regional factors subsume size of the market, size of vertically-related firms, productivity, skilled labour, favourable infrastructure etc.

Firstly, the concept of industrial district propounded by Marshall in the early 1890s, addressed indirectly the issue of start-ups of new firms in a region. Accordingly, concentration of firms in a region has been identified as the determining factor of new start-ups. By establishing new firms in a concentrated region (large numbers of horizontal and vertically-related firms) entrepreneurs are in better position to reap the benefits of easy availability and accessibility of various inputs. The concept of industrial district is limited to only industry-specific determinants; and in this era of information technology, Marshall's industrial district does not qualify as a complete theory of establishment of new firms. But, over the last few decades, a new series of literature has emerged which tried to theorise the determinants of new firms start-ups. This recent literature includes, Regional Innovation System (Cooke, 1997; 2001), Innovative Milieu (Camagni, 1995; Maillat, 1998), Cluster (Porter, 1990; 1998), Learning Region (Florida, 1995), New Economic Geography (Krugman, 1991) etc. The present study is

based on the various determinants suggested in these theories and tried to regress their effects on the start-ups of Indian pharmaceutical firms since 1995.

Size of Market

The significance of size of market in a region has been studied recently in determining the performance of enterprises in a region, in terms of export (Pradhan and Das, 2013; 2015), R&D (Pradhan, 2011) etc. Following the literature of new economic geography propounded by Krugman (1991), Reports say that the magnitude of local demand causes the rising returns to scale and reduced transportation cost. Consequently, companies based in an area with greater demand circumstances are meant to be more successful and draw more businesses to the area. The region where demand conditions are strong enough, witness higher number of new start-ups in a region (Glaeser et al., 1992; Lee et al., 2004). Thus, following the new economic geography literature this study formulates the following hypothesis:

Hypothesis 1 Higher the demand conditions in a state, higher the number of new pharmaceutical start-ups in that state.

Productivity

Productivity of firms located in a region may attract higher number of new start-ups in that region. It has been reported that the probability of new start-ups in a region increase as the productivity of firms increase in a region with the passage of time (Bernard and Wagner, 1997; Baldwin, 2000; López, 2005). Higher productivity tends to make enterprises more competitive than others. By establishing new firms nearer to the productive firms, there are possibilities that new enterprises also obtain the higher productivities due to the imitation and adoption of unique techniques of those existing firms. Thus, the present study formulates the following hypothesis on productivity of existing firms:

Hypothesis 2 Productivity of pharmaceutical firms in a state is directly related to the start-ups of new pharmaceutical firms in that state.

Vertically-related firms

A considerable body of literature has concentrated on examining the relationship of vertically-related firms and new start-ups. Proximity of new firms to the vertically-related firms reduce the transportation cost and provides easy accessibility for the various intermediate inputs. The studies of porter (1990; 1998), Sexenian (1996), Krugman (1991) and Cooke (1997; 2001) provides the theoretical and empirical evidence that existing numbers of vertically-related firms in a region attract higher number of new start-ups in that region. According to Scott (1988) and Beccattini (1992) the concentration of large number of firms in a region attracts higher number of new establishments. Similarly, according to Husain (2015), higher numbers of pharmaceutical-related firms in an Indian state leads the higher growth of new pharmaceutical firms in that region. Based on this framework, present study formulates the following hypothesis:

Hypothesis 3 Percentage share of vertically-related firms are directly related to the new pharmaceutical start-ups in Indian states.

Skilled Labour

Porter introduced the concept of clusters in the 1990s, emphasizing that the accumulation of local knowledge significantly influences the performance of firms in a region, thereby attracting new establishments. Clusters, as a form of economic agglomeration, consist of firms engaged in similar activities, where innovation serves as a critical driver of competition and firm development (Porter, 1998; Krugman, 1991). Morosini (2004) defines a cluster as a

socioeconomic entity characterized by a social community and a population of economic agents situated in close proximity within a specific geographic region. Krugman (1991) characterized clusters as dynamic configurations centered on knowledge creation, increasing returns, and innovation, rather than as static flows of goods and services. The importance of human capital is widely discussed in the cluster literature, and it is well established that availability of skilled labour in a region is positively related to the performance of enterprises in that region. Human capital is the main component of *New Growth Theory* where creation and distribution of knowledge is the primary determinant of economic growth (Grossman and Helpman, 1994). Hence the present study formulates the following hypothesis regarding human capital and pharmaceutical firm's start-ups:

Hypothesis 4 Skilled labour in a state is directly related to the start-ups of pharmaceutical firms in that state.

Innovation

A significance literature is available on innovation and enterprises performance, where most of the studies focused on R&D as the prime determinant (e.g. Aw et al. 2007; Esteve-Perez and Rodriguez, 2012). There are some other indicators of innovation like, new product, new process, new technology etc. These indicators of innovation are firm-specific and tend to enhance the productivity and competitiveness of enterprises. On the other side, the present study focused on regional determinants of firm's start-ups, hence considering the indicators like R&D, technology; new product etc. is not a viable solution. Hence the present study considers patent application as the proxy indicator to represent the innovation in a region. Pharmaceutical industry is an innovation-intensive industry, where higher numbers of patent applications from a region represent the innovation capabilities and stock of knowledge of a region. Hence, the patent applications from a region might be positively related to the start-ups of pharmaceutical firms in that region.

Hypothesis 5 Numbers of patents applications are positively related to the entry of pharmaceutical firms in that state.

Infrastructure

Sufficient infrastructure resources in a given area cause the productivity and efficiency of current businesses there to increase, which then draws other companies to the area (Wheeler and Mody 1992; Asiedu and Lien 2004). Infrastructure facilities include power, roads, teledensity, ports, finance, etc.; the current study, however, considers just power, roads, and teledensity. The present analysis therefore creates the following infrastructure-related hypotheses:

Hypothesis 6a Availability of power in a state is directly related to the start-ups of pharmaceutical firms in that state.

Hypothesis 6b Availability of roads in a state is directly related to the start-ups of pharmaceutical firms in that state.

Hypothesis 6c Availability of communication in a state is directly related to the start-ups of new pharmaceutical firms in that state.

Trends and Patterns

Establishment of new firms in Indian pharmaceutical industry have increased significantly, after the introduction of process patent regime¹. They have increased from 319 in the period of 1981-90 to 1098 in the period of 2011-18² (Table 1). The highest numbers of firms have entered the industry during the period of 2011-18 which might be attributed to the rising performance of existing firms over the previous decade(s) because of economic reforms of 1990s where

firms got benefited indirectly from competitive pressure and directly through access to funds and outsourcing activities. (Joseph, 2012). The rural-urban classification reveals that after the period of 1991-2000, entry of new firms in urban areas remains almost constant at around four hundreds (Table 2). On the other hand, after the period of 1991-2000 rural India has reported continuous rise in the entry of new pharmaceutical firms with doubling the numbers in the period of 2001-2010 and 50 per cent higher during the period of 2010-18 with respect to the earlier periods. These trends confirm that new firms are choosing the rural India as a preferable location instead of urban India perhaps due to the rising congestion and environmental problems.

West India

The regional classification reveals that west India has been one of most dominated regions, since 1981, where numbers of pharmaceutical establishment in the region were 148 in the period of 1981-90, which were quite larger than other regions in that period. These figures have doubled in the next period of 1991-2000 and increased by almost 36 percentage points in the period of 2001-10. But the period of 2010-18 has not been favourable for west India, where the entry of new firms declined by almost 28 percentage points. This declining entry of new pharmaceutical firms in West India could be due to the attractive incentives provided by the states of other regions namely Uttarakhand and Himachal Pradesh in the year 2003 as a result new firm have shifted to these states. These results confirm to the theoretical framework (forward and backward linkages) of Hirschman (1963) and Myrdal (1957) where incentives provided to the new firms by other regions could be the leakages or counter factors against the concentrated regions. Because of these leakages firms tend to locate at non-concentrated regions and forgo the backward and forward linkage advantages.

The two major states of West India are Maharashtra and Gujarat reported the same trends and patterns as of West India i.e. increasing number of new firms till the period of 2000-2010 but considerably declining in the period of 2010-18. In case of rural-urban classification rural areas of both the states attracted larger number of firms after 1991-2000, but in the period of 2010-18 both the areas of states reported declining trends, confirming to the trends depicted at India level.

Table 1
Start-ups of Pharmaceutical Firms in Indian States and Regions, Since 1980s

State	1981-1990	1991-2000	2001-2010	2011-2018
Central India	10	33	38	24
Chhattisgarh	0	2	0	0
Madhya Pr	10	31	38	24
East India	45	46	16	9
Bihar	8	9	4	0
Jharkhand	0	0	0	0
Orissa	4	4	4	1
West Bengal	33	33	8	8
North India	72	116	144	426
Delhi	14	17	10	13
Haryana	24	34	38	16
Chandigarh	0	2	3	0
HP	0	1	13	153
J&K	0	4	2	17

Punjab	12	18	39	8
Uttar Pr	22	40	39	40
Uttarakhand	0	0	0	179
North East	0	2	2	5
Assam	0	2	2	5
South India	44	193	229	325
Andhra Pr	18	50	137	181
Karnataka	4	49	50	34
Kerala	1	55	3	16
Pondicherry	0	1	7	16
Tamil Nadu	21	38	32	78
West India	148	319	434	309
Dadar &NH	0	0	7	10
Daman	0	0	20	24
Goa	1	3	26	20
Gujarat	55	147	204	113
Maharashtra	85	152	159	104
Rajasthan	7	17	18	38
All India	319	709	863	1098

Source: Unit-level data of annual survey of industries (2018-19).

North India

Pharmaceutical start-ups have increased considerably in north India during the last period of 2011-18. Though earlier periods reported increasing entry of pharmaceutical firms in the region (viz. 71, 116 and 144 during the period of 1981-90, 1991-2000 and 2001-10 respectively), but during the period of 2011-18 north India has attracted highest number of pharmaceutical firms i.e., 426. The major north Indian states are, Himachal Pradesh and Uttarakhand. Whereas Uttar Pradesh, reported almost constant entry of new pharmaceutical firms i.e., around 40 over the last three decades.

Table 2

Rural-urban Classification of Start-ups of Pharmaceutical Firms across India States								
State	Entry In Urban Areas				Entry in Rural Areas			
	1981-90	1991-2000	2001-10	2011-18	1981-90	1991-2000	2001-10	2011-18
Central India	10	31	32	17	0	2	6	7
Chhattisgarh	0	2	0	0	0	0	0	0
Madhya Pr	10	29	32	17	0	2	6	7
East India	37	45	16	4	8	1	0	5
Bihar	8	8	4	0	0	1	0	0
Jharkhand	0	0	0	0	0	0	0	0
Orissa	4	4	4	0	0	0	0	1
West Bengal	25	33	8	4	8	0	0	4
North India	71	91	115	141	1	25	29	284
Delhi	14	17	10	13	-	-	-	-

Haryana	24	23	37	13	0	11	1	3
Chandigarh	0	2	3	0	-	-	-	-
HP	0	0	12	33	0	1	1	119
J&K	0	4	1	12	0	0	1	5
Punjab	12	5	24	5	0	13	15	3
Uttar Pr	21	40	28	38	1	0	11	2
	0	0	0	27	0	0	0	152
Uttarakhand								
North East	0	2	2	2	0	0	0	3
Assam	0	2	2	2	0	0	0	3
South India	29	93	112	150	19	100	118	171
Andhra Pr	17	23	62	87	1	27	75	91
Karnataka	4	47	23	16	0	2	28	18
Kerala	0	2	1	0	1	53	2	16
	0	0	3	8	0	1	4	8
Pondicherry								
Tamil Nadu	5	21	23	39	17	17	9	38
West India	132	229	162	133	18	92	275	176
Daman	-	-	-	-	0	0	20	24
&Diu								
Dadra &	-	-	-	-	0	0	7	10
N.H								
Goa	1	1	8	4	0	2	17	15
Gujarat	53	117	98	57	2	31	109	57
	71	95	38	44	16	58	122	60
Maharashtra								
Rajasthan	7	16	18	28	0	1	0	10
All India	276	491	439	447	46	220	428	646

Source: Unit-level data of annual survey of industries (2018-19)

On the other hand, Punjab and Haryana have reported rising number of new firms in the industry till the period of 2001-10, but in the period of 2011-18 these states have reported lower entry of pharmaceutical firms. In terms of rural-urban classification, increasing number of pharmaceutical firms in the period of 2011-18 was completely rural-based where almost all the firms in the states of Himachal Pradesh and Uttarakhand established in rural areas. Consequently, the enhanced performance of northern India can be attributed to two Indian states, Himachal Pradesh and Uttarakhand, which have benefited from the unique concessions and incentives extended by the central government in 2003.

South India

South India is one of the consistent regions in terms of establishment of new pharmaceutical firms over the last four decades. The highest number of new pharmaceutical firms was reported in the period of 1991-2000, where the entry of pharmaceutical firms was five times higher than the previous period. But in the period of 2001-10 new pharmaceutical firms have remain almost constant, but the period of 2011-18 has seen rising trends as the new pharmaceutical firms have increased by almost fifty per cent i.e. 325 from 229 in the period of 2001-10. As far as rural-urban classification is concern, south India has been the only region where much difference has not been found in terms of establishment of pharmaceutical firms in urban-rural areas, over

the last four decades. The state-wise classification reveals that Kerala and Karnataka reported declining entry of new pharmaceutical firms since 1991-2000. Kerala has reported just 3 new firms in the period of 2001-10 which is much lower than the previous period (where entry of 55 firms were reported in the period of 1991-00); on the other hand, Karnataka has reported declining trends in the period of 2011-18, i.e. 34 from 50 in the period of 2001-10. Andhra Pradesh and Tamil Nadu have reported continuously rising trends of new firms in the pharmaceutical industry over the last four decades where Andhra Pradesh has reported highest jump during period of 2001-10 i.e. 137 from 50 in the period of 1991-2000 same trend in the last period of 2011-18.

East India, Central India and North-east India

East India exhibits continuous decline in the establishment of new pharmaceutical firms over the last four decades; the establishment of pharmaceutical firms declined by five times over the periods of 1981-90 to 2011-18. These declining trends in East India are associated with West Bengal where numbers of new firms have declined by four times over the last four decades. As far as the others states of East India viz. Bihar, Jharkhand and Orissa are concern, they have revealed almost negligible entry of new firms in pharmaceutical industry over the last four decades. In Central Indian states namely Madhya Pradesh and Chhattisgarh, only Madhya Pradesh is attracting new pharmaceutical firms in the region. It has been reported that till the period of 2001-10 by almost forty percentage points. The data for most of the north Indian states revealed that there was negligible pharmaceutical firms' establishment over the last four decades. Assam is the only state managed to attract five new pharmaceutical firms in the period of 2011-18.

Data Issues and Methodology

The present study is mainly based on secondary data sources. Start-ups of pharmaceutical firms is calculated from the unit-level data of annual survey of industries (ASI) 2018-19, obtained from the ministry of statistics and programme implementation. The 'initial year of production' has been taken as a measure of entry of firms. As the present study calculates start-ups of pharmaceutical firms from the 2018-19 data, implying that the present study considers establishment of those firms which have survived till the period of 2018-19.

Enrollment data in higher education is sourced from multiple Annual Reports of Higher Education and Selected Educational Statistics published by the Department of Higher Education under the Ministry of Human Resource Development (MHRD), Government of India. The Per Capita Gross State Domestic Product data is sourced from the Statement on State Domestic Product published by the Central Statistical Organisation (CSO). The yearly data on Patent Applications has been sourced from the Annual Reports of the Controller General of Patents, Designs, and Trade Marks. The infrastructure statistics (Per Capita Power Consumption, Teledensity, and Road Length) is sourced from Indiastat.com.

Cumulative entry of new firms in pharmaceutical industry is the variable which has been used for the estimation purpose. As the cumulative entry shows the count variable, where non-negative integer values have been assumed, i.e. $y_i \in \{0, 1, 2 \dots\}$, in this case the OLS method is not an appropriate choice. So, there are other models such as, Poisson and Negative Binomial models which have been suggested to deal with the count data (Hausman, Hall and Griliche, 1984).

In the Poisson regression model, the dependent variable follows a Poisson distribution, with its conditional mean expressed as $E(y_i|x_i) = \lambda_i = \exp(\alpha + x_i)$, where x_i represents a vector of

variables. This distribution possesses the equidispersion property, meaning $E(y_i|x_i) = \lambda_i = \text{Var}(y_i|x_i)$. Typically, the data does not exhibit the equidispersion property, leading most researchers to favor the Negative Binomial model. The Negative Binomial (NB) model accommodates variance deviation from its mean for the dependent variable y_i . The variable y_i is characterized as a Poisson variable with a mean $h_i\lambda_i$, where h_i is considered, a random variable following a gamma distribution (the mixing distribution). Consequently, the observed count variable exhibits an NB distribution (Pradhan, 2013). Parameter estimates of the NB model (α, β, θ) can be derived by maximum likelihood estimation (Hausman, Hall, and Griliche, 1984).

Results and Discussion

Per capita gross state domestic product (PCGSDP_{kt}) has been used as an indicator to represent the demand conditions in the state. The demand conditions are found positively related to the start-ups of pharmaceutical firms in the states. The coefficient has positive values, showing the positive relation between the two variables. It is also found to be highly significant, proving the hypothesis that the demand is positively related to the establishment of new pharmaceutical firms in a state. Thus the states with higher PCGSDP draw higher number of new pharmaceutical firms in the state.

The present study takes labour productivity (LPR_{kt}) as the measure to represent the productivity of existing pharmaceutical firms in the state. Labour productivity is found positively related to the start-ups of new pharmaceutical firms in the states. It is also found that the labour productivity and establishment of pharmaceutical firms are significantly related to each other, hence accepting the hypothesis that the labour productivity and start-ups of pharmaceutical firms are positively related to each other. This implies that the states having more productive firms either due to advanced technology or efficient labour force tends to attract more new firms in the respective sector.

Another essential variable estimated in the present study is percentage share of vertically-related firms (i.e. percentage of chemical industry in the states) (PSCI_{kt}). According to Marshall (1890), the vertically related firms located in the same region get benefits from incidental external economies. These external economies are involuntary and incidentals which are primary factor responsible for the competitive advantage of the firms located in the same region. As a result new firms in the vertically related industry find the region more cost effective. This has been confirmed in the analysis as the existing numbers of chemical firms found positively related to the establishment of new pharmaceutical firms, implying that the entrepreneur do consider the share of vertically related firms while taking the decision of setting up an enterprise. This hypothesis is also accepted where the share of vertically related firms in a state is positively related to the start-ups of new pharmaceutical firms in states.

Skill (ENRL_{kt}) in a state is represented by the enrolments in higher education. The skilled labour is found to be positively and significantly related to the establishment of new pharmaceutical firms in the respective states. These results confirm that pharmaceutical firms consider the availability of skilled labour in the state while taking the decisions to set up their plant. The reason being pharmaceutical industry is a knowledge-based industry and its operation requires sufficient amount of educated and skilled labour force in production, research and development, marketing and other departments.

Negative Binomial Estimation of start-ups of pharmaceutical Firms by Indian States

Dependent Variable: Cumulative sum of Firms Entry

PCGSDP _{kt}	.6295037 (6.69)***
LPR _{kt}	.2039922 (1.77)**
PSCI _{kt}	.0690168 (3.55)***
ENRL _{kt}	.8347579 (6.17)***
PAT _{kt}	.1864996 (2.55)***
POW _{kt}	.0009563 (2.38)***
ROAD _{kt}	.0232571 (0.49)
TEL _{kt}	.0103825 (1.61)
Log likelihood	-818.84629
LR chi2(8)	256.07
Prob > chi2	0.0000
Number of observation	206
Likelihood-ratio test of alpha=0:	
chibar2(01)	2272.49
Prob>=chibar2	0.000

Note: z statistics in parenthesis; *significant at 10%, **significant at 5%, ***significant at 1%. Patent (PAT_{kt}) application is used as an indicator to represent the innovation in Indian states. The patent applications and pharmaceutical start-ups found to be positively and significantly related to each other. This confirms the fifth hypothesis that patent applications are positively related to the establishment of new pharmaceutical firms in Indian states. This reveals that higher the patent applications from Indian states higher are the start-ups of pharmaceutical industry. This result confirms that new pharmaceutical firms considers the level of innovative activities in the states while establishing their business because of the introduction of product patent regime in India in the year 2005 which curbed the re-engineering process for pharmaceutical firms, and made them to undertake more research and development activities. The present study takes three critical variables to represent the infrastructure facilities in a state viz. power, road and telecommunication. In the industrial location theories infrastructure has been considered as one of the major factors for new firms while establishing their business in a region. However, the present study finds significant relation between pharmaceutical start-ups and power only, whereas road and telecommunication turned out to be insignificant. The telecommunication might be insignificant because of its universal wide spread and almost equal accessibility in each Indian state.

Conclusion

Start-ups play an important role in the development of an economy by engaging significant number of working population in entrepreneurial activities which further creates income and employment. Likewise, pharmaceutical start-ups can also play significant role in income and employment generation in general and providing essential pharmaceutical and medicinal products in particular. Pharmaceutical start-ups can also be critical in the current period of pandemic to meet the ever-rising demand for these products.

This study illustrates the state level trends and patterns of pharmaceutical start-ups along with its determinants. The descriptive statistics reveals that the last period of 2011-18 has seen

highest numbers of pharmaceutical start-ups across the Indian states. The decline of west India and rise of north India has also been reported during the last period of 2011-18; whereas south India has witnessed a consistently rising entry of new pharmaceutical firms. The states of Uttarakhand and Himachal Pradesh reported a sudden jump in the last period of 2011-18, and the states like Andhra Pradesh and Tamil Nadu reported consistent rise in the entry of new pharmaceutical firms. On the other hand the states like Maharashtra and Gujarat reported consistent rise in the establishment of new pharmaceutical firms till the year of 2010, but in the last period of 2011-18 they have reported a drastic decline. The rural urban classification reveals some interesting fact that over the period of time, rural areas of different states have reported higher number of pharmaceutical establishment than the urban areas and it has intensified in the last decade.

The second part of study evaluates the role of critical regional factors on establishment of new pharmaceutical firms in the respective states. Five significant factors have been tested in terms of their impact on start-ups of pharmaceutical firms across the Indian states, viz. Demand conditions, share of vertically related firms, labour productivity, skill, innovation and infrastructural facilities. All of the above factors play significant role in the establishment of new pharmaceutical firms, except infrastructural facilities where power is the only infrastructural facility having a significant and positive impact on the establishment of new pharmaceutical firms.

This study has significant policy implications for central as well as local governments as they can promote the entrepreneurial activities in general and specifically the pharmaceutical start-ups by focusing on innovation, skill and infrastructural facilities like power at local level. Further, these factors can play complementary roles in the entrepreneurial development schemes like start-up India and stand-up India.

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