

Impact of Agglomeration Economies on Productivity of Pharmaceutical Firms of Himachal Pradesh

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Abstract

This paper used Levinsohn and Petrin's methodology to assess the productivity performance of the pharmaceutical manufacturing firms of the state of Himachal Pradesh over the period from 2001–2002 to 2015–2016. Further, a fixed effects approach has been brought into use to determine the impact of various agglomeration variables on the total factor productivity of Himachal Pradesh's pharmaceutical manufacturing firms. The total factor productivity of Himachal Pradesh's pharmaceutical firms showed an unsteady performance over the period under study. It was observed that while urbanization has helped increase the productivity of pharmaceutical firms of the State, after a certain level, diseconomies arising from increasing urbanization tend to affect the productivity of firms adversely. Although intraindustry localization tended to impact productivity of the firms negatively, the concentration of a variety of industries affected the productivity of the firms positively.

Keywords : agglomeration economies, total factor productivity, pharmaceutical firms, Himachal Pradesh

Paper Submission Date : November 18, 2019 ; Paper sent back for Revision : November 25, 2019 ; Paper Acceptance Date : December 1, 2019

The pharmaceutical industry of every country is of immense significance as it generates a continuing stream of new products that save lives and raise the quality of life. Welfare states need to maintain not only high standards of healthcare and pharmaceutical production, but also need to ensure availability of adequate drugs at affordable prices. Thus, the growth of the pharmaceutical industry is a *sine qua non* of the overall wellbeing of each and every nation and needs close scrutiny.

To overcome regional economic disparities, the Government of India announced a New Industrial Policy for the hilly and industrially backward states of Uttarakhand and Himachal Pradesh in the year 2003, which offered under its aegis tax exemptions and capital subsidies among other benefits to a select group of industries including the pharmaceutical industry. This was followed by the introduction of the 2004 Industrial Policy for Himachal Pradesh for industrial development and promotion by its State government. As a result, in the last decade, the pharmaceutical industry of the state of Himachal Pradesh has grown by leaps and bounds. The State has since been a breeding ground for various industries such as chemicals, drugs and pharmaceuticals, textiles, food processing, engineering, and paper & packaging industries. Presently, Himachal Pradesh ranks fourth with a share of 11.71% in India in terms of value in the total production of pharmaceutical and medicinal preparations. Within Himachal Pradesh, the basic pharmaceutical products and pharmaceutical preparations, with a share of 26.33%, have the highest contribution in the industrial output of the state. Due to the increasing concentration of pharmaceutical firms in the small towns like Baddi and Paonta Sahib in Himachal Pradesh, these areas are known

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as the pharmaceutical capitals of India (India Brand Equity Foundation, 2010). Given the significance of Himachal Pradesh's pharmaceutical industry, the present study makes an attempt to assess the performance of the pharmaceutical firms of the state in terms of its total factor productivity over the period from 2001–2002 to 2015–2016.

Literature Review

A number of studies have been carried out to examine the impact of agglomeration on productivity of manufacturing firms in various industries in India and abroad.

Mitra (2000) assessed data for 17 major industries across 15 states of India to evaluate how total factor productivity growth is affected by urbanization. The study shed light on the fact that with the increase in urban population, productivity of industrial units across all states of India has been found to be rising. However, after a certain threshold, the economies arising out of increasing urban population turn into diseconomies due to factors such as congestion, pollution, and pressure on scarce resources. In addition, concentration of diverse industries in a particular urban area is found to affect productivity positively owing to information spillovers and concentration of ancillary financial and logistical services.

Lall, Shalizi, and Deichmann (2004) studied the impact of agglomeration economies on the productivity of Indian industry with the help of plant/factory level data garnered from Annual Survey of Industries (ASI) for the year 1994 –1995. The results exhibited that there existed sectoral differences in the sources and effects of agglomeration economies. However, it was observed that agglomeration economies were factor augmenting for most of the sectors. Market access seemed to have a stronghold in terms of its impact on firm-level productivity. On the other hand, it was established that intraindustry concentration and interindustry urbanization economies did not necessarily have a positive impact on firm-level productivity.

Lall and Chakravorty (2005) analyzed the impact of industrial location on performance of manufacturing firms in terms of spatial income inequality for the year 1998. They pointed out how new private investment had an affinity toward existing industries and coastal districts and the same had been depicted with the help of district-level maps of location quotients as visual evidence on the degree to which industrial locations were clustered. The analysis revealed that there was a significant variation in the extent to which firms of different sizes benefitted from location-based characteristics. Regional economic geography factors were in general found to have a reasonable impact on the cost structure of the firms.

Agarwalla (2011) ascertained the impact of agglomeration economies on the productivity growth in industry and service sectors of 25 different states over a period of 27 years, that is, from 1980 – 1981 to 2006–2007. The study exuded that urbanization economies, measured through level of urbanization and diversity, had a negative impact on trade and manufacturing and a significantly positive impact on service sector in general and transport sector in particular. However, at higher levels of urbanization, productivity was found to be increasing for manufacturing industries. Localization economies were found to be positively impacting all sectors except for the service sector.

Kamiike, Sato, and Aggarwal (2012) studied labor productivity and total factor productivity of India's pharmaceutical firms over the years from 2000 – 2001 to 2005 – 2006. The study concluded that the total factor productivity of pharmaceutical firms of India has risen over the period under study. Further, they juxtaposed the performance of pharmaceutical firms in different areas as per the degree of agglomeration and found that productivity tends to be higher in areas with high level of intraindustry agglomeration and low in areas of low intraindustry agglomeration.

Objectives of the Study

- ☞ To determine the total factor productivity for Himachal Pradesh's pharmaceutical firms for the period from 2001–2002 to 2015–2016.
- ☞ To identify the impact of agglomeration variables on the total factor productivity of pharmaceutical firms over the period from 2001–2002 to 2015–2016.

Methodology and Data Sources

(1) Methodology : To gauge firm-level total factor productivity of Himachal Pradesh, the present paper makes use of Levinsohn and Petrin's (2003) methodology as was done by Neogi, Kamiike, and Sato (2012). The technique is a semi-parametric approach that takes into account productivity shocks facing the firms and uses intermediate inputs for measurement of the same. On obtaining the productivity estimates, a regression technique is used to find out how agglomeration variables impact total factor productivity. In the Indian context, Lall et al. (2004) and Chakravorty and Lall (2006) identified three sources of economies of agglomeration that can be classified as market access, intraindustry localization economies, and interindustry urbanization economies.

Urbanization economies arise with factors such as burgeoning city size and widening diversity of economic activity in a particular region. The major sources of such economies are (a) availability of services, such as communication, banking, marketing, advertising, legal, and accountancy services (Jacobs, 1969) ; (b) information transfers at an interindustry level ; and (c) a large labor pool with multiple specializations (Scott, 1986). Urbanization economies will be gauged with the help of two variables : level of urbanization and urban diversity. Level of urbanization will be measured with the help of quantum of population living in urban areas. The second measure of economies of urbanization, that is, urban diversity, is proposed to be measured through identifying the quantum of interindustry agglomeration, which help in information and knowledge spillovers across industries. On the lines of methodology adopted by Agarwalla (2011), urban diversity in the state of Himachal Pradesh is being measured by using the Herfindahl index for industrial diversity, which is as follows :

$$H = \sum_{i=1}^n \left(\frac{E_i}{E} \right)^2 \quad \text{..... (1)}$$

In equation (1), E_i is the employment in the industry i in the given region and E is the total employment in the region. If the value of H comes out to be 1, then the region is dominated by one single industry, and on the other hand, a value of $1/n$ would imply that there is maximum possible industrial diversity in the region.

The present paper will use location quotient (LQ) as a measure of economies of localization :

$$LQ_{ir} = \frac{E_{ir} / E_r}{E_{in} / E_n} \quad \text{..... (2)}$$

where, i stands for industry, r stands for region, and n stands for nation/country.

Following the measures used by Damijan and Konings (2011), firm-level productivity will be regressed on the measures of agglomeration, that is, market access, urbanization, and localization economies. A Cobb – Douglas production function has been taken into consideration for carrying out the analysis, and the same is represented for the sake of simplicity as below :

$$Q = A(U, t) \cdot F(K, L) \quad \text{..... (3)}$$

In equation (3), U is a vector of agglomeration factors. Equation (3) may further be represented as follows :

$$Q_{k,t} = A_{k,0} e^{\sum_{k=1}^p \gamma_k U_{k,t}} \cdot F(K, L), \quad \dots (4)$$

where, $A_{k,0}$ is the initial level of productivity of each firm, t is the time, k is the firm, γ is the parameter describing the size of agglomeration economies, K is the capital, and L is the labor.

Following Hulten, Bennathan, and Srinivasan (2006), the total factor productivity is defined as the ratio of output to the inputs :

$$Tp_{k,t} = Q_{k,t} / F(K_{k,t}, L_{k,t}) = A_{k,0} e^{\sum_{k=1}^p \gamma_k U_{k,t}} \quad \dots (5)$$

Expressing in log form and expanding the right - hand side term related to agglomeration economies, we get :

$$\ln TP_{k,t} = \ln A_{k,0} + \Theta \cdot MA_{k,t} + \gamma_1 \cdot UR_{k,t} + \gamma_2 \cdot UR_{k,t}^2 + \gamma_3 \cdot Div_{k,t} + \beta \cdot LQ_{k,t} + \varepsilon_{k,t} \quad \dots (6)$$

In equation (6), MA represents market access, UR represents urban population, Div represents industrial diversity, LQ represents location quotient, Θ is the coefficient of market access, γ_1 and γ_2 are the coefficients of urban population and square of urban population, γ_3 is the coefficient of diversity, and β is the coefficient of localization represented by LQ . Square of urban population has been included in the model as after a certain level, increasing urban population may lead to diseconomies arising from increasing costs associated with congestion ; pollution ; and increasing cost of land, labor, and transport (Carlino, 1979). Market access is gauged with the help of various factors and one such being the road network on which the data are readily available. Accordingly, following Panda and Mishra (2018), this paper will use road network to assess its impact on productivity performance of pharmaceutical firms of Himachal Pradesh.

(2) Data Sources : The present paper is based on secondary data, that is, unit level panel data on the pharmaceutical firms of Himachal Pradesh for the years 2001–2002 to 2015–2016 garnered from ASIs conducted by Central Statistical Organization. The unit level panel data from ASIs are available for only up to 2015–2016. The broad classification of the industry being studied is laid out in the National Industrial Classification Codes, that is, NIC - 98, NIC - 04 Code 2423, and NIC-08 Code 210. Required adjustment is done in the industrial group following the concordance tables provided by the Central Statistical Organization. For measuring output, gross value added has been taken into consideration and the same has been deflated using the wholesale price index of drugs and medicines. Capital has been measured by taking into consideration initial value of net fixed capital and is deflated by the implicit deflator of net capital stock in the registered manufacturing sector. Quantum of labor has been gauged through the average number of persons employed including supervisors, managers, workers, and other employees. Intermediate inputs are obtained by adding up the value of two variables, that is, material consumed at constant price and fuel consumed at constant prices. Data on urban population of Himachal Pradesh have been taken from *District Handbook of Statistics* for Census 2011. Further, the data on urban population for the years lying between 2001 and 2011 and for the years from 2012 – 2015 were obtained through interpolation and extrapolation, respectively. Data on inter-industry localization and intra-industry localization were obtained from ASIs. Data on road network of Himachal Pradesh, that is, on length of roads including national highways, single lane, double lane, and jeepable roads were obtained from Economic Survey of Himachal Pradesh for various years.

Empirical Analysis and Results

The number of pharmaceutical firms in the state of Himachal Pradesh over the period from 2001 – 2002 to 2015 – 2016 varies from 8 in the year 2001 – 2002 to 107 in the year 2015 – 2016. The results from employing Levinsohn

Table 1. Results from Estimation of Cobb – Douglas Production Function Using Levinsohn – Petrin Methodology

	Coefficient	Z-value
Ln <i>K</i>	0.379	12.01
Ln <i>L</i>	0.622	6.18
Wald test of constant returns	$\chi^2 = 0.39$ ($p = 0.110$)	
No. of observations	1,296	

Note. Dependent variable: Log of gross value added.

Proxy variable for productivity shock : Log of fuels consumed and materials consumed.

Table 2. Total Factor Productivity Behavior of Pharmaceutical Firms of Himachal Pradesh Over the Years : 2001 – 2002 to 2015 – 2016

Year	Mean	Minimum	Maximum
2001–2002	1.07	0.41	4.01
2002–2003	1.79	0.63	4.85
2003–2004	3.68	0.96	11.52
2004–2005	6.13	2.74	38.83
2005–2006	10.92	3.16	60.96
2006–2007	12.23	3.54	61.60
2007–2008	15.58	4.92	63.17
2008–2009	12.42	4.03	60.85
2009–2010	11.68	3.75	59.39
2010–2011	12.31	3.79	66.55
2011–2012	10.28	3.77	54.09
2012–2013	8.51	1.05	52.74
2013–2014	7.63	0.97	50.28
2014–2015	6.28	0.74	48.75
2015–2016	5.33	0.51	42.47
Entire period	8.38	–	–
Pre-recession (2001–2002 to 2007–2008)	7.34	–	–
Post-recession (2008–09 to 2015–2016)	9.31	–	–

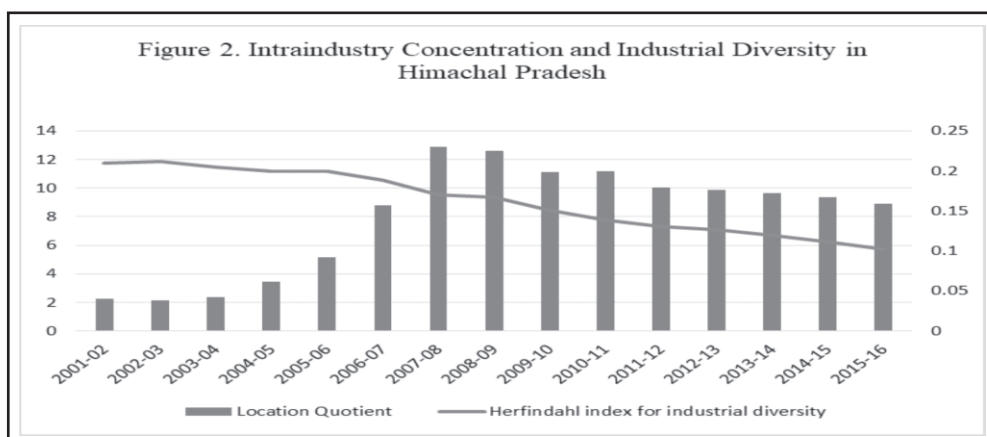
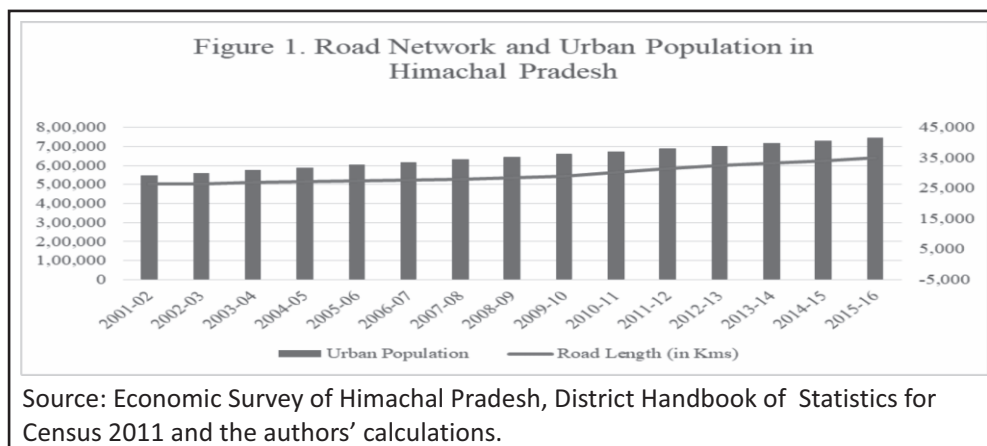
and Petrin's (2003) methodology to arrive at the total factor productivity value of Himachal Pradesh's pharmaceutical firms are presented in Table 1.

From the results in Table 1, it has been found that coefficients of labor and capital have been found to be positive and statistically significant at the 5% level. Although the sum of estimated coefficients is a little more than unity, the result from Wald test of constant returns reveals that the null hypothesis of constant returns to scale is not rejected. The aforementioned estimated coefficients are used to measure the total factor productivity of pharma firms of Himachal Pradesh.

The total factor productivity behavior of pharmaceutical firms of Himachal Pradesh over the period from 2001–2002 to 2015–2016 is assessed by studying the average productivity of these firms over the given years.

From Table 2, it can be seen that the mean productivity of the pharmaceutical firms of Himachal Pradesh rose up to the year 2007 – 2008, with significant increases being registered from 2003 – 2004 onward. The same seems

to be an outcome of the incentive package provided by the Central and State governments to promote industrialization. However, the productivity performance of the firms was erratic after the year 2007 – 2008 and in fact depicts an “ebb and flow” performance. The year 2008 – 2009, which was marked by global economic slowdown, arrayed a decline in the mean productivity of the pharmaceutical firms of the State with a marked decline in the maximum productivity. This is because many of the high-productivity firms were exporting more than 40% of their products/by-products and, therefore, had high exposure to global markets. The following year, that is, 2009 – 2010 showed a strengthening of the productivity behavior exhibited by the firms in the year 2008 – 2009, which indicates a deepening effect of the global recession. A slight improvement in the productivity was observed in the year 2010 – 2011, which did not last very long. A continuous decline in productivity was registered by the pharmaceutical firms of Himachal Pradesh from 2011 – 12 to 2015 – 2016. This could be explained by factors such as the double dip recession spawning from the Eurozone crisis that gripped the world economy including many of India's pharmaceutical export destinations. During this period, the pharmaceutical industry of Himachal Pradesh was marred by high transport and labor costs due to the increasing concentration of industrial units in the State, as reported by various news articles. Further, the excise tax exemption provided under North-East Industrial and Investment Promotion Policy 2007 beyond the year 2013 may have also pulled out high-performance firms out of Himachal Pradesh and into North-Eastern states like Sikkim. As far as the performance of the pharmaceutical firms of Himachal Pradesh in the pre - recession and post - recession period is concerned, an analysis of average productivity of the firms reveals that the mean productivity in the pre -



recession period (i.e., 7.34) was lower than the mean productivity levels in the post - recession period (i.e., 9.31). This, however, may be the result of including the average productivity levels for the pre-Industrial Package years, that is, 2001–2002 and 2002–2003, which registered very low productivity performance by pharmaceutical firms of the state. Excluding these 2 years, the mean productivity level for the pre - recession period (2003–2004 to 2007–2008) figures out to be 9.70, which is higher than the mean productivity level for the post - recession period under study (i.e., 9.31).

To assess the impact of agglomeration economies on the total factor productivity of pharma firms of the state, productivity levels have been regressed on length of road network in Himachal Pradesh, urban population in Himachal Pradesh, square of urban population in Himachal Pradesh, diversity index for measuring industrial activity in the state, LQ, and time dummies. The values of these agglomeration variables over the period of study are presented in Figures 1 and 2. It can be seen from Figure 1 that there has been a constant increase in road network and urban population in Himachal Pradesh over the period of study. Further, it can also be seen from Figure 2 that intraindustry localization in terms of pharmaceutical industries of Himachal Pradesh increased until the year 2007–2008 and, thereafter, started falling. On the other hand, industrial diversity in the state of Himachal Pradesh has been increasing continuously over the period of study.

As per the results of Hausman test, panel data model using fixed effects approach has been used to identify the impact of agglomeration economies on the total factor productivity of the pharmaceutical firms of Himachal Pradesh over the period of study. Fixed effects model has been used to account for unobserved difference in productivity of the pharmaceutical firms. Further, in order to find out whether unexpected variation or special events over time may have affected the outcome variable, the present study has tested whether dummies for all the years are equal to 0 or not. The results show that the null hypothesis, that is, the coefficients for all years are jointly equal to 0, is rejected, and therefore, we introduce time fixed effects in the model stated in equation (7). Thus, the model used by Agarwalla (2011) has been modified in respect of the present analysis as specified below :

$$\ln TP_{k,t} = \ln A_k + \Theta \cdot MA_t + \gamma_1 \cdot \ln UR_t + \gamma_2 \cdot \ln UR_t^2 + \gamma_3 \cdot Div_t + \beta \cdot LQ_t + \Psi_2 T_2 + \Psi_3 T_3 + \dots + \Psi_{11} T_{11} + \varepsilon_{k,t} \dots (7)$$

$\ln A_k$ has been shown to be the unknown intercept for each firm that affects their total factor productivity. Further, 14 dummy variables related to time period have been introduced as the present paper spans over 15 years. The results obtained from the regression are depicted in Table 3.

Table 3 shows that road network has a significant positive impact on the total factor productivity of pharmaceutical firms of Himachal Pradesh. The results reveal that a doubling of road network results in a 0.12% increase in the total factor productivity of pharmaceutical firms of Himachal Pradesh. It has also been found that the impact of urban population on the total factor productivity of pharmaceutical firms of Himachal Pradesh is positive and significant. A coefficient of 0.067 suggests that a 1% increase in the level of urban population results in 0.067% increase in the level of the total factor productivity. A negative nonlinear relationship between the level of urban population and the total factor productivity of pharmaceutical firms in Himachal Pradesh is depicted by the negative coefficient of the square of urban population. It has been found that there exists an inverse U - shaped relationship between productivity of the pharmaceutical firms of Himachal Pradesh and urban population. This suggests that initially as the level of urbanization increases, emergence of higher levels of concentration produces information spillover, larger input and output market size, and forges backward and forward linkages with other activities. However, at higher levels of urbanization, the benefits tend to dissipate and are taken over by diseconomies arising from congestion, increased competition for transportation facilities, labor, and land, thus leading to increasing costs. Similar results have been posited by several studies. The inverse U-shaped relationship between the total factor productivity of pharmaceutical firms of Himachal Pradesh and quantum of urban population is presented in Figure 3. Figure 3 shows that after reaching a size of more than 650,000, urban population tends to have a negative impact on the total factor productivity of pharmaceutical firms of Himachal Pradesh.

Table 3. Impact of Agglomeration Factors on Productivity

Sl. No.	Variable	Estimate
1	Market Access (<i>MA</i>)	0.0012** (2.03)
1	Urban Population (<i>UR</i>)	0.0678** (6.47)
2	Square of Urban Population (<i>UR</i> ²)	−0.0019** (−9.01)
3	Diversity (<i>Div</i>)	0.1298* (5.28)
4	Location Quotient (<i>LQ</i>)	−0.1763** (−5.53)
5	Year 2002–2003	0.0135 (0.94)
6	Year 2003–2004	0.0832 (0.98)
7	Year 2004 – 2005	0.4385* (6.92)
8	Year 2005 – 2006	0.6585 (0.17)
9	Year 2006 – 2007	0.0491 (1.50)
10	Year 2007 – 2008	0.2193 (1.01)
11	Year 2008 – 2009	−0.3151* (−8.79)
12	Year 2009 – 2010	−0.0128 (0.66)
13	Year 2010 – 2011	0.0011 (0.35)
14	Year 2011 – 2012	0.0482 (1.10)
15	Year 2012 – 2013	−0.0170** (−9.30)
16	Year 2013 – 2014	−0.0008 (1.13)
17	Year 2014 – 2015	0.0044 (0.01)
18	Year 2015 – 2016	0.0016 (1.09)

Hausman Test :

$$\chi^2(18) = (b - B)' [(V_b - V_B)^{-1}] (b - B) = 37.85.$$

$$\text{Prob} > \chi^2 = 0.0009$$

Test for Time Fixed Effects:

$$F(14, 1,281) = 3.08$$

$$\text{Prob} > F = 0.0003$$

$$F\text{-test} : 5.67 (0.000)^*$$

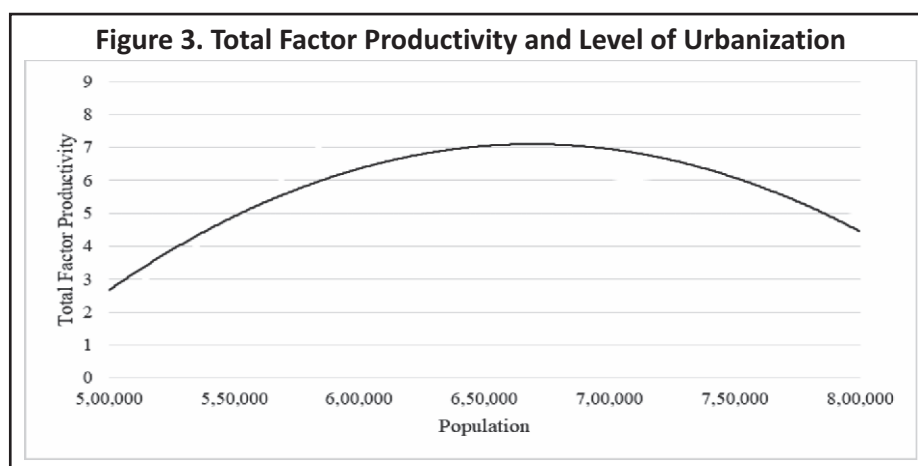
$$R^2 : 0.4976 \text{ (within)}$$

$$0.0641 \text{ (between)}$$

$$0.3084 \text{ (overall)}$$

Note. Figures in parentheses are values of *t* - statistic ; * and ** show significance at 1% and 5% levels, respectively.

Further, it has been found that a one unit increase in the diversity index results in an almost 12.9% increase in productivity of pharmaceutical firms in Himachal Pradesh. As a result of the special status that provides a fillip to the industrial presence in Himachal Pradesh, various engineering, packaging, electricals, food processing, and textile units have come up in areas like Baddi, Solan, and Nalagarh. A testimony to the same is the fact that a total investment of INR 10,680 crore between July 2003 and December 2014 was made in Solan district alone as reported by *Outlook Business* ("State of the Economy 2015 : Shrouded in mist," 2015). The resulting boost to industrialization led to improvement in the total factor productivity of pharmaceutical firms in the state. The final measure of agglomeration used in the present study, that is, *LQ* reveals a significant negative relationship between localization and productivity of pharmaceutical firms in Himachal Pradesh. In addition, the same is in line with



various news reports highlighting the reduced margins of pharmaceutical firms competing with each other while facing the headwinds of increased land, labor, and transportation costs occurring due to increased concentration of pharmaceutical firms in the areas in and around Baddi – Barootiwala – Nalagarh and other areas. During the years 2010–2014, transportation and labor cost were almost double in Himachal Pradesh as compared to other states as reported by *Outlook Business* (2015), which added to the increasing cost woes of the pharmaceutical firms in Himachal Pradesh. Among the year dummies, only 3 years tend to have a significant impact on the level of productivity of the pharma firms of the State, that is, 2004 – 2005, 2008 – 2009, and 2012 – 2013. Only year dummy for the year 2004–2005 has a significant positive impact on the productivity ; whereas, other the 2 years, that is, 2008–09 and 2012–2013 have been found to be impacting the level of productivity of the pharmaceutical firms of the State negatively. The year 2004 – 2005 probably exhibits an increase in productivity due to the lagged manifestation of the impact of the New Industrial Policy, which was introduced in the year 2003 for the hilly and industrially backward states of Himachal Pradesh and Uttarakhand. Although the total factor productivity of the pharmaceutical firms of Himachal Pradesh saw a continuous increase from 2003–2004 up till the year 2007–2008, only the year dummy for the year 2004 – 2005 has proved to be statistically significant in the current panel data model. The year 2008 – 2009 showed a decline in productivity, which prima facie seems to be the result of global economic slowdown that took into its grip the pharmaceutical industry of Himachal Pradesh as well. Finally, the year 2012–2013 was the year when double-dip recession had hit many European countries, while United States was still in doldrums. United States and many European countries were export destinations for many pharmaceutical firms of India including Himachal Pradesh. This is also corroborated by the fact that in the year 2012–2013, 11% of the total output of the pharmaceutical firms of Himachal Pradesh was being exported. It is significant to note that it was not only the blow that was dealt by the w-shaped recession, but also the fact that for many pharma firms set up in Himachal Pradesh in the year 2003–2004, the 10 year tax sops and subsidy benefits were witnessing a dusk and, therefore, many MNCs and other domestic firms were fleeing the State. Perhaps, as a result of all these factors, the year 2012–2013 witnessed a significant decline in the productivity of pharmaceutical firms of Himachal Pradesh.

Conclusion

The paper reveals that the average total factor productivity of pharmaceutical firms of Himachal Pradesh saw a sharp upturn after 2003–2004 as a result of the Industrial Package conferred upon the State by Central Government and New Industrial Policy introduced by the Government of Himachal Pradesh and the same rose up to the year 2007–2008. However, the productivity performance of the firms has been erratic after 2007–2008 such

that the years 2008 – 2009 and 2009 – 2010 showed a nosediving trend of the productivity and indicated a deepening effect of the global recession. A slight improvement in average productivity performance of the pharma firms of the State was observed in the year 2010 – 2011; however, the same was ephemeral and the mean productivity level of the industry kept falling from the year 2011 – 2012 to the year 2015 – 2016.

Further, in terms of impact of agglomeration on productivity of these firms, it has been found that market access, being gauged by length of road network, and quantum of urban population have a significant positive impact on the total factor productivity performance of pharmaceutical firms of Himachal Pradesh. However, a negative nonlinear relationship between the level of urban population and the total factor productivity of the pharmaceutical firms in Himachal Pradesh has been observed, as depicted by the negative and statistically significant coefficient of the square of urban population. It has been found that after reaching a threshold size of around 650,000, urban population tends to have a negative impact on the total factor productivity of pharmaceutical firms of Himachal Pradesh. It is found that a one unit increase in the diversity index results in an almost 12.9% increase in productivity of pharmaceutical firms in Himachal Pradesh. The paper also brings to fore a negative relationship between intraindustry localization and the productivity of pharmaceutical firms in Himachal Pradesh. This is also corroborated by various news reports that highlight that pharmaceutical firms of the State are grappling with reduced margins while competing with each other and facing the headwinds of increased land, labor, and transportation costs. It is also observed that the year 2004 – 2005 had a significant positive impact on the productivity, while the year 2008 – 2009 significantly negatively impacted productivity of pharmaceutical firms of Himachal Pradesh. The year 2004 – 2005 perhaps exhibited an increase in productivity due to the lagged manifestation of the impact of the New Industrial Policy that was introduced in the year 2003 for the hilly and industrially backward states. The year 2008 – 2009 showed a decline in productivity possibly due to the global economic slowdown as many of the pharmaceutical export destinations for Indian pharmaceutical firms were reeling under the impact of the slump. The Euro zone crisis along with phasing out of tax sops negatively affected the productivity of pharmaceutical firms in year 2012 – 2013.

Policy Recommendations

From the inference drawn from the evolution of pharmaceutical industry of Himachal Pradesh, it can be concluded that location-based incentives can prove to be a springboard for industries that are critical to overall development and well-being of the nation. Although agglomeration of pharmaceutical firms in Himachal Pradesh contributed to increased productivity, however, after reaching a certain level of urbanization and level of industrialization, diseconomies of agglomeration start to set in. Thus, locational policy should be formulated in a manner that increases the regional “carrying capacity,” which is the region's ability to sustain specified quantum of profitable “representative” firms. Lessons could be drawn from countries like Norway that have been successful in servicing technology to build rail network in tedious topography. The same could be replicated in the state of Himachal Pradesh to ease off the burden on road transport and help reduce transportation costs. Further, the simplification of labor laws into four codes by the government is a commendable move toward streamlining issues related to labor landscape in India. This will help reduce labor unrest that has marred states like Himachal Pradesh and similar industrial hubs.

It has also emerged from the present study that the productivity of pharmaceutical firms of Himachal Pradesh was marred due to the global recession of 2008 and the double dip recession that spawned from European sovereign debt crisis. An important lesson emanating out of this experience is to emphasize on the role of diversification of export destinations. Therefore, a fillip should be provided to the Indian pharmaceutical exports to destinations other than United States and Europe, which are going through a structural slowdown and are saturated markets.

Limitations of the Study

The data for measuring all the parameters of agglomeration in this paper are not readily available. The industrial units in Himachal Pradesh are bereft of rail and air transport and, therefore, transportation of inputs and outputs is done via road network for which data are sparsely available. Furthermore, some of the measures of agglomeration economies may not be relevant in the context of pharmaceutical industry of Himachal Pradesh, for example, the measures of market access that include per capita purchasing power of the area. For pharmaceutical industry of Himachal Pradesh or that of any state, the market is spread throughout the country and for which data are not readily available. In addition, another widely used measure of market access, that is, distance from market centers is also not very significant in context of pharmaceutical firms of Himachal Pradesh as the input and the output market for the pharmaceutical firms are spread all across India and abroad. Therefore, the present paper has only taken into account the impact of market access on productivity with the help of data on road network in Himachal Pradesh.

Scope for Future Research

The present paper focuses only on the intertemporal difference in the pharmaceutical firms of Himachal Pradesh. Further research can be extended to comparing the productivity of those districts of Himachal Pradesh where pharmaceutical industry is concentrated with those in the bordering districts of other states using difference-in-difference method. In addition, the methodology used in the study may be refined in the future in order to provide useful insights.

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