A Chayanovian approach to vulnerability: Re-evaluation of Vulnerability using Indian Data

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Abstract

Vulnerability is regarded as the ability of withstand income shocks. This is true of the functioning –entitlement approach, the social constructivist approach, or the qualitative approach (Addison, Hulme and Kanbur 2009). In the standard economic theory, a somewhat distinction is made between production and income. While the battery of production analysis uses terms such as efficiency, technological diffusion, and scale economies and so on, the earning side are related to poverty, inequality, subsistence and host of such issues. In the present paper, we used the approach pursued by A. V. Chayanov. In the approach of Chayanov (1966, 1989), for the life of poor, production and earnings are so strongly correlated that it would be impossible to dichotomise them. In fact, it would be wrong and probably unjust to do so. Keeping this idea in view, we have constructed the vulnerability indices for Indian states based on production data. Our data reveals that the vulnerability in India is more widespread than is commonly thought. We have also examined various factors that are responsible for this scenario. In short, our exercise puts forth a completely different picture of vulnerability in India than is commonly thought.

1. Introduction

Vulnerability is regarded as the ability of withstanding income shocks. This is true of the functioning –entitlement approach, the social constructivist approach, or the qualitative approach (Addison, Hulme and Kanbur 2009). While arguing how to view non-attainment, they all fundamentally focused on the family centred view of economics. In this approach, the emphasis is to judge income and/or consumption so as to recur their impact on an individual well-being. Such attainment centric approach becomes somewhat problematic in the world affected by Covid19.

It was Professor Alfred Marshall who declared long ago that "economics enquires how a man gets his income and how he uses (spends) it. Thus, it is on one side a study of wealth and on the other, and more important side, a part of the study of man." (*Marshall).* In the study of poverty and vulnerability, we have safely neglected the first aspect of this definition. We were concerned more about the spending aspect of income and how to augment it, should it fall from a prescribed optimum. In empirical literature in India, for example, even income was not considered. The entire emphasis is on spending or consumption (Addison, Hulme and Kanbur 2009, Shaffer, Kanbur and Sandbrook 2019). The plea was that of data availability and reliability. Almost all the large-scale surveys in India emphasises on consumption pattern only. Numerous commentators have argued that this would only veil income and inequality since consumption smoothing is a standard practise for most families (Harriss 2009). Through borrowing, gift, transfer or even collecting alms families tend to smooth their income (Harriss 2009). Such activities have important effect not only current welfare but of the future indebtedness and freedom of the families (Sengupta and Ghosh *IJHD*). Hence there should be a more radical basis of assessing poverty, inequality.

However, the more neglected point is the issue of earning. Numerous studies have shown that poor heavily depend on informal sector for their earning (Lewis, Harris and Todaro). Only a small portion of them get employed in the formal sector. However, to eke out their living, they are largely dependent on a wide variety of informal activities. They may include simple self-employment like street hawking, roadside stalls to employment in small production units. It is customary to dub them under the heading of informal sector (or unorganised sector)[1] .

In the standard economic theory, a somewhat distinction is made between production and income. While the battery of production analysis uses terms such as efficiency, technological diffusion, and scale economies and so on, the earning side are related to poverty, inequality, subsistence and host of such issues. The argument is framed in such a way as to demarcate between them. Thus, we hear the phrases such as poor but efficient, highly profitability but low capital as so on (Banerjee and Duflo, Poor Economics).

 The approach was first challenged by A.V. Chayanov-the doyen of peasant economics[2]. For the life of poor, production and earnings are so strongly correlated that it would be impossible to dichotomise them. In fact, it would be wrong and probably unjust to do so. The production process chosen are related to the income and vice-versa. The distinction had fallen completely in the post Covid world. The unplanned lockdown in India has seen a huge exodus of migration labour on road (Sengupta and Pal 2020). These migrants included all

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[1] Informal employment is a global phenomenon. The informal employment among the five major regions of the world is: Africa 85.7 %, Arab States 68.6%, Asia and Pacific 68.7%, America 40%, Europe and Central Asia 25.1%. (International Labour Organisation Report "Women and Men in the Informal Economy – A Statistical Picture "(Third edition) 2018). Again, the income for people engaged in this sector is generally low. This means that this sector covers a significant of human populace mostly those who are at the bottom of income ladder. Focussing on this sector would thus enable us to track the pattern of vulnerability in a country/region.

[2] It is wrongfully assumed that peasant refers only to farmers. By peasants, Chayanov included all types of informal activities run at small scale (Chayanov 1966,1989) . In some references, it is assumed that Chayanov referred only to family farms. But as Bardhan (1984, 2003) argued for rural families, farm servants are rarely differentiated from family members especially those who are employed for a longer period. The crucial issue is the scale of production and the conditions under which they are operated.

types of workers-self-employed, domestic and those employed in small informal units. With lockdown they lost all opportunities of income. Faced with the dire consequence of death by hunger and the lure of home drove these "country less" people (Sengupta and Pal 2020) into the road. Their plight is now the daily news of mainstream media[3].

These stories not only speak of public policy failure -though they are-but a commentary on our effort to delink income from work in the standard analysis of poverty. Long ago Chambers (1995) argued that poverty is a relational concept. It is the web of informal relations that helps a poor to eke out his meaningful life when the market resources are inadequate. He criticised the current mainstream thinking on poverty as reductionist and derided them. He argued linking poverty with the web of social networks that help a poor man to sustain in bad times. Much of these social networks emanate from the site of production and employment. Employment not only provides livelihood to a poor, it also provides an informal network without which he simply cannot survive. With the spread of Covid19 and associated lockdown, social distancing this web of social network has been broken (Sengupta, Pal, Hazra and Seth 2020). In this post Covid world, we are bound to take the footsteps of Chayanov by linking income and employment in our study of poverty and vulnerability.

We posit our analysis for India. In order to fashion our analysis, we have used the NSSO data pertaining to *"Unincorporated Non-Agricultural Enterprises (Excluding Construction) - JULY 2015 - JUNE 2016, 73 round"*. This round collect data on the input use and output procured for the unorganised enterprises in India. It has never been customary to use this data for studying poverty and vulnerability. Rather it is used for matters of production-efficiency, productivity and technological issues. All the poverty, inequality and

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[3] The scene of a migrant female child labour dying in exhaustion, a child trying to wake up her dead mother-a migrant worker left on a railway platform, a mother dragging her sleeping child on a suitcase are some of the poignant figures that are coming out in daily news.

vulnerability studies are based on NSSO rounds on household consumption. We have broken this tradition by utilising this data for the study of poverty and vulnerability. It is for the first time (at least to the best of present authors) that this type of analysis is put forth for the input-output data. We used the tools of poverty and vulnerability analysis to the state level features at an all-India level.

The paper is organised as follows. Section 2 gives a brief description of the theoretical issues used. Section 3 gives the data description. Section 4 gives the methodology used. Section 5 discusses our basic results. Finally, we conclude in section 6.

2. Theoretical issues

Vulnerability is a complex issue. Chambers (1989) defined vulnerability both from an external and internal context. From the external side it refers to the presence of shocks while internally it measures resilience to such shocks. Moser (1998) Broadens the concept of vulnerability. According to him, vulnerability has two sides: resilience or responsiveness in facing adverse situation and trying to make best out of it as well as the ability to recover from negative situations. To Moser (1998), both of these are closely related to the ownership of assets. Watts and Bohle (1993) stressed not only on risk but also on the capacity to bear the risk and the potentiality of the risk. In almost all other definitions of vulnerability, (Sinha and Lipton 1999; Clark et.al. 2000, Kamanou, 2002; UNDP 2004) the emphasis is always on twin aspects: the outward risks and the ability to encounter such risks. Vulnerability can arise from a number of factors: social, economic, political, and environmental.

On the other hand, poverty also has a number of theoretical bearings. Poverty may be defined as the lack of access to some features that are deemed to be important for meaningful existence. It is possible to define poverty on several parameters and also a conglomeration of parameters. In short, poverty always entails deprivation. Deprivation can come in the relative

or absolute sense. In the present paper, we take to mean poverty in an absolute sense. It infers lack of access to some opportunities that are deemed essential for a meaningful living.

The question then naturally emerges- how does poverty is relevant for the study of informal sector producing units. The answer to this lies in the basic assessment of informal sector in the lines of Chayanov (Chayanov 1966,1989). In the standard taxonomy informal sector firms are designated as those running on a small scale. Many argued that the basis of informal sector lay in the desire to avoid legal systems. However, Chayanov (1966,1989) postulated that smallness is not a defining feature of these type of producing units (whom he termed as Peasant farms). It is not in the smallness but in the operation, they differ from capitalist (or commercial) firms. A capitalist firm is run by a legally binding contract. All inputs are to be paid according to the pre-prescribed rate. An informal firm runs in an informal manner. It may use contracted inputs, but a major share is through informal network. Thus, the concept of profit or loss is irrelevant here and so maybe of other categories (such as wages). Chayanov (1966) has shown how an informal firm can outperform a capitalist firm because it has no contractual formalities as the latter[4].

This paper has attempted to view vulnerability from a new perspective. While the traditional analysis of vulnerability emphasises on the income and consumption aspect, here the emphasis is on production. As argued by many economists, consumption might not be a very ideal basis of vulnerability. In many cases consumption smoothing occurs that tend to shield the differences in income. Bhaduri (1973) argued that the process can lead to virtual debt bondage. In such a case, the figures of smoothed consumption may hide the real issue of loss of freedom that is inimical to welfare [5]. In such a case, figures on production might be an

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[4] The argument is given by Chayanov (1966) through a simple numerical example. The example illustrates the futility of using the categories such as wages and profits in analysing a peasant farm.
[5] In the Indian adoption of Samuelson-Nordhaus elementary textbook on Economics, Chaudhuri and Sen (2020) notes that the Gini coefficient calculated on the basis of NSS data on consumption is only 0.325 in 2004-05

ideal indicator of vulnerability. This is particularly for the small unorganised firms that are not run by profit but by the need of bare subsistence. Keeping this idea in view, we have constructed the vulnerability indices for Indian states based on production data.

Given this characterisation, the most important aspect of an informal unit is its viability. This is determined by two parameters. One is its capacity of generate enough income so as to enable the owner to rise above the subsistence level. The second is vulnerability- the ability of the production unit to tide over difficult times. In the post Covid world where the possibilities of consumption smoothing is declining rapidly due to social distancing and/or lockout that is breaking the informal ties that bound a firm, the issues remain of paramount importance.

Chakrabarti (2010) has detailed the development of such social network as a part of conscious effort on the part of the poor. He argued that the poor has to grow a 'goodwill' (as an intangible asset) in order to get loans that are essential for his survival. Pathways of developing this intangible asset come through social and economic interactions with groups and peers. Chakrabarti (2010) argues that without this intangible asset survival would have been impossible for most of the poor[6].

In the present study, we have thus focussed on several aspects of an informal that renders it vulnerable. It depends on a number of factors. There are some general factors. The first and foremost is the subsistence viability of the firms. We are to see whether the Gross

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much lower than many developing countries including China. The same Gini coefficient calculated on NCAER income data in household surveys is 0.535 in 2004-05 compared to 0.387 for China. Since Household surveys on income are occasionally done by NCAER, this is not readily available as the consumption data. They also cite the work of Chancel and Piketty (2017) that says that share of top 1% of income earners grabbed 21% in the late 1930s that dropped to 6% in 1980s but again rose to 29% in 2015. Clearly consumption is a bad yardstick of measuring vulnerability.

[6] For the migrant poor, the problem becomes quite difficult since he has to prove himself in an alien landscape far from his home place thus losing the natural advantage of local upbringing.

value added per labour for a firm is above the official poverty level or not. Here we are directly comparing the firm's output with the subsistence level[7]. This is so important for informal firms that often run at the risk of survival. Another aspect is registration. With registration, several benefits is garnered. Unregistered firms are less vulnerable than registered ones. Again, so the workers are concerned, payment of compensation is of utmost importance.

We then consider whether the firms are manufacturing or not. Manufacturing firms generally have longer term contract and more viable. On the other hand, those that are categorised under trade and services are highly vulnerable. In most cases, they depend heavily on the fluctuating local demand. Also, they generally have no long run contract. Covid led lockdown have hurt them the most.

However, all types of manufacturing firms are not equally vulnerable. We have considered two aspects of vulnerability- from the production structure and from demand uncertainty. Firms having no fixed premise and/or no structure are in a very precarious condition. Again, firms that face mobile market are also not very vulnerable.

In the light of above discussion, we have chosen the following the following eight factors that deemed important to us.

1) General factors
   a) Proportion of firms having less than Gross Value Added Per Labour below the Official Poverty line
   b) Proportion of firms without registration.
   c) Proportion of firms not giving compensation to the workers.

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[7] The theoretical justification for this is given in Chattopadyay and Sengupta (2001).

2) Firm operational factors

   a) Proportion of firms involved in trade & other services.

   b) Proportion of manufacturing enterprises without fixed premises.

   c) Proportion of manufacturing enterprises with fixed premises but without any structure.

   d) Proportion of manufacturing enterprises experiencing mobile market.

   We can now proceed in our analysis starting with the data description.

3. Data Description:

For the present study we considered the 73rd round NSSO data on Unincorporated Non-Agricultural Enterprises (Excluding Construction) for the period July 2015- June 2016. This gives us some important characteristics of the unincorporated non-agricultural enterprises. This gives in detail the information about the gross value added produced, the inputs used such as labour and capital, loan received, types of enterprise – whether it is own account enterprise (OAE) or establishment, major activity type- whether it is Manufacturing, Trade or Other services. It also gives us information about the operation of the firms in this sector. These include the information about the types of ownership, location of enterprises, nature of problems faces by an enterprise, types of assistance received from the government, nature of operation- whether perennial, seasonal, or casual etc.

Though NSSO gives data for 36 states and Union Territories for the sake of comparability we have taken 22 major states including Delhi. These are Assam, Bihar, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Telangana, Uttar Pradesh, Uttarakhand, and West Bengal.

Here we give a brief description of the data used.

Table 1 Description of variables

	Mean	Standard Deviation	Coefficient of Variation (CV)	Maximum	Minimum
Total number of firms	2838342	2325848	81.94%	8999647	392122
Number of firms having less than BPL level GVALP	279245	353586	126.62%	1590798	5634
Number of firms without registration	871903	736125.17	84.43%	2614846	156676
Number of firms not giving compensation to the workers	2210036	1948813.79	88.18%	7539427	203896
Number of firms involved in trade & other services	1954044	1521350	77.86%	6790128	298218
Number of manufacturing enterprises without fixed premises	12719	20375.31	160.20%	97558	179
Number of manufacturing enterprises with fixed premises but without any structure	6160	6287.83	102.08%	22104	0
Number of manufacturing enterprises experiencing mobile market	9578	14147.70	147.72%	59919	0

Source: Authors' calculation from 73rd round NSSO data.

The average number of firms in 22 major states is 2838342 with high standard deviation of 2325848 high coefficient of variation (CV) OF 81.94%. The maximum number of firms is 8999647 in Uttar Pradesh and the minimum number of firms is 392122 which is found in Himachal Pradesh. We considered the number of firms which has gross value added per labour employed (GVAPL) less than below poverty line (BPL). We found that in 22 states the average number of such firms is 558490 with a high coefficient of variation of 126.62%. The maximum number of such firms exists in West Bengal (1590798) and minimum number (5634) in Delhi. Existence of such firms represents the vulnerability of the firms in case of sudden fall of income. Similarly, firms which does not have registration are not likely to get any type of benefits from government. We found that on average there are 871903 firms which do not have any king of registration. Maharashtra has highest number of such firms (2614846) and Jharkhand has lowest number (156676) of such firms. Across the major states the variation is high. The coefficient of variation is 84.43%. Firms which are not

giving compensation to their workers is another source of vulnerability. On average there are 2210036 firms with maximum value 7539427 (West Bengal) and minimum value 203896 (Himachal Pradesh). The coefficient of variation is 88.18% indicating large variation among the states. The firms which are involved in the trade and other services are vulnerable to contagious disease due to their very nature of operation. The operation of such firms requires close human interaction thus making them vulnerable to such diseases. It is seen that on the average there are 1954044 firms with maximum of 6790128 (Uttar Pradesh) and minimum (298218). This feature shows relatively low variation (CV=77.86%). We found there are some manufacturing firms also which do not have fixed premises. Average number of such firms are 12719. Maximum number of such firm exists in West Bengal (97558) and minimum number (179) is found in (Delhi). The coefficient of variation is 160.20% indicating largest variation. Similarly, those working in the manufacturing firms which have fixed premises but do not have any structure are very much vulnerable to any type of contagious disease. Average number of these firms is 6160. Most of the firms are in Tamil Nadu (22104) and minimum value is 0 (zero) in Uttarakhand. Here the coefficient of variation is 102.08% which shows large fluctuation. There are on average 9578 manufacturing firm operating in the mobile market. Most of the firms are in Gujarat (9578) and there are no such firms in Kerala (0).

Next, we discuss our basic methodology.

4. 1 Methodology:

Given the wealth of the data we now proceed on to establish the vulnerability. As the vulnerability is multidimensional it is necessary to construct a multi-variable index denoting vulnerability. In the standard literature there are various attempt to measure vulnerability. However, all these measures are based on consumption or likelihood aspect (Chaudhuri, Jalan and Suryahadi, 2002).. In this paper we are trying to relate vulnerability to the production.

Hence index is basically different from those commonly used. We have already mentioned various variables that reflect vulnerability. We now are going to combine all these into a scaler index. This aggregation procedure may be done in various ways. However, we prefer for Principal Component Analysis (PCA) because of its ability to generate data driven weight based on the variability and correlation. We first provide a brief recapitulation of the method of PCA used by us and some primary statistical values that they generate. Then we go on to understand the vulnerability situation of India on the basis of these indices.

According to Johnson and Wichern (2006) Principal Components (PCs) are the linear combinations of p random variables $X_1, X_1 \ldots \ldots, X_p$. These depend on the covariance matrix (Σ) or correlation matrix (ρ) of $X_1, X_1 \ldots \ldots, X_p$. Let $X' = [X_1, X_1 \ldots \ldots, X_p]$ be any random vector with variance co-variance matrix Σ and Eigen values $\lambda_1 \geq \lambda_2 \geq \cdots \ldots \ldots \lambda_P \geq 0$

Consider the linear combination-

$$\left.\begin{array}{l} Y_1 = q_1'.X = q_{11}X_1 + q_{12}X_2 \ldots \ldots \ldots \ldots. q_{1p}X_p \\ Y_1 = q_2'.X = q_{21}X_1 + q_{22}X_2 \ldots \ldots \ldots \ldots. q_{2p}X_p \\ \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \\ Y_1 = q_p'.X = q_{p1}X_1 + q_{p2}X_2 \ldots \ldots \ldots \ldots. q_{pp}X_p \end{array}\right\} \quad (A)$$

Using the property of mean vector and variance-covariance matrix (Σ), we have:

$$Var(Y_i) = q_i'\Sigma q_i \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots. (B) \; i = 1,2, \ldots \ldots \ldots p$$

$$Cov(Y_i, Y_j) = q_i'\Sigma q_j \ldots \ldots \ldots \ldots \ldots \ldots. (C) \; i,j = 1,2, \ldots \ldots \ldots p$$

As PCs are the uncorrelated components $Y_1, Y_1 \ldots \ldots, Y_p$ whose variance in equation (B) is as large as possible so these could be increased indefinitely simply multiplying some constant with q. This indeterminacy can be eliminated if we consider coefficient vectors of unit length.

Therefore:

First PC= linear combination $q_1'.X$ that maximises $Var(q_1'.X)$ subject to $q_1'q_1 = 1$

Second PC= linear combination $q_2'.X$ that maximises $Var(q_2'.X)$ subject to $q_2'q_2 = 1$ and $Cov(q_1'.X, q_2'.X) = 0$

Similarly, i^{th} PC = linear combination $q_i'.X$ that maximises $Var(q_i'.X)$ subject to $q_i'q_i = 1$ and $Cov(q_i'.X, q_j'.X) = 0 \; for \; j < i$

In the next section, we begin the empirical results of indexing using PCA. We start by providing a basic description of the variables used in the index.

4. 2 Basic components of the vulnerability index:

Firstly, we consider Proportion of firms having less than Gross Value Added per Labour (GVAPL) below the Official Poverty line. From the Table A-1 of the appendix we see that Andhra Pradesh has the highest per cent of firms (21.33%) less than BPL level GVAPL. West Bengal, Odisha, Chhattisgarh closely follow suit with the ratio of 17.94%, 16.57%, 15.69% respectively. At the other hand Delhi has the lowest per cent of about 0.60%. Other states having less than 2% of firms having GVAPL below BPL are Bihar, (1.98%), Assam (1.52%) and Jammu & Kashmir (1.21%). This shows wide disparity among the states in this regard.

Secondly, Table A-2 in appendix shows per cent of firms without registration. Firms without registration are more vulnerable as generally they are not entitled to get any government assistance. Data show that Kerala has the highest per cent of that firm (60.28%). Some states which have more than 50% of unregistered firms are Uttarakhand (58.21%),

Jammu & Kashmir (55.85%), Maharashtra (54.72%) and Himachal Pradesh (53.16%). On the other hand, Jharkhand has lowest per cent of such firms (9.87%).

Thirdly, there are some firms which do not give compensation to the employees. This also creates vulnerability to the employees. Table A-3 in the appendix gives the percent of such firms in the 22 major states. On the average about 78% of the firms do not give compensation to the employees. While Jharkhand tops the list with 89.20% of such firms, Delhi posits itself at the bottom of the list with 47.57% of such firm. Though range is high even lowest value is substantial.

Fourthly, persons related to service sector are more vulnerable to viral disease like Covid-19. The table A-4 in appendix give per cent of such firms in each of 22 major states. This table shows that the lowest value is occupied by West Bengal and that has the share of service sector firms of about 53%. This value is itself high. On the other hand, Assam has highest number of such firms (83.26%). On the average 68.84% of all firms are of this type. This shows the extent of vulnerability of the unorganised sector in India.

Fifthly, among the manufacturing firms there are some firms which do not have fixed premises. They are also vulnerable to any contaminating disease. The table A-5 shows the per cent of such firm with respect to total number of firms in the unorganised sector in the major states. Here we see that Uttarakhand has highest per cent of such firms (4.15%) and Delhi has lowest per cent of such firms (0.10%)

Table A-6 gives the per cent of manufacturing firms with fixed premises but without any structure with respect to all firms in each state in the unorganised sector. The feature that they do not have fixed premises makes the firms vulnerable. From the table we can see that Odisha has the highest per cent of such firms (2.24%) while Uttarakhand does not have such firms.

In Table A-7 we show the state-wise distribution of manufacturing firms in the mobile market. From the table we can read that Gujarat has about 4.83% of such firms, which is the highest. At the other end Kerala has no such firms.

The parameters evolved in the PCA will now be discussed.

4.3. Principal Components and its technicalities:

For our analysis we considered seven variables. These are -

(i) Percent of firms in trade and other services, (ii) Percent of manufacturing enterprises with fixed premises but without any structure (iii)) Percent of manufacturing enterprises in mobile market (iv)) Percent of manufacturing enterprises without fixed structure (v)) Percent of firms without registration (vi) Percent of firms not giving compensation (vii) Percent of firms that have less than BPL level GVAPL. Normalised values of the variables are taken. Using Stata software, we calculated PCA. The calculated Principal components are given in the following table.

Table I-A: Principal Components (Eigen values)

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.21936	0.819683	0.3171	0.3171
Comp2	1.39968	0.228409	0.2	0.517
Comp3	1.17127	0.0999012	0.1673	0.6843
Comp4	1.07137	0.447206	0.1531	0.8374
Comp5	0.624164	0.270437	0.0892	0.9265
Comp6	0.353727	0.193299	0.0505	0.9771
Comp7	0.160427	.	0.0229	1

Source: Authors' calculation from 73rd round NSSO data.

Form the above table (Table-I) it is found that 7 components are created. But from component-5 onwards the eigen vector is less than one. Therefore, only first 4 components are retained and used for index formation as described in the above formula. These four components capture about 83.74% of variance. The corresponding eigen values are 2.21936,

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1.39968, 1.17127 and 1.07137. Now following (Raychaudhuri & Haldar, 2009) we calculated

the index. The method is summarised as below.

Table I-B: Principal Components (Eigen vectors)

Variable	Comp1	Comp2	Comp3	Comp4
var1	0.544	0.1492	-0.2277	-0.2774
var2	-0.3581	0.535	-0.0818	-0.1122
var3	0.5342	0.1741	0.1202	0.302
var4	-0.2611	0.0805	0.7721	-0.2753
var5	0.1955	0.5515	0.3561	0.49
var6	0.4285	-0.1357	0.3667	-0.5309
var7	0.0195	-0.5763	0.2637	0.4707

Source: Authors' calculation from 73rd round NSSO data.

We multiplied the eigen vectors with the corresponding eigen values for the first four

components. For example, we multiply first eigen value (2.21936) with first component

(0.544, -0.3581, 0.5342, -0.2611, 0.1955, 0.4285, 0.0195), the second eigen value (1.39968)

with second component (0.1492, 0.535, 0.1741, 0.0805, 0.5515, -0.1357, -0.5763), third

eigen vector (1.17127) with third component (-0.2277, -0.0818, 0.1202, 0.7721, 0.3561,

0.3667, 0.2637) and forth eigen value (1.07137) with forth component (-0.2774, -0.1122,

0.302, -0.2753, 0.49, -0.5309, 0.4707). In this process only absolute values of the components

are considered i.e, negative values are considered as positive. We then take summation of the

values obtained for each variable. For example, for the first variable   2.21936 X

0.544+1.39968 X 0.1492 + 1.17127 X 0.2277 + 1.07137 X 0.2774 = 1.890. Here the

negative values of the third and fourth components are ignored, and positive values are used

instead. We have calculated weights of the other variables in the same way.

Table I-C: Weights of the variables.

Variables	Weights
var1	1.980
var2	1.760

var3	1.894
var4	1.891
var5	2.148
var6	2.139
var7	1.663
Total	13.475

Source: Authors' calculation from 73rd round NSSO data.

Next, we calculate the index using the following formula (Raychaudhuri & Haldar, 2009).

$$I = \sum_i C_i \left(\sum_{j=1} |L_{ij}| E_j\right) / \sum_i \left(\sum_{j=1} |L_{ij}| E_j\right)$$

Where, I is the index; C_i is the i-th indicator; L_{ij} is the factor loading of the i-th variable on j-th factor.

The index value calculation for the state of Andhra Pradesh is given for example.

Table I-D: Calculation for Index value.

State	var1	var2	var3	var4	var5	var6	var7	Sum
Weight	1.9801	1.7596	1.8936	1.8914	2.1479	2.1392	1.6631	13.475
Andhra Pradesh	1	0.3273	0.8298	0.5586	0.4019	0.9495	0.0136	
Weight X values	1.9801	0.5759	1.5714	1.0566	0.8632	2.0311	0.0226	8.101

Source: Authors' calculation from 73rd round NSSO data.

Index for Andhra Pradesh= $\frac{8.101}{13.475} = 0.601$.

In the same way index values for all the 22 major states have been calculated.

5. The face of vulnerability in India:

The vulnerability index is calculated for 22 major states of India is presented in the following table (Table I). This table shows that Odisha tops the list while Haryana is at the bottom of the list. Three states Odisha, Chhattisgarh and Andhra Pradesh has the index value of 0.6 or more while three states i.e., Punjab, Telangana and Haryana have the index value less than 0.3. The mean value of the index is 0.431. Out of 22 major states in India, 9 states have index value more than average.

Table II: Vulnerability index of the states

States	Index	Rank
Odisha	0.662	1
Chhattisgarh	0.622	2
Andhra Pradesh	0.601	3
Uttarakhand	0.551	4
Assam	0.544	5
Kerala	0.507	6
Jharkhand	0.500	7
Maharashtra	0.453	8
Karnataka	0.440	9
Uttar Pradesh	0.419	10
West Bengal	0.408	11
Tamil Nadu	0.398	12
Bihar	0.397	13
Gujarat	0.386	14
Jammu & Kashmir	0.385	15
Madhya Pradesh	0.367	16
Rajasthan	0.363	17
Himachal Pradesh	0.360	18
Delhi	0.305	19
Punjab	0.292	20
Telangana	0.271	21
Haryana	0.260	22
Average Value	0.431	

Next, we conducted concordance analysis. One the one hand we have ranking of states on the basis of vulnerability index. On the other hand, we have ranking of states on the basis of our seven variables. Now we want to know how these rankings are related. The results are given in Table II

Table III: Vulnerability index of the states

tau_a (Sig. level)	Percent of firms having less than BPL level GVAPL	Percent of firms without registration	Percent of firms not giving compensation	Percent of trade & other services	Percent of manufacturing enterprise without fixed premises (street vendors)	Percent of manufacturing enterprise with fixed premises but without any structure	Percent of manufacturing enterprise in mobile market
Vulnerability Index	0.3247 (0.0369)	Not significant at 10% level	0.3506 (0.0241)	Not significant at 10% level	Not significant at 10% level	0.2900 (0.0627)	-0.2727 (0.0804)

Source: Authors' calculation from 73rd round NSSO data.

From the above table we can see that ranking of vulnerability index is positively and significantly related with the ranking on the basis of Percent of firms having less than BPL level GVAPL, Percent of firms not giving compensation, Per cent of manufacturing enterprise with fixed premises but without any structure. For the factor Percent of manufacturing enterprise in mobile market the vulnerability is negatively related. On the other hand, lack of registration, non-availability of fixed premises and the category trade services have no relationship with the vulnerability.

6. Conclusion:

The exercise is based on measuring vulnerability based on production rather than consumption. The reason is simply because for small unorganised firms consumption may be smoothened with loans, gifts and other non-economical transfers (Bhaduri,1973, Samuelson et al, 2020). This consumption data has two deficiencies. Firstly, this shield the likelihood uncertainties that are more reflected on production. Secondly, they are often associated with liabilities – monetary and non-monetary (Bhaduri, 1973, Bharadwaj, 1978) Thus, we depend more on the production data and the uncertainty associated with it. This is the very basic reason for using production data in the calculation of vulnerability. We have selected few variables in our exercise for this purpose. We do not claim the variables are comprehensive. However, these seem to be more pertinent for the present study. Using these variables, we constructed a multidimensional vulnerability index utilising PCA. Estimating these indices for states gives a glaring picture.

Our data reveals that the vulnerability in India is more widespread than is commonly thought. About 65% of the Indian states are vulnerable (below the average level) by our measure. This is almost twice the official figure of poverty based on consumption data. We have also examined various factors that are responsible for this scenario. In short, our exercise puts forth a completely different picture of vulnerability in India than is commonly thought.

References:

1. Addison, Tony & Hulme, David & Kanbur, R. (2009). Poverty Dynamics: Interdisciplinary Perspectives. 10.1093/acprof:oso/9780199557547.001.0001.

2. Banerjee, A. V., & Duflo, E. (2012). Poor economics: a radical rethinking of the way to fight global poverty. Paperback edition. New York: Public Affairs.

3. Bardhan Pranab (1984), Land, Labor, and Rural Poverty – Essays in Development Economics , Columbia University Press

4. Bardhan Pranab (2003), Poverty, Agrarian Structure, and Political Economy in India: Selected Essays, Oxford University Press

5. Bhaduri, A. (1973). A Study in Agricultural Backwardness Under Semi-Feudalism. *The Economic Journal*, *83*(329), 120. https://doi.org/10.2307/2231104

6. Bharadwaj, K. (1978). Maurice Dobb's critique of theories of value and distribution. *Cambridge Journal of Economics*, *2*(2), 153–174. https://doi.org/10.1093/oxfordjournals.cje.a035383

7. Raychaudhuri, A., & Haldar, S. K. (2009). An investigation into the inter-district disparity in West Bengal, 1991-2005. *Economic and Political Weekly*, *44*(26–27), 258–263.

8. Chakrabarti, S. (2010). Concept and method of ascertaining assets of rural households. The Journal of Income and Wealth, 32 (1),3–13.

9. Chambers, R. (1989). Editorial Introduction: Vulnerability, Coping and Policy. IDS Bulletin 20(2), 1-7

10. Chancel L. and Piketty T. (2017). Indian Economic Inequality. 1922-2015: https://wid.world/document/chancelpikety2017widworld/

11. Chattopadhyay M. and Sengupta A. (2001). Farm Size and Sharecropping Efficiency: Some theoretical issues. Keio Economic Studies,37(2).

12. Chaudhuri, S., J. Jalan and A. Suryahadi (2002). "Assessing Household Vulnerability to Poverty from Cross-sectional Data: A Methodology and Estimates from Indonesia", Discussion Paper, Columbia University, New York.

13. Chayanov, A. V. (1966). A. V. Chayanov on the Theory of Peasant Economy, Univ. of Wisconsin Press, Madison

14. Chayanov, A. V. (1989). The Peasant Economy: Collected Works. Moscow. Ekonomika.

15. Clark W.C. et.al. (2000). Assessing Vulnerability to Global Environmental Risk, Discussion Paper, 2000-12, Environment and Natural Resources Program, Belfer Center, September 2000.

16. Harris, J., and M. Todaro (1970). Migration, Unemployment and Development: A Two-Sector Analysis. American Economic Review 40, 126–142.

17. Harriss J. (2009). Bringing Politics Back into Poverty analysis: Why Understanding of Social Relations Matters More for Policy on Chronic Poverty than Measurement in Addison T, Hulme D ,Kanbur R. 2009. Poverty Dynamics - Interdisciplinary Perspectives. Oxford University Press, USA.

18. Kamanou, Gisele and Morduch, Jonathan (2002). Measuring Vulnerability to Poverty. World Institute for Development Economic Research. (UNU-WIDER). Working Papers. :10.1093/0199276838.003.0009.

19. Lewis, W. A. (1954). Economic Development with Unlimited Supplies of Labor, The Manchester School of Economic and Social Studies 22, 139–191.

20. Marshall, Alfred (1920). Principles of Economics (Revised ed.). London: Macmillan; reprinted by Prometheus Books.

21. Moser, Caroline O.N.(1998). The asset vulnerability framework: Reassessing urban poverty reduction strategies. World Development , 26(1), 1-19

22. Samuelson Paul. A., William D. Nordhaus *Special Indian Adaption* 2020, Indian Adaption by Dr S. Chaudhuri and Dr. Anindya Sen (2020). Economics. McGraw Hill Education (India) Private Limited.

23. Sengupta Atanu , Sanjoy De, Anirban Hazra, Ujjwal Seth (2020). The Trails of a Blood-Sucking Vampire: Ingredients of COV19 Pandemic Analysis. Mainstream. VOL LVIII No 19 New Delhi, April 25.

24. Sengupta, Atanu & Ghose, Manas, (2010). Vulnerability in India: A Simple Consumption-based Approach. Indian Journal of Human Development. 4. 393-405.

25. Shaffer, Paul & Kanbur, Ravi & Sandbrook, Richard. (2019). Immiserizing Growth: When Growth Fails the Poor.:Introduction.

26. Sinha, Saurabh & Lipton, Michael & Church, Joanna & Leavy, Jennifer & Litchfield, Julie & Ronchi, Loraine & Straub, Rachael & Yaqub, Shahin. (1999). DAMAGING FLUCTUATIONS, RISK AND POVERTY: A REVIEW. Background Paper for the World Development Report 2000/2001.

27. Watts, Michael & Bohle, Hans-Georg. (1993). The Space of Vulnerability: The Causal Structure of Hunger and Famine. Progress in Human Geography - PROG HUM GEOGR. 17. 43-67. 10.1177/030913259301700103.

8. Appendix

Table A-1: Percent of firms having less than BPL level GVAPL

States	Percent of firms having less than BPL level GVAPL	Rank
Andhra Pradesh	21.33%	1
West Bengal	17.94%	2
Odisha	16.57%	3
Chhattisgarh	15.69%	4
Kerala	12.27%	5
Telangana	11.02%	6
Rajasthan	9.55%	7
Karnataka	8.57%	8
Uttar Pradesh	8.40%	9
Jharkhand	8.19%	10
Maharashtra	8.12%	11
Himachal Pradesh	7.64%	12
Tamil Nadu	7.36%	13
Gujarat	6.97%	14
Punjab	4.65%	15
Madhya Pradesh	3.59%	16
Uttarakhand	3.22%	17
Haryana	2.82%	18
Bihar	1.93%	19
Assam	1.52%	20
Jammu & Kashmir	1.21%	21
Delhi	0.60%	22
Total	9.75%	

Source: Authors' calculation from 73rd round NSSO data.

Table A-2: Percent of firms without registration

States	Percent of firms without registration	Rank
Kerala	60.28%	1
Uttarakhand	58.21%	2
Jammu & Kashmir	55.85%	3

States	Percent	Rank
Maharashtra	54.72%	4
Himachal Pradesh	53.16%	5
Karnataka	49.57%	6
Assam	44.30%	7
Tamil Nadu	42.78%	8
Telangana	30.30%	9
Gujarat	29.04%	10
Delhi	28.69%	11
Chhattisgarh	28.56%	12
Punjab	27.27%	13
Andhra Pradesh	26.36%	14
Madhya Pradesh	26.20%	15
Haryana	24.39%	16
West Bengal	23.63%	17
Uttar Pradesh	19.08%	18
Rajasthan	19.02%	19
Odisha	14.99%	20
Bihar	13.36%	21
Jharkhand	9.87%	22
Total	30.72%	

Source: Authors' calculation from 73rd round NSSO data.

Table A-3 Percent of firms not giving compensation to the workers.

States	Percent of firms not giving compensation to the workers	Rank
Jharkhand	89.20%	1
Odisha	87.90%	2
West Bengal	85.01%	3
Uttar Pradesh	83.74%	4
Madhya Pradesh	82.57%	5
Andhra Pradesh	82.11%	6
Rajasthan	79.87%	7
Chhattisgarh	79.76%	8
Bihar	79.58%	9
Uttarakhand	79.21%	10
Assam	77.79%	11
Jammu & Kashmir	75.92%	12
Telangana	75.46%	13
Karnataka	75.12%	14
Kerala	73.63%	15
Maharashtra	72.58%	16
Tamil Nadu	70.33%	17
Punjab	68.37%	18

States		Rank
Gujarat	66.39%	19
Haryana	63.92%	20
Himachal Pradesh	52.00%	21
Delhi	47.57%	22
Total	77.86%	

Source: Authors' calculation from 73rd round NSSO data.

Table A-4 Percent of firms involved in trade & other services.

States	Percent of firms in trade & other services	Rank
Andhra Pradesh	69.85%	1
Assam	83.26%	2
Bihar	77.62%	3
Chhattisgarh	77.03%	4
Delhi	80.65%	5
Gujarat	62.58%	6
Haryana	81.14%	7
Himachal Pradesh	76.05%	8
Jammu & Kashmir	66.94%	9
Jharkhand	68.88%	10
Karnataka	67.43%	11
Kerala	77.06%	12
Madhya Pradesh	68.84%	13
Maharashtra	73.98%	14
Odisha	75.48%	15
Punjab	73.81%	16
Rajasthan	72.05%	17
Tamil Nadu	64.74%	18
Telangana	56.11%	19
Uttar Pradesh	75.45%	20
Uttarakhand	82.68%	21
West Bengal	52.88%	22
Total	68.84%	

Source: Authors' calculation from 73rd round NSSO data.

Table A-5 Percent of manufacturing enterprises without fixed premises (Street Vendors).

States	Percent of Manufacturing Enterprise without fixed premises (street vendors)	Rank
Uttarakhand	4.15%	1
Chhattisgarh	2.41%	2
West Bengal	2.33%	3

States		Rank
Assam	2.32%	4
Karnataka	2.31%	5
Bihar	1.73%	6
Andhra Pradesh	1.73%	7
Odisha	1.56%	8
Gujarat	1.40%	9
Uttar Pradesh	1.33%	10
Tamil Nadu	1.17%	11
Punjab	1.09%	12
Jammu & Kashmir	1.07%	13
Jharkhand	1.00%	14
Rajasthan	0.92%	15
Kerala	0.72%	16
Himachal Pradesh	0.43%	17
Maharashtra	0.41%	18
Madhya Pradesh	0.39%	19
Telangana	0.31%	20
Haryana	0.15%	21
Delhi	0.10%	22
Total	1.44%	

Source: Authors' calculation from 73rd round NSSO data.

Table A-6 Percent of manufacturing enterprises with fixed premises but without any structure.

States	Percent of Manufacturing Enterprise with fixed premises but without any structure	Rank
Odisha	2.24%	1
Andhra Pradesh	2.13%	2
Chhattisgarh	2.00%	3
Jharkhand	1.42%	4
Madhya Pradesh	1.27%	5
Tamil Nadu	1.27%	6
Kerala	0.99%	7
Maharashtra	0.98%	8
Delhi	0.98%	9
Assam	0.85%	10
Bihar	0.74%	11
Rajasthan	0.55%	12
Uttar Pradesh	0.52%	13
Himachal Pradesh	0.50%	14
Telangana	0.32%	15
Karnataka	0.25%	16

States		Rank
West Bengal	0.18%	17
Gujarat	0.12%	18
Jammu & Kashmir	0.11%	19
Punjab	0.04%	20
Haryana	0.03%	21
Uttarakhand	0.00%	22
Total	0.70%	

Source: Authors' calculation from 73rd round NSSO data.

Table A-7 Percent of manufacturing enterprises experiencing mobile market.

States	Percent of Manufacturing Enterprise in mobile market	Rank
Gujarat	4.83%	1
Jharkhand	3.77%	2
Odisha	3.06%	3
Delhi	2.32%	4
Assam	2.26%	5
Jammu & Kashmir	2.15%	6
Bihar	1.53%	7
Uttar Pradesh	1.11%	8
Himachal Pradesh	1.06%	9
West Bengal	0.85%	10
Maharashtra	0.80%	11
Haryana	0.67%	12
Karnataka	0.62%	13
Chhattisgarh	0.56%	14
Madhya Pradesh	0.42%	15
Punjab	0.37%	16
Rajasthan	0.27%	17
Telangana	0.15%	18
Uttarakhand	0.11%	19
Andhra Pradesh	0.07%	20
Tamil Nadu	0.06%	21
Kerala	0.00%	22
Total	1.08%	

Source: Authors' calculation from 73rd round NSSO data.