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Innovate: A Study Of
'Grassroot' Innovators In India**

by

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TRACING THE MOTIVATION TO INNOVATE: A STUDY OF 'GRASSROOT' INNOVATORS IN INDIA

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Abstract

Extrinsic motivations like intellectual property protections and fiscal incentives continue to occupy the centre stage in debates on innovation policies. Joseph Schumpeter had, however, argued that the motive to accumulate private property can only explain part of innovative activities. In his view, “the joy of creating, of getting things done” associated with the behavioural traits that “seek out difficulties...and takes delight in ventures” stand out as the most independent factor of behaviour in explaining the process of economic development, especially in early capitalist societies. Taking the case of ‘grassroot’ innovators in India, we re-examine the motivations behind innovative behaviour. We draw upon the literature on effectance motivation theory to construct operational indicators of extrinsic and intrinsic motivations. Interestingly, we find that pure extrinsic forms of motivation drive only a fraction of individual innovative behaviour. Also, importance of intrinsic motivation in guiding innovative behaviour is found to high when uncertainty is high. We accordingly draw a few policy implications.

KEY WORDS: *Motivation, Grassroot Innovation, India*

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1. Introduction

There is little disagreement over the fact that technological changes and innovations are crucial for economic change. A somewhat less amount of agreement, however, prevails on what drives technological change and innovation. In modern economies, intellectual property rights and fiscal incentives are often regarded as two major tools of innovation policy. Conventionally, intellectual property rights (patents in particular) were believed to add fuel of incentives to the fire of individual genius. However, widespread use of strategic patenting to stall, rather than promoting, innovation has dented the credibility of patent as a prime driver of innovation (see, for instance, Mansfield 1986, Gallini 2002, Noble 1977: chapter 6). Over time, it has also been realised that patent has, by and large, failed to induce innovative activities where commercial prospects are low (e.g innovating orphan drugs, in the areas of neglected diseases)¹. Fiscal incentives also have been criticised for their inability to induce innovation to any considerable extent, because of its limitation to alter risk perception, and reach out to small scale R&D by small firms or individuals, especially when difference between social and private return to R&D is substantial (see Mansfield 1986, Hall and Reenen 2000).

Besides such empirical criticisms of the viability of extrinsic incentives like IPR and fiscal incentives, the effectance motivation theory points out that externally provided incentives (extrinsic incentives) only have limited success in motivating human behaviour in the longer run. This literature makes two important points: (a) extrinsic incentives are only useful in the short run, but (b) they might prove to be counterproductive in the long run by crowding out intrinsic motivation of individuals (Kohn 1993; Frey 1997, Sansone and Harackiewicz 2000). This conceptual framework has been used to theorise, as well as to empirically verify, various economic acts, ranging from backward bending blood supply curve (Osterloh and Frey 2000), to willingness to host nuclear waste in one's backyard (Osterloh and Frey 2000) to R&D activities (Kreps 1997).²

Schumpeter (1934) had also argued that the motive to accumulate private property can only explain part of innovative activities (p. 94), especially in early capitalist societies. The wheel of economic development in such societies was kept moving by “personality” and

¹ See, for instance, Troullier and Olliaro (1999).

² In general, research on non pecuniary sources of motivation has increased in recent years. These studies incorporate factors like fairness, preference to cooperate, morale, and status on incentives and organisational practices. See Akerlof and Kranton (2005) for a review.

“will” of individuals (p 89-94). In his view, “the joy of creating, of getting things done” associated with the behavioural traits that “seek out difficulties...and takes delight in ventures” stand out as the most independent factor of behaviour in explaining the process of economic development (pp. 93-94). In more matured phases of capitalism, however, innovation might become a routine activity of large firms and such psychological factors might become less important for innovation (Schumpeter 1943. p 132). Noble (1977) also gives detailed account of how scientists lost their individual freedom in such a set up, which redefined their roles merely as ‘R&D inputs’.

This paper intends to identify the various kinds of motivation behind “grassroot innovation” in India. The term grassroot refers to individual innovators, who often undertake innovative efforts to solve localised problems, and generally work outside the realm of formal organisations like business firms or research institutes. Although recent literature on organisational science and evolutionary economics have emphasised that intrinsic motivation is a key driver of economic activities, studies relating intrinsic motivation to innovative behaviour are few and far between. Our paper attempts to contribute to this growing body of research by analysing the motivation of grassroot innovators in India. The primary reason behind inadequate focus on this area seems to be the unavailability of any operational indicator of intrinsic motivation in the field of innovation. An objective of this paper, therefore, is also to develop such operational indicators of intrinsic motivations to innovate.

In the next section we discuss the various characteristics of grassroot innovation. Section 3 provides a review of the various strands of motivation theories and explores their link with innovation studies. We discuss our data and methodology in section 4. Section 5 analyses the data and develop the indicator of motivation. Finally, section 6 synthesises and draws broad policy implications.

2. Grassroot Innovation

Conventionally, innovations were defined as drastically ‘new technological combinations’ enabling an economy to depart from its state of circular flow of income (Schumpeter 1934). Over the years, scholars like Nathan Rosenberg, Richard Nelson, Sanjaya Lall have broadened the definition of innovation by incorporating ‘minor’ or ‘incremental’ changes in technical combinations into the ambit of innovative activities. Such

minor or incremental innovations are most commonly observed in technologically backward countries, primarily to make an existing technology suit better in an environment, where market size is small, capital scarcity is high, and preference for novelty is relatively low. Such modified technologies are often categorised as ‘appropriate technologies’ (Stewart 1987). However, even these studies did not cover individual level innovative behaviour to any significant extent.

Recent research in the fields of science technology and society (STS) studies and organisational theory has paid renewed attention to individual level understanding of innovation processes, albeit within the organisational framework. Amabile (1996), for instance, suggest that innovation is the culmination of creative ideas conceptualized by an individual or a group. She further emphasises that generation of such creative ideas or novelty seeking behaviour is, in itself, a complex phenomenon. Scheweizer (2004), for instance, argues that:

Innovation is... “an outcome of an interaction between individual and social factors including on the one hand an individual’s behaviour fed by specific personality traits and achievement needs and on the other hand the either intrinsically or extrinsically motivated social judgment behaviour of others... (p. 62)”.

Researchers have extensively pointed out that innovation is a long process and is shaped by a complex interplay of various biological (genetic, cognitive-neuroscience and neuro-psychological etc.), social, political, psychological and other environmental factors besides potential economic gains (Basalla 1988, Jamison 1989; Scheweizer 2004; Jayasinghe et. al 2007). Shavinina and Seeratan (2003) define innovation as generation, acceptance, and implementation of new ideas, process, products, or services. Redelinghuys (2006: 63) suggests that an innovation should be psychologically and historically original in nature. Pointing out the importance of psychological and cognitive factors behind innovation, these studies admit the roles of individuals in generating innovations.

In this respect, a study of grassroot innovations can prove to be important. Grassroot innovations bear similarity with the early-Schumpeterian (1934) concept of innovation where individuals, and not corporate R&D units, are the main agents of innovative activities. However, unlike the Schumpeterian innovations, grassroot innovations mostly represent minor or incremental changes in existing technological artefacts. One interesting feature of grassroot innovation is perhaps the diverse set of knowledge sources it uses. On one hand, some grassroot innovations are based on locally available traditional knowledge; while on the

other hand, grassroot innovations also represent modifications of mainstream modern technologies.

Intellectual inspiration of such need based local innovations can be traced in the writings of Mahatma Gandhi and Rabindranath Tagore-the two most eminent philosophers and social reformers of the 20th century India. Gandhi's contempt for large scale mechanisation is well known (Gandhi 1997 Chap 19, pp.107-111). He ideated that large scale use of machinery will lead to exploitation in the society and disturb the social order (Vishwanathan 1998). He rather supported need based and local community centric approach towards technological activities, which was epitomised in the form of *Charkha*.³ Bakker (1990) argues that Gandhi's approach helps to achieve greater equity or "distributive justice," by promoting technologies that are appropriate to "basic needs" i.e. food, clothing, shelter, health and basic education. He also attempted to connect this Gandhian approach to technological change with his idea of "Swadeshi". The concept of "swadeshi" refers to local self-reliance and use of local knowledge and abilities in day to day life. Thus, grassroot innovation, in a sense, echoes the Gandhian philosophy of technology and social development by the common people. These technologies are not only based on the values of "swadeshi" but also symbolises a process of empowerment through self help.

Tagore also sought to patronise development of local handicrafts and artefacts with the conviction that such activities would enrich creative aspirations of rural communities. He established a training centre, whose main objective was to "help villagers and people to solve their own problems instead of a solution being imposed on them from outside"⁴. Jain (undated)⁵ suggests that scholars like Tagore and Gandhi believed that India could only regenerate itself to face the challenges ahead by seeking out those beliefs, values, knowledge systems, and technologies, which had organically grown from her local communities. The grassroot innovations, therefore, represents a complex set of socio-political and economic aspiration of people, who normally bank on their skills and practical experience, rather than formal body of technical knowledge, to carry out technological activities.

³ A Charkha is one form of the spinning wheel. MK Gandhi brought Charkha into larger use through his teaching. Charkha was believed to be a symbol of self sufficiency during India's freedom movement, where each household would contribute to making their own clothes by using charkha, and would be rejecting foreign made clothes, in the process.

⁴ www.visva-bharati.ac.in. Last accessed on 10 January 2009.

⁵ <http://www.swaraj.org/shikshantar/newpoetschallenge.pdf> [Accessed on 10 January 2009]

What, however, baffles the researcher is the observation that many of the ‘grassroot’ innovators are not much keen on commercialising their innovations. Often they seem to be happy if the innovation is able to solve some of the daily problems faced by themselves or their communities, disregarding the prospects for private appropriation or monetary gains. In many cases people continue to experiment with new things despite getting no recognition. There are also cases where innovators distribute their innovated technologies without any profit (see NIF 2001).⁶ All these instances persuade us to develop an understanding of the complex canvas of human motivation behind such innovative activities.

3. Motivation to innovate: an outline of the basic framework

Motivation is a complex psychological process that causes the arousal, direction, and persistence of behaviour (Mitchell 1982), positively or otherwise. The complexity arises from the counterbalancing effects of various motivating factors working on the same individual or group at any particular point in time. In other words, positive and negative motivating factors may be at work simultaneously, making it difficult for a person or a group to undertake any action. Scholars often distinguish between ‘voluntary’ or ‘intrinsic’ and ‘goal directive’ or ‘extrinsic’ motivation (Deci 1971). Intrinsically motivated behaviours are those whose locus of control lies within the individual. Whereas, locus of control of any extrinsically motivated behaviour lies externally, in the said incentives. Moreover, what makes studies of motivation all the more important is the argument that impact of intrinsic and extrinsic motivation on behaviour is neither complimentary nor linear. In fact, a whole range of studies point out that extrinsic rewards and pressures, in general, undermine intrinsic motivations through ‘over-justification effect’ or through ‘manipulation of behaviour’⁷.

⁶ The evidence of such behaviour is not restricted to the field of grassroot innovation. Tagore (1996: 146) recollects how a poor man had refused to accept monetary compensation for the effort he undertook to find drinking water for some travelers who were passing through their village on a hot summer afternoon. He was baffled to see that the inexorable law of demand and supply was not operating even when supply of water is scanty and travelers would constantly need water! Tagore’s only explanation was that ‘they did not claim any personal merit for possessing them’.

⁷ Among economic studies, for instance, Osterloh and Frey (2000) find that the intrinsic willingness to host nuclear waste in one’s backyard is crowded out when incentives are offered, by the State, to host such wastes. Akerlof and Kranton (2005) point out that extrinsic incentive are insufficient to motivate people whose efforts cannot be observed, and hence, rewarded. Benabou and Tirole (2003) argue that principal’s offer of a reward to an agent is believed to signal a lack of trust, or lack of faith, in agents, and reduce the personal motivation of the latter. For studies in psychology, and organizational behaviour see also Deci (1971) Amabile et al. (1976), Koestner et al (1984); Kohn (1993); Sansone and Harakiewicz (2000), Zuckerman et al. (1978).

The importance of such non-economic incentives was highlighted in the works of Schumpeter. To quote Cohen and Sauermaun (2007):

“...although [he] was mainly concerned with the effect on economic performance of the incentives of the principals.....Schumpeter’s discussion expands our notion of incentives beyond a focus on the pecuniary gains from innovation. [he] suggests that the benefits that motivate innovation and economic initiative more generally on the part of the individuals may be non-pecuniary, including, for example, an individual’s satisfaction of realizing a “vision,” or “the opportunity to fling himself in to the fray,” or the opportunity to exercise autonomy and responsibility... (pp. 74-75).”

Among the more recent studies on innovation, Osterloh & Frey (2000) argue that tasks of creativity, transfer of tacit knowledge, are some of the tasks where intrinsic motivation becomes crucially important. Similarly Kreps (1997) emphasises that tasks like research are inherently uncertain. The main enjoyment in such tasks comes from the challenges that lie in dealing with these uncertainties. Due to attached uncertainties, moreover, these tasks cannot be perfectly regulated by external means. As a result, intrinsic motivations hold the key for successful completion of these tasks. Jong (2006) discusses the role of intrinsic motivation in relation to “decision to innovate”. He argues that over and above the perceived payoff of an innovation, what crucially determines the decision to innovate is the competence of the innovator in appreciating the necessity of the innovation. Cameron and Pierce (1994) consider innovation as a process comprising multiple tasks, driven by multidimensional driving forces. They found that unexpected rewards have positive impact on intrinsic motivation. Similarly, verbal rewards also increase intrinsic motivation to undertake creative tasks. The tangible rewards have the desired positive effect when they are delivered unexpectedly and they are not detrimental when they are expected and contingent on level of performance.

3.1 Indicators of intrinsic and extrinsic motivation: A conceptual framework

Despite well documented assertions that “the motive of *gain* is not natural to man”, and “the usual incentives to labour are not gain but reciprocity, competition, joy of work, and social approbation” (Polanyi 1944: 271), the early development of modern theory of motivation had revolved exclusively around externally administered rewards and regulations (Morgan et al., 1993; Ryan & Deci, 2000). Such motivations take the forms of pay, material

possessions, prestige, and/or positive evaluations from others (Thorndike 1911)⁸. In other words, whenever an activity is done in order to attain some “separable outcome” it is assumed to be extrinsically motivated task.⁹

In contrast, intrinsic motivation is said to exist when activities are done for its own sake rather than to respond to external reinforcers (Ryan & Deci 2000)¹⁰.

“...These spontaneous behaviours, although clearly bestowing adaptive benefits on the organism, appear not to be done for any such instrumental or extrinsic reason, but rather for the positive experiences associated with exercising and extending ones capacities (p. 56).”

According to Deci and Ryan (1985), intrinsically motivated behaviour is supposed to satisfy innate psychological needs for enjoyment, competence and autonomy. Deci (1980) explains that “perceptions of personal (not external) control satisfy these needs, and constitute the fundamental feature distinguishing intrinsically motivated behaviour from extrinsically motivated behaviour.” Morgan et al. (1993) further argue that these motivations stay lifelong, whereas extrinsic motivations decay with the fulfilment of given goals¹¹.

An understanding of the parameters of intrinsic and extrinsic motivations can be developed by reviewing the Self-Determination Theory (SDT) proposed by Deci and Ryan (1985, 2000). The SDT suggests that the need for competence, autonomy and relatedness are the three main psychological needs that drive human behaviour (Deci 1975), and are key to intrinsic motivation. The SDT also identifies rewards, communications, and feedback as some of the important factors which influence intrinsic motivation behind a task or action (Deci and Ryan 1985). However, Deci & Ryan (2000) propose to revise the conventional understanding that *all* extrinsic motivations necessarily reflect social/environmental pressures, where locus of control is external. They conceptualise a motivation continuum comprising amotivation, extrinsic motivations and intrinsic motivations. In this continuum, there are at least two kinds of extrinsic motivations, where locus of control is substantially internal.

⁸ Morgan et al. (1993) provide brief historical sketch of the theories of motivation. They discuss Drive Theories, Incentive Theories, Opponent Process Theories, Optimal-level theories and also discussed biological motivation, in which they cover hunger motivation, sexual motivation etc. Lastly they discussed Social Motives in which they discussed achievement motivation, power motivation, effectance motivation. They kept intrinsic and extrinsic motivation theories in effectance motivation theories.

⁹ Separable outcomes refer to goals other than self-enjoyment.

¹⁰ The origin of this concept may be traced to White's (1959) usage of “competence or effectance” motivation. Morgan et al. (1993) describe “effectance” as stimulus and exploration needs geared towards establishing competence in dealing with the environment.

¹¹ Effectance motivation plays an important role in human behaviour. Goals are reached, but effectance motivation is not satisfied; it remains to urge behaviour toward new competencies and masteries (p. 297).

One such type of extrinsic motivation is “regulation through identification.” Here an activity is undertaken after completely understanding the worth of it. To put it differently, an individual is able to consciously value a regulation and, thereby, decides to internalise it. The other form of extrinsic motivation, perhaps closest to intrinsic motivation, is “integrated regulation.” According to Ryan and Deci (2000), integration occurs “when identified regulations have been fully assimilated to the self (p. 62)”. This occurs through evaluation of a regulation and bringing it in congruence with one’s values and needs. The more one internalizes the reasons for an externally motivated action and assimilates them with the self, the more these actions become self-determined (Ryan and Deci, 2000).¹²

Indeed, it is difficult to distinguish between such autonomous forms of extrinsic motivations like “regulation through identification” or “integrated regulation” and intrinsic motivation. Both these kinds of motivation draw interesting parallel to the concept of ‘duty’ (see also Deci and Ryan 2004: 38-39). Although Deci and Ryan (2004) treats fulfilment of obligation or duty as externally motivated act (page 38) a re-examination of this treatment may not be out of place.

Duties are of two types. The first kind of duty, as mentioned in *The Arthashastra*¹³- the most ancient document on Indian polity and economy, is known as ‘dharma’, ‘(which)...every human being owes to oneself, to society as a whole, to one’s ancestors and to universal orders...it is the law in its widest sense’ including moral and ethical dimensions (Rangarajan 1987: p. 13). Radhakrishnan (1998: p. 223) further elaborates that “observance of duties result in virtue, when they are done *without* a desire for gaining any visible result (like wealth)”¹⁴. Observance of duty can, thus, in principle result in non-pecuniary, innate psychological gains. Tagore (1996), for instance, argues that such duties are voluntary obligations, one of the prime virtues of Man, which play important role in forging relationships between individuals and the society. According to Tagore, being related with the larger universe, while maintaining individuality, is the supreme goal of human beings (Tagore 1996: 100, 169, 194). Note that relatedness is also considered as an important innate psychological need in the literature on intrinsic motivation. Duty can, therefore, have

¹² Often, the “integrated regulation” and intrinsic motivation, both being autonomous and non-conflicted, may appear to be very similar. However, the former is still extrinsic because behaviour motivated by “integrated regulation” is done for its presumed instrumental value with respect to some outcome that is separable from the sheer enjoyment of undertaking the behaviour itself.

¹³ The Science of Economics.

¹⁴ Emphasis own.

significant overlap with intrinsically motivated acts. In fact, if autonomy-another innate psychological need that drive intrinsic motivation- is made synonymous to freedom, and if harmony of relationships is believed to augment freedom (Tagore 1996: 157), then relationships can be assumed to augment autonomy and, hence, intrinsic motivation. Indeed, duty, for Tagore, is a way to build up such relationships with one's community and the universe. A desire to fulfil such duties may, therefore, be believed to promote one's intrinsic motivation.

However, along with the abovementioned kind of duties that are universally obligatory, there are duties specific to particular conditions of life (Radhakrishnan 1998: pp 222-23). While the first kind of duties pertains to basic qualities of human beings (e.g. integrity, trust, non-neglect of duty etc.), the second type of duties are often made specific to clans, castes and communities, and are more vulnerable to misuse by powerful social or political groups. Such duties would hardly be internalised by the subjects and the locus of control of such behaviour would remain external (e.g. social sanctions, caste specific occupations). Tagore, for instance, argued that caste based occupational hierarchy have seriously restricted the innovative capacity of the Indian society.

“.....the pursuit of hereditary occupations, generation after generation, involves mindless repetition and degrades the quality of mind that is needed to make innovations even within the limited sphere of an occupation” (R. N Tagore in Bhattacharya 1997, p.12)

Performances of these second types of duties are, therefore, closer to externally regulated acts. Some scholars, however, suggested treating social motivations like responsibility and duty separately from extrinsic and intrinsic forms of motivations (see Cohen and Sauermann 2007). Nevertheless, it is important to note that many pro-social human activities like cooperation, fairness have been found to be prone, much like intrinsic motivation, to crowding out effect when faced with extrinsic incentives.¹⁵ We, therefore, do not use any third category for social motivations and include them in either of two categories depending on their locus of control.

Ryan and Deci (2000) also highlight that motivation might change over time. While in some cases people may, over time, internalise some social norms and values, in other cases

¹⁵ See Akerlof and Kranton (2005) for review of such studies in economics and Deci and Ryan (2004) for related studies in social-psychology. We, in line with many unorthodox economic theories (e.g. Witt 1998), take a broader view of human motive and argue that human being can internalize social values and act in conformity with social values for reasons other than self interest (award or punishment). See Banebou and Tirole (2006) for a similar line of argumentation for pro-social act.

people may cease to be motivated intrinsically and become depended on externally provided motivation. The second process holds true particularly when someone's intrinsic motivation is high initially, but is asked to respond to extrinsic incentives. One's past experience and various situational factors would also determine the speed and direction of this process (Ryan & Deci, 2000).

3.2. A synthesis:

Based on the above discussion, parameters for extrinsic motivations are relatively easier to identify. For instance, monetary incentives, tangible or intangible rewards, peer group pressure, statutory bindings, work deadlines-can reasonably be taken as various forms of extrinsic motivations (positive or negative).

In contrast, intrinsic motivation refers to one's own enjoyment, or sense of 'duty' in undertaking a work. It can, therefore, be conceivably argued that the behavioural characteristics of an agent guided by intrinsic motivation would not be much influenced by concerns of economic profit in particular, or individualistic gains in general (Akerlof and Kranton 2005, Benabou and Tirole 2006). Rather, their behaviour would be primarily guided by the commitment to successful completion of the job and fulfilling responsibilities for the social 'common', often at the cost of individual gains (Benabou and Tirole 2006). The literature on intrinsic motivation also points out that intrinsically motivated acts are associated with feeling of competence. For an inherently uncertain task like innovation, however, competence is difficult to measure since outcomes of a new innovative tasks is, by definition, different from previous outcomes. Also, an innovative task often requires a novel approach (say, process) not undertaken before. Competence therefore loses much of its meaning in the context of uncertain events like innovation. Instead, what becomes important driving force is self-confidence (Knight 1921, see also Banebou and Tirole 2002). It may be argued though that competence and confidence are not completely unrelated. In so far as competence is accumulated through past experience with a task, it can be seen as a source of confidence to undertake activities in the face of uncertain outcome. The latter, in turn, also helps augment competence for the task at hand.

We now move on to analyse how these characteristics can be made operational taking the case grassroot innovators in India after discussing our data and methodology.

4. Data, Sample and Methodology:

4.1 Data Source

The National Innovation Foundation (NIF) gives various awards to the grassroots innovators on annual bases. Our research work is based on the secondary data, collected from the SRISTI web site of the first year awardees. The selection of awardees involves a rigorous search of grassroots innovators from the remotest parts of the country. Our data set contains 87 grassroots innovators, who were awarded by the NIF for on the merit of their innovation or innovative ideas in the year 2001. The data set contains a detailed biography of each awardees. From these descriptions, therefore, we needed to extract information pertaining to their motivations at various stages of innovative activities. To meet this objective, we have considered their subjective views as well as their actual actions during the process of innovation. We then coded these responses to measure their motivation along a binary scale¹⁶.

4.2 Motivation Scale:

Motivation scale is relevant at three levels: global, contextual and situational (Deci and Ryan 2004, Hayamizu 1997). The motivation scale at the global level intends to capture the overall motivation behind *all* activities that an individual undertakes. The contextual motivation, on the other hand, is task specific. The situational scale goes one step further to measure individual motivation for a task at a particular point in time (Deci and Ryan 2004: 46). Deci and Ryan (2004) argue that the global scale is too broad while the situational scale is too narrow, and one should ideally measure motivation at the contextual level. Most of these scales have been used to study individual motivation in the field of education (Deci and Ryan 2004, Vallerand et al. 1992) drawing samples largely from students in a school or college set up. Analyses are mostly based on perceptive views of the respondents. Another major feature of these studies has been to analyse amotivation along with extrinsic and intrinsic forms of motivation. Our study, however, does not incorporate amotivation, since we are concerned primarily with innovators, who are free from any organisational dictates. Presumably, nothing would force them to take up an innovative project, if they chose not to.

¹⁶ This questionnaire was also administered on 22 grassroots innovators during the 4th year award function held in New Delhi in 2007. Although, we have not made use of this data set, the exposure to such primary level information has importantly contributed to formation of our hypotheses and analyses of data.

Also, to measure various kinds of motivation we use, besides subjective views, actual actions undertaken by the respondents. At each of the three stages of innovation, motivations have been measured along two individual indicators. We then calculate the composite motivation at each stage by taking into consideration both the indicators of motivation. We measure the internal consistency of these indicators by Cronbach's alpha (Cronbach 1951).

Cronbach's alpha measures how well a set of variables (or components) measures a single, unidimensional latent construct. If x_i , $i=1, \dots, k$ denotes the number of components 'c' denotes the average covariance of all components, and 'v' denotes the average variance of all components, then

$$\text{Cronbach alpha} = kc/[v+(k-1)c]$$

5. Towards some operational indicators of intrinsic motivation to innovate:

An analysis

5.1 Motivation at the stage of Idea generation:

All four indicators of intrinsic motivation are visible in this stage of innovation. We, therefore have to provide arguments for how to operationalise each of them. For this stage, we develop the indicator of motivations based on responses with regard to 'source of idea' and 'driving force' behind their innovations. The scales constructed on the basis of these responses are binary in nature. We then construct the composite scale by matching their responses along these two individual scales (or components).

We find a variety of responses from the grassroots innovators on each component. With regard to 'source of idea', responses are of two types. Either the idea has been generated by oneself through his/her interaction with problem situations (environment), or has been given/suggested by others. The second source is also of two types: sponsored research projects or informal suggestions by others in the community. Since, sponsored research projects often come with pre-defined research objectives and/or deadlines, the locus of control of one's behaviour would lie outside, curtailing one's autonomy of work. Such innovative ideas can be called externally motivated. For some innovator-entrepreneurs, new idea has come while dealing with a business crisis. Although generated by one self, we categorise such ideas as externally motivated since desire for economic profit rather than any motive of self-enjoyment or duty to social common was the key motivating factor.

On the other hand, when new ideas are the outcomes of one's interaction with a problem situation faced by the society, we call it intrinsically motivated, irrespective of whether the idea was generated by the innovator or suggested by others informally. Very often, the innovators take up problems that are local in nature and have been in existence for a long period. In some cases, problem situations may have emerged as a result of some drastic changes in the environment (for instance, some natural calamity). In many such cases, there are hardly any externally imposed deadlines or any predefined incentives. The underlying motivation behind such innovative efforts may be characterized as 'intrinsic' since such efforts reflect the fulfilment of innate psychological need associated with 'joy of work' as well as certain amount of duty to one's own community/society.

In few cases such innovators are the scientists working in public funded research institutions.¹⁷ Proponents of privatizations in India very frequently argue that job security and absence of properly designed reward-incentive schemes bred inefficiency in public sector organizations. In fact, perhaps in tune with such doctrines, Indian government changed its funding policies towards public sector research institutions in the year 1995. In the changed policy environment, these institutes have been asked to generate around 30% of their total budgetary requirement through external commercial funding. It has been observed that many scientists, in the aftermath of this policy change, switched over to research projects which have high commercial prospects, often at the global level (Ray 2004). In such an environment, if a scientist shows interest to initiate a research project on his own, specifically aiming at solving a problem of local community (having low commercial prospects and small market demand) the underlying motivation may be argued to be intrinsic in nature. Here either a sense of duty to one's community or 'joy of work' becomes the prime driving force rather than private gains through appropriation. Also, if an idea is generated from one's theoretical or practical knowledge in a field, the underlying motivation is categorised as intrinsic. Conceivably, individuals hold complete autonomy in such cases

According to the component 'driving force', once again, two kinds of responses emerge. Some individuals cite 'gaining business advantage' or to 'leapfrog competitors' as the main driving force behind their innovative research efforts. Such efforts often have strict deadline, and competitive pressure to deliver on time. Joy of work or fulfilment of duty may

¹⁷ Amotivation, as an option could have been relevant for this group of respondents.

not remain the overriding criteria that guide such activities. We categorise these motivations as extrinsic motivations.

On the other hand, some individuals cite their ‘experimenting nature’, ‘curiosity’ or ‘inquisitive mind to observe things differently’ as prime driving force behind taking up any particular research effort. We categorise them as intrinsic motivation since satisfying one’s innate psychological need for enjoyment seems to lie at the core of these responses

Finally, we combine these two individual scales to come up with the composite motivation indicator for this stage. When the motivation is intrinsic in terms of both scales, the aggregate motivation remains intrinsic. Similarly, the aggregate motivation is marked extrinsic when motivations in terms of both scales are extrinsic. However, if a response is categorised as ‘intrinsic’ in terms of one scale, and extrinsic in terms of the other, the resultant motivation is categorised as ‘mixed motivation’.

We have been able to find out data for “driving force” only for 62 individuals, out of 87 grassroot innovators (Table 1).

Table 1: Components of Motivation - Idea Generation Stage

Source of Idea	Driving Force	
	E	I
E	10	12
I	6	34
Total	16	46

Note: ‘E’ refers to extrinsic motivation, and ‘I’ refers to intrinsic motivation

Based on above discussion, we, therefore, observe that 10 individuals at this stage are guided by extrinsic forms of motivation (E, E), 34 individuals are guided by intrinsic forms of motivation (I,I). There are 18 other individuals whose motivations are intrinsic by one criterion but extrinsic by the other [(E, I) or (I, E)].

Note that ‘source of ideas’ and ‘driving force’ captures motivation in binary scales. We assign ‘1’ to responses that qualify for intrinsic motivations and ‘0’ to those qualify for ‘extrinsic motivations’. Since both the parameters intend to measure motivation at the stage of idea generation we also check for their internal consistency. The Cronbach’s alpha is 0.51 approximately.

Table 2: Composite Motivation - Idea Generation Stage

Motivation	Frequency	Percent (%)
Extrinsic	10	16.12
Intrinsic	34	54.83
Mixed	18	29.03
Total	62	100.00

5.2 Motivations at the stage of experimentation

Innovation involves uncertain trials and experimentation. Success in experimentation requires two important things; (a) continuous up gradation of tacit and codified forms of knowledge through new information, and (b) funds to support the uncertain experimentation process.

Motivation at the stage of experimentation is measured along two binary scales in terms of their responses with regard to ‘cooperation and sharing of information’ and ‘source of funds’. Once again, all four indicators of intrinsic motivation become crucial in analysing motivation at this stage. However, while ‘joy of work’, ‘confidence’ and ‘duty’ seems to guide one’s behaviour pertaining to cooperation and sharing of information, the behaviour with respect to ‘source of funds’ seems to be guided more by the concerns of retaining autonomy and confidence.

Cooperation and discussions with people is one important means to upgrade one’s knowledge about the problem at hand. However, while cooperation may bring about new insights, it is fraught with the possibility of threat of information leakages. Thus, in so far as one carries out a research effort to further one’s private gains, one would weigh the potential benefit of gaining new insights vis-à-vis the threat of leakage before inviting cooperation. Such threats, on the other hand, would not deter one from engaging in cooperation when the researcher is *confident* that much of his competitive strength lies in the tacit knowledge that he possesses, and/or when they appreciate that knowledge so developed is open and local in nature, and therefore cannot be imitated perfectly. Also, when one has undertaken the research effort primarily with the purpose of ‘joy of work’ or fulfilment of duty to ‘social commons’, such threats of leakage would be discounted highly, paving the way for cooperation.

Empirical measurement of cooperation is a difficult task. Such a measurement is all the more difficult in a set up where innovations are largely the outcomes of sporadic individual efforts, rather than a systematic team effort, as may be the case in research institutes or business organisations. However, attitude towards cooperation can be proxied by one's willingness to share information and discuss about research problems with others. If a grassroots innovator feels free to share ideas and information about his experiments and remains open to suggestions from others his motivation can largely be regarded as intrinsic. Such openness may reflect confidence the innovator has about inimitability of his ideas¹⁸. Also, such openness may signal a kind of indifference to threat of leakage, especially when somebody's research effort is guided by innate psychological need of enjoyment, or fulfilment of duty.¹⁹

On the other hand, reluctance to engage into discussions with others may be a reflection of lack of confidence or higher preference for secrecy to protect one's idea and nurture prospect for economic gains. Nelson (2001) points out that prospect for higher economic gains in the post Bayh Dole era has had adverse consequences for discussions and informal cooperation among university professors in the USA. Such a tendency can therefore be attributed to existence of extrinsic motivation behind one's innovative efforts.

Regarding the second criterion - source of fund - it is perhaps obvious to assume that individuals will retain more autonomy and control over their experimentation when own funds are used. External funding in R&D has moral hazard problems. Much of the moral hazard problem arises due to uncertainty in R&D outcomes, which makes funding agencies reluctant to fund R&D projects if sufficient information about its validity is not disclosed. In such cases, funding agencies might fund researchers having high reputation. Indeed, Robert K Merton (1968: 62), while discussing about the "Matthew effect in science" argues that "centres of demonstrated scientific excellence are allocated far larger resources for investigation than centres which have yet to make their mark". Young and less known

¹⁸ Indeed, different individuals may see different prospects of one basic idea, leading to variety of innovative outputs (Merges and Nelson 1990)

¹⁹ We find an interesting exception to this hypothesis. One grassroots innovator points out that she shied away from discussing her ideas with others not because of any perceived threat of leakage of knowledge, but because she apprehended some negative reaction against her unorthodox thinking from the community. Ironically, therefore, non-discussion may signal an attempt to retain autonomy, when the possibility of adverse reaction is high, perhaps prompting one to consider such acts as intrinsically motivated. However, in so far as such responses signal a lack of confidence on one's research project they cannot be treated as intrinsically motivated acts.

researches, under such circumstances, may be asked by the funding authorities to align their research objective or design of experiment as per the wishes of the funding agency, leading to reduction in autonomy²⁰. Note that our sample of grassroots innovators consists of such individuals only.

Carrying out experimentation with own funds may also reflect confidence in one's research endeavour. Indeed, external-funds often subsidise risky behaviour. Lack of confidence in the research endeavour may thus make a researcher eager to look for external funding, where he can externalise part of the research costs arising out of uncertainty. However, there is no obvious correlation between lack of confidence and eagerness to ask for external funding. Also, in today's highly capital intensive research, outside funding is often a prerequisite. One may also argue that for a given level of confidence and desire for autonomy, wealthy researchers would have an advantage over poor researchers in funding their innovative efforts through own funds. However, our data set is replete with evidences where individual researchers have continued with their innovative efforts using own funds, even if it led to economic hardships. Thus we argue that when innovations are not much capital intensive, one can describe a research effort as intrinsically motivated if it has been carried out by using own funds, often entailing economic hardships. Research experimentations using outside are categorised as extrinsically motivated.²¹

According to source, we are able to categorise funding into two groups: informally arranged funding, and formal research funding. Informal source of funding includes own funds, funds arranged from family members, or friends. Formal funding, on the other hand, implies funding from banks, or agencies like NIF and TIFAC²². Often such fundings are usually given to projects with high commercial prospects. Interestingly, a main task of such funding agencies (especially NIF) is to assist innovators to acquire intellectual property rights for their research outputs. Also, instances of such funding at the stage of idea generation and experimentation are rare. Mostly funding is made available only after successful completion of an innovation. Thus, funds from these agencies are either given on the basis of commercial prospects of research projects or come with conditionality to protect intellectual property

²⁰ In our dataset we have found two such cases where innovators could not obtain any external funding due to lack of reputation.

²¹ There are instances where people withstood adverse reactions from family members on allocating funds to such innovations, have mortgaged/sold their lands and borrowed money to successfully complete their innovations. See NIF (2001: 26) and NIF (2002:37) for detail.

²² Technology Information Forecasting and Assessment Council, a wing of the Ministry of Science and Technology, Government of India.

rights-both characterising extrinsic forms of control. Research efforts carried out using such funds are characterised as extrinsically motivated acts.

On the other hand, informally arranged funds, though repayable, are neither linked directly with commercial success of any particular project or probability of success nor has any deadline. Social relatedness, rather than any predefined conditionality, binds the lenders and the borrowers in such cases. Repayment is obligatory not to retain creditworthiness, but to retain trustworthiness-a parameter of universal duty of human beings discussed in the earlier section. Therefore, research efforts using informally arranged funding have been treated at par with research efforts using own funds. The research efforts using such funds are categorised as intrinsically motivated acts.

Like in the stage of idea generation, the composite motivation at this stage is categorised as ‘intrinsic’ or ‘extrinsic’ if motivation is found to be either intrinsic or extrinsic, respectively, in terms of both components. The underlying motivation is, once again, ‘mixed’ if it is intrinsic according to one scale (component), while extrinsic according to the other.

Table 3: Components of Motivation - Experimentation Stage

Cooperation/Discussion	Source of funds		Total
	Extrinsic	Intrinsic	
Extrinsic	4	50	54
Intrinsic	8	25	33
Total	12	75	87

Note: ‘E’ refers to extrinsic motivation, and ‘I’ refers to intrinsic motivation

Interestingly, only 4 individuals seem to be motivated by pure extrinsic motivations, down from 10. The number of innovators motivated by intrinsic motivation with respect to both components has also gone down to 25. The motivation of a large number of 58 individuals is mixed in this stage. A careful observation of Table 4 reveals that around 2/3rd of individuals having intrinsic motivation with respect to source of funds are driven by extrinsic motivation with respect to cooperation/discussion. This is largely due to inadequate information on the behaviour with regard to cooperation/discussion. It is not clear from our data set whether non-discussion is a wilful act or reflects unavailability of competent people in the neighbourhood of the researcher. The Cronbach’s alpha coefficient for internal

consistency of these two scales in this stage is rather poor, showing a figure of 0.37 approximately.

Table 4: Composite Motivation - Experimentation Stage

Motivation	Frequency	Percent (%)
Extrinsic	4	4.60
Intrinsic	25	28.74
Mixed	58	66.67
Total	87	100.00

5.3 Motivation at the stage of application:

Index of motivation at this stage is constructed by looking at one's behaviour vis-à-vis appropriation of innovation. As has been mentioned before, two indicators of intrinsic motivations, namely, duty and joy of work can be observed in this stage of innovation. It is widely believed that knowledge has public good properties, and, therefore, cannot be fully appropriated. As a result, the innovator is threatened by the free rider problem once the innovation is disclosed. This free rider problem is supposed to have two possible consequences. First, it may make the innovator reluctant to disclose the innovation. Secondly, over time, it can discourage private investment in R&D and innovation. Both would ultimately reduce the gains from innovation available to the society. Intellectual property rights laws were thus designed so that innovators gain a temporary monopoly rights over their innovation in exchange of disclosure. Such disclosures help the society by enriching its innovation basket as well as by facilitating further research, which may be based on such disclosed data and information. Innovators, on the other hand, gain exclusive rights to commercially exploit their innovations for a limited period to recoup the costs of their research efforts. Historically, intellectual property rights have been justified both on grounds of natural rights as well as economic efficiency (see Machlup 1958). In recent years, however, economic gains in terms of increased incentives for R&D and technology transfer are propagated to be the prime objective behind intellectual property rights protection.²³ Thus, one can safely categorise intellectual property protection as an extrinsic incentive,

²³ The Trade Related Intellectual Property Rights, and the Bayh Dole Act in the USA, which grant intellectual property rights protection to public funded research, both have been constituted on the basis of this argument.

which incentivises private efforts in research and technology transfer by providing temporary monopoly over innovations. In many cases, however, innovators do not even want to share the limited information that a granting of patent would require. Lerner (1995, 2002) provides evidence how innovators often prefer to appropriate the fruit of innovation through various means of business secrecy rather than opting for patent protection. Disclosure is therefore believed to run counter to the logic of private appropriation, and a source of eroding innovator's competitive edge.

We have two indicators of motivation at this stage represented by the two binary scales, namely 'protection' and 'disclosure'. With regard to disclosure, we assume disclosure to be voluntary or devoid of any extrinsic commercial motives if an innovator either shares his innovation with the society without charging any price, disseminate information about the innovation through training or workshops or do not hesitate to put their design in the public domain without patent. The website of the National Innovation Foundation (NIF) is one way of putting designs in the public domain. In our view, such steps demonstrate either their sense of 'duty' for the societal commons, or their indifference to threat of leakage and erosion of competitiveness. The overriding objective behind such innovations may have been self-enjoyment. Thus innovations that are voluntarily disclosed are categorised as intrinsically motivated acts. Similarly, innovations that are not protected (or intended to be protected) through patents are categorised as intrinsically motivated acts. For this indicator, we examine whether a patent application has been filed or granted for the said innovation. If innovations are sought to be protected either through patent, or through other modes of secrecy, the underlying motivation may be termed as extrinsic.

The composite motivation is intrinsic (extrinsic), if motivations in terms of both components (protection and disclosure) are intrinsic (extrinsic), and it is mixed if motivation is intrinsic with respect to one component, but extrinsic with respect to the other.

Table 5: Components of Motivation - Application Stage

Protection	Disclosure			Total
	Extrinsic	Intrinsic	Unknown	
Extrinsic	20	2	0	22
Intrinsic	13	33	19	65
Total	33	35	19	87

Table 6: Composite Motivation - Application Stage

Motivation (EM=0, MEM=2, IM=1)	Frequency	Percent (%)
Extrinsic	20	22.99
Intrinsic	34	39.08
Mixed	14	16.09
Unknown	19	21.84
Total	87	100.00

We take the 2x2 matrix table (Table 6) for ‘protection’ and ‘disclosure’. For 19 innovators data on ‘disclosure’ are not available. Out of 68 innovators 20 are extrinsically motivated with respect to both parameters, and 34 are intrinsically motivated with respect to both parameters. A total of 14 innovators report ‘mixed motivation’. The Cronbach’s alpha for internal consistency records a value of 0.74 (approximately).

Table 7: Stage-wise Motivation Index

Motivation	Idea Generation	Experimentation	Application
Extrinsic	10 (16.12%)	4 (4.6%)	20 (23%)
Intrinsic	34 (54.83%)	25 (29%)	34 (39%)
Mixed	18 (29.03%)	58 (67%)	14 (16%)
Total	62	87	68

6. Conclusion

We made an attempt to understand the motivations of individual innovators working outside the realm of formal organisational set ups like business firms, universities and research organisations. Deviating from the common understanding that prospect for private extrinsic gains is the main motivation behind human innovative efforts, this paper found empirical evidence of a complex interaction of extrinsic and intrinsic motivations guiding local need based innovations in India.

To understand the various motivations to innovate, we first had to construct operational indicators of intrinsic motivations. Drawing upon the literature on effectance

motivation theories, we identified four key indicators of intrinsic motivation, namely, joy of work, confidence, autonomy and duty, and made them operational in the context of innovative behaviour. The fulfilment of duty has been conventionally treated as extrinsic motivation in the literature. But, based on the Indian philosophical thoughts on economy and polity, the paper argues that certain kinds of duties (e.g. dharma) are voluntary obligations, which form an integral part of human cognition. Fulfilment of such duties brings about freedom, enjoyment, and relatedness, and hence promotes intrinsic motivation. The indicators of extrinsic motivations are straightforward, and include rewards, intellectual property rights, prospect of business gain, competitive pressures, deadlines and external conditionalities.

To understand how these various forms of motivations operate during an innovation process, we categorised a typical innovation process in three stages. These are (a) idea generation, (b) experimentation, and (c) application or diffusion.

Table 8: Intrinsic Motivation – Stage-wise Manifestation

	Idea generation	Experimentation	Application
Joy of work	✓	✓	✓
Autonomy	✓	✓	
Confidence	✓	✓	
Duty	✓		✓

Source: own compilation.

In our conceptualisation, ‘joy of work’ manifests itself in all three stages of innovation. Manifestations of indicators like autonomy (or freedom) and confidence are possible in generating new ideas and during experimentations. Duty to social commons is manifested in the stages of idea generation and application of innovation.

Our analysis shows two important things. First, only a fraction of innovative efforts are motivated by pure extrinsic motivations. We find that only about 16%, 5% and 23% innovators are purely extrinsically motivated in the three stages of innovation. On the other hand, around 55%, 29% and 39% innovators are purely intrinsically motivated in the abovementioned three stages of innovation. Motivation of the remaining 29%, 67% and 16% innovators are mixed, implying both intrinsic and extrinsic forms of motivations influence

their innovative efforts. Thus, one may reasonably argue that pure extrinsic motivations have not been the main driving force behind grassroots innovation in India.

On visual observations it appears that intrinsic motivation is most highly rated at the stage of idea generation (55%), whereas extrinsic motivation is highest at the stage of application or diffusion of innovation (23%). This observation is statistically confirmed when we test for equality of means of our aggregate motivation indicators of these two stages after omitting the observations with mixed motivations.²⁴ The mean of aggregate motivation indicator (share of '1' in total observation) at the idea generation stage is found to be higher than the mean of aggregate motivation indicator at the stage of application, the difference being significant at 5% level. Note that these two stages have important implications for uncertainty. Uncertainty of innovation is perhaps the highest at the stage of idea generation and lowest when the innovation is ready, awaiting application. One can, therefore, argue that intrinsic motivations are the most important driver of human behaviour when uncertainty is high. The effectiveness of extrinsic motivations, on the other hand, increases when uncertainty is low. Indeed, 6 individuals, who were intrinsically motivated at the first stage shifted to extrinsic motivations when innovation became ready.²⁵

Our study has important policy implications. The National Innovation Foundation (NIF) in India has taken various initiatives to promote grassroots innovation by providing extrinsic forms of incentives such as monetary support, rewards, and patenting. But, crowding out theory suggests that many such extrinsic forms of incentive may crowd out intrinsic motivation to innovate. Literature on IPR and public health indeed brings out that an innovation system primarily geared towards accumulating private property through IPR leads to distorted allocation of resources on drug discovery research against 'orphan' diseases, having low commercial prospects. In the context of grassroots innovation, such a policy thrust may have serious adverse implications for 'localness' of these innovations, especially if the market for such local innovations is perceived to be low. Many studies also point out that extrinsic incentives crowd out interpersonal cooperation. We have found in our sample that farming communities in Indian villages often do not hesitate to share their innovations with others. A strong extrinsic incentive based policy thrust may also change the forms of such

²⁴ The difference of means is not statistically significant when these observations are merged with extrinsic motivation.

²⁵ In contrast, only one individual shifted motivation from extrinsic to intrinsic between these two stages.

pro-social acts. Further studies need to be undertaken to understand the intricacies better before formulating an effective policy framework.

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