"The Question of Inverse Relation between Farm Size and Productivity: A Revisit".

Mr. Rajeev Kumar,
Assistant Professor,
Department of Economics,
Shri Ram College of Commerce,
University of Delhi.

Abstract

This paper revisits the question of inverse relation between farm size and productivity. The paper examines the inverse relation on the basis of available literature. This analysis shows that the observed inverse relation does not reflect the superior efficiency of the family labor based farms but the class differentiation within the petty family producers themselves and the desperate struggle to get a livelihood from absolutely inadequate fragments of land as the size of holding per capita declines on these family farms.

Keywords: Agriculture, Farm, Productivity, Relation, Peasant, Labour .

The background to this question of superior viability of family labor based farms over capitalist farms is the observation of the studies in the Economics of Farm Management (FMS) in the mid 1950s that smaller holdings had the highest yield per unit of land i.e. the much debated and much theorized inverse relation between farm size and yield. The theoretical explanations (also supplemented by valid and invalid empirical studies) advanced for such an inverse relation fall into mainly three categories:

1. Difference in techniques: the small farms using superior technique.
2. Difference in qualitative aspects of farm endowments i.e. either land or labor in small farm are, without any involvement of human effort, intrinsically of superior quality.
3. The difference in intensity of application of various inputs like labor, bullock power or irrigation.

The three categories are not mutually exclusive. One type of difference may be reflected in other two types of variations. The question of superior efficiency and viability of family labor compared to capitalist farms pertains to the third category of difference, in so far as it questions, in what sense are small farms inefficient in use of resources and what explains unequally efficient input combinations on farms of different size groups. The superiority of family labor is basically a neo-populist proposition, the most synthesized version of which has been given by Chayanov. In India a number of economists while explaining inverse relation show a tendency towards Chayanov's idea.

So before we probe further into the argument let us have a look at what Chayanov has to tell us and at the implicit application of his theory by the neoclassical Indian economists to the inverse relation's implication for Indian agriculture. According to Chayanov, the equilibrium output for a family labor will be where the marginal utility of the extra Ruble (The Russian unit of money measure) earned by employing an extra unit of labor is equal to the drudgery attached to its acquirement. The subjective valuation of the values generated by the marginal unit of labor will depend on the extent of its marginal utility which in turn will depend on the total number of consumers in the family and therefore on the family size.

Thus the degree of self exploitation of family labor i.e. how hard the family members work assuming the labor productivity at local level to be constant as determined primarily by the pressure of consumption demand or more specifically, the consumer- worker ratio in the family. More the number of consumers with respect to number of workers the more is pressure on the workers in the family to provide for the needs of the family. So more is the labor they apply to the farm. Due to their greater intensity of application of labor higher output per acre is generated on the family farms[1] than by capitalist farms. Therefore family farms are more efficient. Capitalist farms cease to apply more labor when marginal product of labour (MP$_L$) is equal to real wage rate. Family labor farms on the other hand can apply more labor in the same situation if their subjective valuation of the earning from additional work so permits.

---

[1] Family farm means a farm normally run by a family without hired outside wage labour.

Chayanov proposes that as family labor can absorb unfavorable price fluctuations, unlike the capitalist farm which would cease to operate in this situation, they are more stable and viable. Chayanov's theory is full of theoretical and statistical fallacies. In his classical model Chayanov says that the family labor farm, with expansion of family size succeeds in increasing the land resource in same proportion as the required increase in labor input to keep at least the previous level of consumption. The implicit assumption here is that land availability poses no problem which is an obvious fallacy and so the optimum level of production by family labor farm resulting thereby is also a fallacy. In his deviate model Chayanov rises to the fact that it is not easy to increase land resource as the family size expands. The increase in land resource relative to family size is not optimal. However he argued that this sub-optimality is a short-lived phenomenon. In the long run there will be optimal distribution of land.

In Chayanov's theory land shortage arises from unequal distribution of population. High population density even in an area with large land resources means that all households will have lower land resource. Land possession differences among the households are not a long term phenomenon. If there is land shortage there is an aggregate land shortage. The difference across households in their land possessions is corrected by growth in family through marriages, children and subsequent divisions of large farms into small ones. Thus this is quite in contradiction to the Marxist land shortage, which arises from unequal distribution in relations of production.

According to Chayanov land shortage results in an intensive self-exploitation of labor. The notion of a reflexive relation in exploitation of labor is peculiar to Chayanov. The degree of self-exploitation depends on consumption demand of the family and therefore on family size and composition. This appears quite obvious and appeals to commonsense. Chayanov uses cross-sectional data to illustrate his point in which he assumes intrinsically that all holdings in the cross sectional sample are family labor farms so that observed variations in days worked per worker and output per worker in the sample are to be explained wholly or mainly by variations in consumer-worker ratio.

Table-1 shows that the alternative proposition is consistent as well. Not only family size but also consumer worker ratio also varies positively with farm size. In Table-1 the output per workday is substantially higher on the holdings with higher consumer worker ratio. This puzzle is solved only if we say that these are large holdings, which have higher consumer/worker ratios, but Chayanov has not given this explanation. So it is the farm size, which should be taken in the statistical sense and analytical sense as the explanatory variable.

Table - 1				
	Consumers per worker			
c/w ratio	1.01-1.20	1.21-1.40	1.41-1.60	1.61- ∞
Worker's Output (Ruble)	131.9	151.5	218.8	283.4
Working Days per worker	98.8	102.3	157.2	161.3
Source: Chayanov				

Chayanov based his theory on subjective utility and disutility evaluations, which is tautological. Chayanov has left the equilibrium level of marginal product of labor indeterminate. In fact he uses this to argue that family labor farm members can accept an average product of labor lower than wage rate and so family labor farms are more viable in comparison to capitalist farms in the face of price fluctuations.

Chayanov's proposition that observed changes in area over time is the result of changes in family size, ignores and rejects the observed phenomenon of class differentiation among the peasantry, which implies that these changes in area distribution are due to interactions based on property relations among these various classes. His framework of a homogenous peasantry treats land shortage as an exceptional situation remedied in the long run. The theory of demographic differentiation denies inequality in resource endowments of cultivators by saying that farm size adjusts to family size.

The superior viability of family labor farm and the illustrative example carries the assumption of an identical production function. This is full of theoretical inconsistencies. Firstly the analysis of the situation of a large price fall leads us to a situation where the peasant family will carry production even when it is starving and it has to borrow for its consumption needs. How viable a holding is when the producers face such extreme economic duress is a point in question. Another fact is that this shows the persistence of family labor farms when there are no economic alternatives because a capitalist farm will cease to operate in a drastic situation. But this is a situation to be deplored, rather than to be taken as an advantage, both from humanistic and economic sense.

In Chayanov's numerical example in this regard, 40Rb and 60Rb are both assumed as consumption as he uses subjective analysis without a determinate idea of consumption. Thus we cannot objectively determine the either economic surplus or deficit. Again the coexistence of family farm and capitalist farm with identical production functions gives rise to logical contradictions. If the family farm is defined as one that produces only to satisfy consumption needs, then it means that there is no surplus generated above consumption needs. If the same output is produced by capitalist farm at the same cost and the family consumption cost replaced by the wage bill for hired labor then there is no profit for the capitalist in the production. However, capitalistic production takes place only for the profit motive. If, however, we say that capitalist farm makes a profit over and above wage and material input cost then it implies that the family labor farm makes an equivalent surplus in which the definition we began with loses its meaning or it will imply, to avoid this contradiction, that the surplus is also spent on consumption giving an above wage level of consumption. If we assume the latter, then it agrees with Chayanov's implicit assumption of an indeterminate, objective, consumption which implies what we observe to be consumed by the family is also what it started as its objective of producing.

It is equivalent to say what one achieved is what one had aimed to achieve which is a historical logical contradiction. Also this implication needs the support of another implicit assumption of Chayanov i.e. wage rate is given by all together different sets of forces and is unconnected with consumption. This implies that all surpluses get absorbed as higher than wages consumption and all deficits are absorbed as lower than wage consumption. There is no idea of saving here. This second assumption carries in it the assumption of an absence of labor hiring market. *So family farms and capitalist farms can coexist in separate economically insulated compartments with no relation through the labor market.* This violates the assumption of competitive market in neo-classical theory. Chayanov uses the neo-classical 'utility maximization' prefects but rejects the perfectly competitive markets as competitive market in land renting implies that capitalist farms cannot coexist with different returns to hired labor and family worker, which is the case when we say surplus accrues to and is used for consumption needs of family labor farms as family labor farm get higher than wage return to their labor (similarly in case of deficit). But in some other works Chayanov refers to labor hiring when the inadequate land resource or fall in price of output forces them to seek wage employment.

A.K. Sen's modern model of family labor farm operates under assumption of competitive markets. But he avoids this contradiction of existence of equilibrium in which family farms and capitalist farms co-exist with identical productions but different returns to labor and differing output per unit area by saying that in reality the markets are imperfect. In reality, peasants are not confined to consumption needs but have to produce a surplus to meet the requirements of rents etc. The consumption level determined as a result of the struggle between surplus appropriating classes and peasants is given for a particular country for a given historical period though it can vary over different historical periods and over different regions.

Again historically there has been close link between wage rate and average product for worker on the poor peasant holdings. Such a situation is likely to give rise, sooner or later, to capitalistic production. In reality capitalistic farms and rent paying commodity production have been found to co-exist, linked through markets. Such coexistence is impossible with identical production functions because high level of pre-capitalist rent (absolute ground rent) usually found to prevail in petty commodity production as in family farms, possesses a barrier to capitalistic production. This is because capitalist will have to produce a surplus which will cover the rent requirement and also the normal profit which it could alternatively earn whereas the poor peasant has only to produce a surplus to cover the rent requirement assuming that both of them rent land. With the same productivity of labor this is possible only if the capitalist adopts technically improved production methods and switch to raised output and surplus per unit land i.e. if he adopts different or higher production function.

Costs cannot be reduced as an alternative to a higher production function because the petty producers are already reducing their consumption costs to maximum extent (semi-starvation, accepting lower level of productivity etc) thus the two basic assumptions, which leads to all other inconsistencies are:

i. Identical production functions with the assumption that family size determines the size of land holdings.
ii. Absence of links through market in labor hiring between capitalist farms and family labor farms.

The first assumption makes it possible to propose that family size determines farm size and the second assumption gives logic to all other inconsistencies coming up from the first assumption. We have seen the fundamental fallacies in the neo-populist theory. In the Indian context this theory has been said to be reflected in the inverse relation between per acre yield and farm size.

A.K. Sen amalgamates this neo-populist notion into a neoclassical framework of peasant exploitation, in which the equilibrium condition for production in family labor farms is given by:

$$f_1/f_2 = Q'(L) = MP_L$$

Where Q'(L) is the marginal product of labor, L shows labor units employed and f_1/f_2 is ratio between work and leisure utilities which Sen calls the real cost of labor, which is subjectively determined by the family labor farm workers. According to Sen, total family output and total income can be expressed as functions of real labor cost i.e.

$$L = N\{Q'(L)\} = N(x)$$

$$Q = \Theta\{Q'(L)\} = \Theta(x)$$

$$x = f_1/f_2 = \text{real cost of labor}$$

He assumes that N and Θ are decreasing functions of x i.e. higher equilibrium real cost of labor goes with lower volume of total family labor and output. Now the real cost of labor is less than market wage rate. So the equilibrium marginal product of labor will be less than market wage rate. This is because (a) the real cost of labor is a subjective evaluation. (b) in reality (Sen argues) there are imperfections in the market. The gap between real cost of labor and market wage rate is called wage gap, which exists due to market imperfections. This gives a probabilty of getting wage paid work < 1. So that the opportunity cost of labor for peasants is not w but it is p.w. Thus the wage gap exists in spite of prevalence of other perfect conditions. As w >x capitalist farm will have lower output per acre than the peasant farms as:

$$\Theta(x) > \Theta(w)$$

$N(x) > \Theta(x)$ i.e. more labor will be applied on family labor farm. So family labor farm will have less output per unit of labor than a capitalist farm. So while a capitalist farm has a higher productivity of labor, the peasant farmers will have a higher productivity of land. Sen argues that family labor farms enjoy a flexibility which the capitalist farms do not have as the capitalist farms are bound by the profit maximizing condition:

$$MP_L = w$$

The lower labor cost on family labor farms (which is subjectively arrived at) denies the FMS findings that whole lot of farms in India are operating at a loss, as Sen argues. Since it has also been observed that amount of labor applied per acre decreases with increases in the size of farms. This is in agreement with the theoretical findings. Since this lower labor cost have an effect on capital used also, so capital used on family labor farms is more per acre as lower price of one factor tend to increase use of its complimentary factor. Thus the family labor farms will be more efficient than capitalist farms.

Again he uses Chayanovian idea of demographic differentiation to sight land fertility as a factor. According to him more fertile land tends to raise family size. The expanding family size in turn leads to fragmentation of land which in turn results in small holdings having more fertile land and therefore more productive and efficient than bigger holdings. But then we see here that we are comparing family labor farms and capitalist farms, not small holdings and large holdings, in face of which the aforesaid conclusions only indicate that all small holdings are family labor farms and all large holdings are capitalist farms, which in Indian context is not true due to the existence of a whole range of economic classes in the peasantry.

According to Sen, FMS finding that Indian agriculture is being run at losses on basis of the inverse relation is because of illogical imputation of market wage rate from farm income. In FMS calculation:

profit of the farm = Farm Business Income – unpaid wages.

Here Farm Business Income = Net Output = Imputed Rent & Interest   as the real labor cost on small farms was less than market wage rate due to prevalence of wage gap. The real labor cost reflect a rate at which peasant family is ready to substitute labor for output but the capitalist farmer is misguided by an inefficient market mechanism. Wage gap may be a reflection of higher social cost of hired labor as opposed to own labor as people may prefer to work for themselves rather than for others. The higher market wage rate, as Sen says, may be interpreted to indicate higher efficiency of wage labor. But according to him this is not valid as the inverse relation shows that productivity per acre is higher for family labor. Now this has two puzzles.

i. Why should we see greater land productivity as being symbol of higher efficiency rather than the greater labor productivity?

ii. If we say the observed relation between yield per acre and size of holding is a relation between yield per acre and modes of production in farms then it amounts to assuming that the modes of production and size of holding are related in a specific direction which in the Indian peasantry is a drastic and bold assumption because it is as heterogeneous as one could please.

Sen's theory is puzzling because it suffers from the same defects as that of the neo populist theory cited by Chayanov, namely the assumption of identical production function even though it operates with the

assumption of competitive markets. The neo–populist theory applied to explain inverse relation is that high yield farms are family farms and low yield farms are capitalist farms so the relation explained in that family labor farms are more efficient and viable. But we have already seen how fallacious the neo-populist theory itself is. Now its application in the Indian context show that the technical components of higher yield has been confused with its analytical explanation as higher yield may be due to higher proportion of net sown area under irrigation, a higher ratio of gross sown area to net sown area and a cropping pattern with high value crops.

The answer given as to why the smallest holdings have more intensive cultivation in neo-populist theory is that in terms of more labor, supporting Chayanov's observation that farms with land shortage in particular would go for labor intensive cropping pattern (high value crops needing more irrigation). This argument is logical but neo-populist theory commits a blunder in relating the variation in yield to family labor and capitalist production, which is based on assumptions of a homogenous peasantry and identical production functions, either of which do not hold in India. The inverse relation is actually observed within the category of family labor holding and arises due to class differentiation within holdings. This class differentiation is with respect to the size of farm holdings and hiring of labor. The family labor based holdings showing inverse relation are owned by peasant families from the absolutely landless laborer class to middle category of peasants.

The alternative explanation to the inverse relation therefore as has been given by U. Patnaik that finds support on a reclassified data of F.M.S. given by R.S. Rao and S. Brahme is as follows: This rich peasants corresponds to the capitalist tendency whereas the smaller holdings ranging from very tiny ones to small scale tillers holdings and larger holdings corresponding to middle peasant status will constitute the family based sector. However none of these is a fully family based sector that is, though degree of hiring out labor varies it prevails over all these classes. These small farms, owing to acute shortage of land, make up for their income by hiring out labor in other people's farms. Thus the degree of hiring out corresponds to size of holdings and determines the class status of the farm. The inverse relation is marked within this sector.

However the rich peasants show very high yields. This is because these have the capitalistic character, use improved cultivation techniques, and raise yields even beyond the highest levels achieved under economic duress by the semi proletarian small holdings. If efficiency rested in the lowering of labor productivity and consumption levels then half starved laborer class with highest yield are certainly the most efficient. But how long such efficiency would last if the whole economy was to keep fasting following the norm of "work more and eat less" for the sake of efficiency? The capitalistic farms have the highest of everything except the number of holdings. The capitalist tendency has received a strong stimulus in 1950's through a boost in agricultural prices and favorable income terms of trade and also subsidization of improved techniques. Clearly small scale farmers can hardly take up the huge investment to adopt these techniques.

Thus this discussion has shown that there can't be a single production function in case of a highly differentiated peasantry as in India owing to a hierarchical sequence of resources. In this situation production function for individual crops from cross sectional sample of holdings can't be estimated correctly. However the acreage level has been widely used to argue on the inverse relation by the most economists. Farm size group is a poor indicator of even the land resource endowments as it leaves out irrigation, cropping pattern, size of family etc. So if one correlates yield with farm size and then relates it to the fact of whether it is family labor based or capitalist it is bound to give fallacious conclusions. Besides farm size grouping fails to take into account the differential degree of present investment of capital on similar physical areas.

Agricultural production of farming households depends not only on the input of labor per unit of area and the associated level of technology. The potential for investment of capital depends on the surplus generated per unit of area. How much and whether surplus is retained by the household for investment depends on its class position which again is determined by the real resource endowment with the household. Thus the question ultimately rest on classification of the peasantry. Bearing on this question we cite here the empirical exercise on identification of peasant classes done by Patnaik. She has given the labor exploitation (E) index to capture the class status of the household.

$$E = X/Y = \{(H_i - H_0) + (L_0 - L_i)\}/ F$$

Where, H_i = Labor days hired on the operational holdings of the household.

    H_0 = Family labor days hired out to others.

    L_i = Labor days worked on leased in land (whether family or by hired labor)

    L_o = Labor days worked on land leased out by households.

    F = Labor days worked by household workers on the operational holding

    E is thus a pure number, a ratio.

On basis of a real classification in six mutually exclusive and all exhaustive classes of the peasant household have been given in Patnaik (1999). This index was applied to farm economics data relating to Haryana, India along with other conventional grouping methods. This empirical exercise shows that there is considerable class differentiation within the cultivating peasantry class.

The observed yield per acre is actually the yield per acre weighted by the area in each acreage group. So if within family labor based holdings there is an inverse relation this is likely to show up in a moderate farm when weighted averages are taken as long as the yield difference is not very large between two types of holdings, even if hired labor are free to a great extent of such an inverse relation. If however the hired labor based holdings raise their yields at a faster rate by investing more, over time then the relation of farm size and yield will show as a direct one, as the proportion of hired labor farms is larger in the larger acreage groups, which, during the period of conduction of this exercise, was already showing in some parts of Punjab.

Now for this discussion we can expect the labor hiring holding to retain surplus above the family's consumption needs out of net output whereas poor and small peasants would tenaciously meet their subsistence requirements. Actually this has been brought out by the empirical exercise by comparing income and imputed value family labor on one hand and poverty levels on the other. This comparison will tell us if the return to labor of family workers is equal to wage rate. The two concepts of income used in this regard are farm labor income and farm disposable income because the farm labor income includes the surplus claims of rent, interest etc. in cost of production. So it is disposable farm income which can better reflect whether family labor farm's workers are better off than their counterparts in labor hiring farms. Farm labor income per household per peasant is less than that of the rich peasants. Poor peasants supplement their low farm incomes through wage-paid work.

When the poor and small peasant households can't reach even the poverty line how can they be expected to undertake investment to adopt new technology to expand production and thereby be more efficient and viable? Rather labor hiring and rent appropriating classes, by their exploitative position and surplus appropriation are in a strong position to invest in expanding the scale of production.

This shows that the observed inverse relation does not reflect the superior efficiency of the family labor based farms but the class differentiation within the petty family producers themselves and the desperate struggle to get a livelihood from absolutely inadequate fragments of land as the size of holding per capita declines on these family farms. Efficiency can never stand upon the pillars of starvation and economic duress. The only viable path to greater efficiency is a combination of improved technology, quantitatively and qualitatively superior capital but over and above this the welfare of the masses of small peasants and laborers who form the base of agricultural economy.

Bibliography

Benjamin, D. (1995): *'Can Unobserved Land Quality Explain the Inverse Productivity Relationship?'* Journal of Development Economics, 46 (1): 51–84

Bhalla, S.S, Roy, P. (1988): *'Misspecification in Farm Productivity Analysis: The Role of Land Quality'*, Oxford Economic Papers, 40(1):55–73.

Carter, M. (1984): *'Identification of the Inverse Relationship between Farm Size and Productivity: an Empirical Analysis of Peasant Agricultural Production'* Oxford Economic Papers 36 (1): 131–45.

Chadha, G.K. (1978): *'Farm Size and Productivity Revisited: Some Notes from Recent Experience of Punjab'*, Economic and Political Weekly, pp. A87-A96

Chayanov, A.V. (1926): *'The Theory of Peasant Economy'*, ed. Thorner Kerblay and Smith

Dorward, A. (1999): '*Farm Size and Productivity in Malawian Smallholder Agriculture*' Journal of Development Studies 35 (5): 141–61

Lipton, M. (2006): *'Can Small Farmers Survive, Prosper, or be the Key Channel to Cut Mass Poverty?'* Electronic Journal of Agricultural and Development Economics 3(1): 58-85.

Mazumdar, D. (1965): *'Size of Farm and Productivity: A Problem of Indian Peasant Agriculture'* Economica 32 (126): 161–73.

Patnaik, U. (1999): *'Economics of Farm size and Farm scale Some Assumptions Re-examined'* in 'The Long Transition', Manohar Publishers, Delhi

Patnaik, U. (1999): *'Ascertaining the economic characteristics of Peasant classes in themselves in India- A methodological and empirical Exercise'* in 'The Long Transition' Manohar Publishers, Delhi

Schultz, T.W. (1964): *'Transforming Traditional Agriculture'*, New Haven, CT: Yale University Press.

Sen, A. K. (1966): *'Peasants and Dualism with and without Surplus Labor'*, Journal of Political Economy, Vol.-74

Taslim, M.A., (1989): *'Supervision Problems and the Size-Productivity Relation in Bangladesh Agriculture'* Oxford Bulletin of Economics and Statistics 51 (1): 55–71.