

Marginal Productivity Theory : What Does it Explain – Distribution or Employment?

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Abstract

Marginal productivity theory occupies a prime and significant place in the section on distribution in almost all microeconomics textbooks, explaining the determination of factor prices. In fact, historically and logically, it stands as the tallest theory in this group. This paper tried to examine the validity of marginal productivity theory as the theory of distribution. After a series of logical arguments advanced herein, I came to a conclusion that marginal productivity theory explains employment at the micro as well as macro levels, but fails to provide a satisfactory answer to the question of factor pricing.

Keywords : theory of distribution, marginal productivity, factor prices, perfect competition

JEL Classification : A20, D00, D33

Paper Submission Date : January 11, 2016 ; **Paper sent back for Revision :** July 6 , 2016 ; **Paper Acceptance Date :** July 28, 2016

Universal scarcity of resources has led to the emergence of three fundamental economic problems, namely, (a) what to produce and how much?, (b) how to produce?, (c) for whom to produce? Of these three, the final question deals with the problem of distribution of national income among four factors of production (namely land, labor, capital, and enterprise) in the form of rent, wage, interest, and profit. It seeks to find answer to the question – how are factor prices determined? (i.e. how is rent, wage, interest, and profit determined?) Broadly speaking, there are two answers to this question as they have evolved in economic literature over many centuries, namely,

- (i) A general answer in the form of marginal productivity theory of distribution (giving the general principle or basic framework of factor price determination) and ,
- (ii) Specific answers in form of different theories related to rent, wage, interest, and profit.

This paper attempts to analyze the validity of marginal productivity theory in explaining factor price determination. The paper takes up for discussion the statement of the theory, its explanation, and proof. Then it goes on to examine the treatment of this theory at the hands of popular microeconomics textbook authors. Finally, on this basis, I arrive at certain inferences and conclusions.

Statement of the Theory and its Explanation

Marginal productivity theory (MPT) of distribution states that in equilibrium, factor price will always equal marginal revenue productivity (MRP) of the concerned factor. That is,

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- (i) rent = MRP of land,
 - (ii) wage = MRP of labor,
 - (iii) interest = MRP of capital.
- (profit is not being discussed for the reason that has been discussed later herein)

In other words, in equilibrium, factor price cannot be less than or more than the MRP of the factor under discussion.

Clarity of the following four concepts is essential to understand the proof of the theory :

- (i) Physical productivity : It refers to the total units of a commodity that the factor units help to produce.
- (ii) Marginal physical productivity (MPP) : It refers to the change in total output due to the employment of an additional unit of a particular factor. Symbolically,

$$MPP = \Delta Q \div \Delta F$$

where, Q is output, F is factor, and Δ refers to change.

- (iii) Value of marginal physical productivity (VMPP) : It is MPP expressed in money terms. It is obtained by employing the following formula :

$$VMPP = MPP \times P$$

where, P refers to the price of the product produced by the factor.

- (iv) Marginal revenue productivity (MRP) : It is change in total revenue (TR) of the firm due to the employment of an additional unit of a factor, symbolically expressed as :

$$MRP = \Delta TR \div \Delta F$$

OR

$$MRP = MPP \times MR$$

It should be noted that since in perfect competition, P equals marginal revenue (MR) so $VMPP = MRP$ but in imperfect markets, since P is greater than MR , $VMPP > MRP$.

Proof of the Theory

For the purpose of maximizing profits, a firm will compare marginal cost (MC) of factor with MRP of that factor. Rational behavior implies that a firm will employ that many units of a factor which equalizes MC of factor with its MRP.

The proof that follows assumes the existence of a perfectly competitive market framework and it has been advanced in the context of labor, that is, wage determination (the logic of this proof can be extended to explain rent determination and interest rate determination. However, profit determination cannot be explained by this theory as entrepreneur is a fixed factor from the view point of a firm, and hence, it is not possible to measure its marginal productivity.).

(i) First Dimension of the Proof (Macro Level) : Suppose the MRP of labor has been found out to be ₹ 40 and wage rate has been fixed at ₹ 30. Since the wage rate is less than the MRP of labor, it is profitable for the firm to employ more number of laborers. Demand for labor will increase. Given the fixed supply in the short run, competition among firms to employ more labor will push up the wage rate to ₹ 40. At this point, wage rate will equal the MRP of labor and firm would maximize profits.

On the other hand, if the MRP of labor is found out to be ₹ 40, and if the wage rate has been fixed at ₹ 50, then it would be profitable for the firm to employ less number of laborers. This will induce firms to reduce the number of laborers employed with them. As laborers are removed from their jobs, unemployment in the economy would increase. Competition among the unemployed labor to get job would lower the wage rate to ₹ 40 where once again, wage will equal MRP of labor and the firms maximize profit.

(ii) Second Dimension of the Proof (Micro/Firm Level) : Another way of proving the theory is to assume that wage is given and due to the change in the number of labor units, MRP of labor changes and the firm tries to equate the new MRP with the given wage. Two situations can be thought of.

First, let us start from the position where MRP of labor was ₹ 40 and the wage that was being paid too was ₹ 40. Now, if labor employment is increased, for whatever reasons, MRP of labor will start decreasing (as law of variable proportions comes into force) and the firm will profit only if it decreased its wage to the new MRP. Secondly, let us start from the position where MRP of labor was ₹ 40 and the wage that was being paid too was ₹ 40. Now, if labor employment is decreased, for whatever reasons, MRP of labor will start increasing (as law of variable proportions, in reverse, comes into force) and the firm will have to increase its wage to the new MRP.

Observations

In the above given proof, we had to assume that the wage is given and then we compared the given wage with the existing MRP of labor. The adjustment by the firm to equate the given wage rate with the existing MRP of labor was in terms of number of labor. Here lies the paradox. The theory should have explained wage determination. But without assuming the given wage, it would not have been possible to advance the proof.

I surveyed many major books to find out the status of MPT of distribution. The following is the summary of conclusions from each of these books :

(i) Boyes and Melvin (2005) : Resources will be employed up to the point at which MRP of factor equals marginal factor cost.

(ii) Sloman (2002) : MPT is a theory that the demand for a factor depends on its MRP. A firm will try to equate MC of labour with MRP of labour.

(iii) Schumpeter (1967) : According to Schumpeter, J. B. Clark's marginal productivity theory of distribution is a guiding principle for determining *fair* wages.

(iv) Frank and Bernanke (2007) : No specific mention of MPT of distribution, but only stated that the firm will hire labor till it equates wage rate with VMP of labor.

(v) Begg, Fischer, and Dornbusch (1994) : The firm's employment rule is that expand (contract) employment if the marginal value product of labor is greater than (less than) the wage of an extra labor.

(vi) Mandler (1999) : MPT, as pioneered by J. B. Clark, Wicksteed, Wicksell and others, provides an original and powerful explanation of the factor demands of both individual firms and the economy as a whole. It quickly established itself as the leading neoclassical theory of factor demand.

(vii) Sundharam and Vaish (1997) : The MPT concludes that in equilibrium, each factor of production will receive reward in accordance with its marginal productivity. An employer will employ a particular factor unit up to that unit for which the remuneration paid is equal to the contribution made by that unit to total production.

(viii) Samuelson and Nordhaus (2010) : In competitive markets, the demand for inputs is determined by the marginal productivity of factors. In the simplified case where factors are paid in terms of the single output, we get wage rate equal to marginal productivity of labor. Marginal productivity theory of income distribution analyzes the way total national income gets distributed among the different factors. A firm maximizes profit (minimizes costs) when it sets MRP of each factor equal to that factor's marginal cost, which is the factor's price.

(ix) Parkin (2000) : Two conditions for a firm to maximize profit are MR should equal MC and MRP of labor should equal wage rate. If MRP of labor is greater than wage rate, the firm will employ more labor, and if MRP of labor is less than wage rate, the firm will do away with some laborers.

(x) Colander (2001) : MRP of labor is one of the most important factors in determining wage rate by a firm. If MRP of labor is greater than the wage rate, then the number of laborers hired will increase, and if the MRP of labor is less than the wage rate, then the number of laborers hired will decrease. The author discusses cost minimization condition when many factors are considered together. This condition states that the ratio of marginal productivity to the price of each input should be equal for all inputs, that is, $MP_L / w = MP_K / r$ where L is labor, K is capital, w is wage rate, and r is interest rate.

(xi) Dorfman (2008) : *The New Palgrave Dictionary of Economics* states that MPT explains only the amount of each factor that an enterprise will employ at different rates of payment for its services and in the presence of given quantities of the other factors used. As such, it explains only the demand side of the factors.

(xii) Kennedy (1999) : Quoted Prof. Mark Blaug, “the MPT contends that in equilibrium, each productive agent will be rewarded in accordance with its Marginal Productivity”. She further stated that the logic of MPT can be extended to inter-factor substitutions. The employer tries to achieve the least cost combination of factors. The employer attains equilibrium when marginal productivities of factors in proportion to their prices become equal, that is,

$$MP \text{ of factor A} \div \text{price of factor A} = MP \text{ of factor B} \div \text{price of factor B}$$

(xiii) Ahuja (2006) : Stated that the essence of this theory is that the price of a factor of production depends upon its marginal productivity. An individual firm or industry will go on hiring more and more labor units as long as the addition made to the total product by a marginal labor unit is greater than the wage rate it has to pay for it. The employer will reach equilibrium position when the wage rate becomes equal to marginal productivity of labor. At the micro level, MPT is a theory of employment. At the macro level, he has advanced the proof (which has been taken up earlier in this paper) showing that wage rate will equal MP of labor.

Inferences

I have come to the following conclusions from the above analysis:

(i) Marginal productivity theory of distribution is not, strictly speaking, a theory of distribution. As seen, this theory cannot explain why factor price should always be equal to marginal revenue productivity of the factor in question. It takes as given, the variable (the factor price), whose determination has to be explained by this theory. Even otherwise, it is beyond the comprehension of the one as to how to prove that factor price should always equal the MRP of a particular factor.

(ii) At equilibrium, factors are paid their marginal products because, by definition, equilibrium is the equality of demand and supply and, by derivation from the theory of the production, the demand curve is a marginal product schedule. There is thus no 'one-way' causality between factor payments and marginal products. At best, as Robertson (1931) suggested, factor payments are the measure of marginal products in equilibrium and consequently, the marginal productivity theory can be regarded as a mere technical characterization of that equilibrium. This amounts to no more than a tautological exercise of defining equilibrium in respect of factor payments. Continuing in the same vein, Cassel (1918) warned that marginal productivity itself is not an objectively ascertained factor in the pricing problem, but is in fact one of the unknowns in the problem. A factor's marginal productivity, then, cannot be defined as anything other than its price, for this price represents precisely the contribution of the labor in question to the price of the product. The statement that wages are determined by the marginal productivity of labor thus loses all independent meaning.

(iii) In one sense, MPT can definitely be regarded as a theory of factor demand. This has strongly been asserted by Alfred Marshall who in fact criticized MPT as a theory of distribution, blaming it of considering only one side of the theory – the demand side and neglecting the other. Modern economists have established the importance of both demand and supply side of factor in understanding the process of its price determination.

(iv) One cannot refute the fact that marginal revenue productivity (translated as efficiency in management language) is definitely one of the most important factors affecting factor price. But it would be an exaggeration to state that it is the only factor determining factor prices. As a limiting case, it can be said that MPT is only a guiding principle to the problem of distribution/factor price determination. In the sense that firms would definitely consider marginal productivity of the factor while deciding about the price to be paid to it.

(v) At the micro level, it is a theory of employment. As explained by most of the authors, firms would equate the given wage rate with MRP of factor and decide whether to increase the factor units or decrease it.

(vi) At the macro level, it is not a theory of distribution. Specific theories more satisfactorily explain distribution of national income among factors. There is a doubt whether it satisfies the criteria of a theory of distribution at the aggregate level. Then, as seen, one of the authors, Ahuja (2006), convincingly drives home the point that it is a theory of employment. He has advanced a logical proof in this context. But the validity of this deductive proof has never been tested in context of the working economy, neither it would be possible to do so.

(vii) Therefore, this theory does not deserve a prime place in the microeconomics section of distribution. It should just be explained by the teachers in the passing as a principle guiding the firms to determine the number of factor units to be employed.

(viii) An objective theory is one that is arguable, which can be exposed to rational criticism, preferably a theory which can be tested; not one which merely appeals to our subjective intuitions. One way of looking at the MPT of distribution is that it has a moral tinge when we put it flat that wage rate should equal MRP of labor. In this sense, it fails to qualify as an objective theory. To moral philosophers of the sort of Adam Smith, it might be highly valuable and things should have happened like this, but whether it really happens is something of immediate concern to me. Under constant returns to scale, the marginal product will be equal to the average product and so, in that case, the payment to a factor will indeed be equal to his contribution and thus, Clarkian 'moral justice' is achieved. But if there are no constant returns operating, then this would be considered unjust.

(ix) According to Karl Popper, the scientific status of a theory is its falsifiability / refutability / testability

(Shuttleworth, 2008). The most common argument made for this is the basic premise of rational behavior on which the mainstream economics is based, and the realm to which this theory too belongs. Along with the assumption of rationality, this theory in particular houses many other restrictive assumptions (like homogeneity of factor units, absence of institutional factors in the process of factor price determination, flexibility in the use of factor combinations, etc.) which almost makes it impossible to test its validity. So, it is a very beautiful exercise in logical abstraction, but fails the primary test of being a theory as per the Popperian's widely accepted criterion.

Research Implications

I have come to two important research implications based on this study :

Practically, one should understand the nitty-gritty of the MPT before using it for some policy (for example, in wage based performance systems in public sector and private sector companies) based on it.

Academically, while teaching this theory to graduate and postgraduate students of economics, a lot of emphasis needs to be given to its critical evaluation which can help the student community to grasp, in the real sense of the term, the training to think analytically and critically, which is hallmark of the faculty of economics.

Conclusion

Through the survey of several popular textbooks in microeconomics, I come to a strong conclusion that marginal productivity theory explains employment at micro as well as macro levels, but fails to provide a satisfactory answer to the question of factor pricing. Without doubt, marginal productivity is one of the important factors in the process of factor price determination. But to treat that as a lone and significant factor in explaining the process amounts to overstating its logical validity. Surprisingly, the MPT is taught across universities and many programmes as a factor price determining theory. This anomaly needs to be corrected. MPT is just a guiding principle at the limit for a firm with regards to the employment of specific number of units of a factor. Teachers should introduce this theory only as one explaining marginal productivity as one of the important factors in determining factor prices. Instead, more attention needs to be paid to specific theories of factor price determination.

Limitations of the Study and Scope for Further Research

Despite all the efforts made by me to study all important historical sources regarding the critical evaluation of the MPT and to arrive at sound and logical conclusions, it is quite possible that in this daunting task, some elements may have been missed out. This forms the theme of further research in this area. Also, researchers can dig far deeper into the critical evaluation of this theory and devise a more sophisticated method of measuring marginal productivity of factors considering the recent changes in computer technology and advances in statistical methods.

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