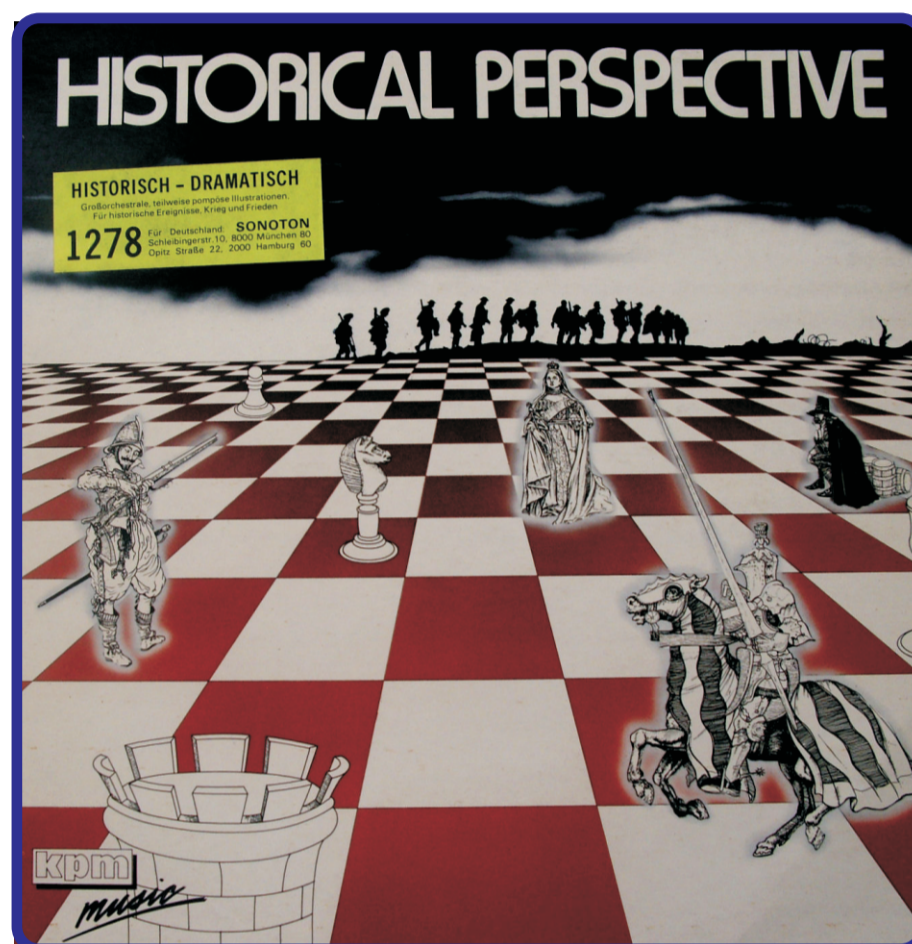


REVISITING THE CAPITAL CONTROVERSY: A HISTORICAL PERSPECTIVE



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Abstract:

This paper reviews the history of Capital Controversy. The issue of capital measurement has been debated ever since the beginning of systematic economic analysis. The paper starts first with the discussion on the related ideas of classical economists like Marshall and Ricardo. After which the ideas of Joan Robinson, considered to be the whistle blower of the debate, are highlighted. Finally, the views of some other key participants in the debate such as Sraffa, Solow, Jevons, Stiglitz, Garegnani, Swan and VaunNeuman are discussed.

KEYWORDS:

Capital controversy, History, Neoclassical measurement, Circularity.

INTRODUCTION

Capital theory has been perhaps the most controversial and intellectually challenging area of investigation in the subject of economics. Much of the interest in the theory of capital lies in the fact that it holds the key to the explanation of profits. Since the notion of capital is at the centre of inquiry about laws of production and distribution in a capitalist economy, controversies in the theory of capital are reflected in virtually all other parts of economic analysis.

The so-called “Cambridge controversy” in this regard was triggered off by a seminal paper by Robinson. This is essentially a debate among economists concerning the nature and role of capital (see Robinson, 1953-54; Sraffa, 1960). The foremost problems addressed in this debate are: (i) measurement of capital in models with heterogeneous capital goods; and (ii) phenomenon of “reswitching of technique”, which means that the same technique of production can be profitable at more than one rate of profit.

HISTORY OF THE CONTROVERSY

The capital controversy has a long historical genesis starting from Adam Smith--a classical economist known as the father of economics--to the brilliant theoretical contribution of Sraffa. As such, the historical perspective of the problems related to the theory of capital is discussed first. Then, the major problems and controversies involved mainly between Cambridge England (represented by Robinson and Sraffa as mentioned above) and Cambridge Massachusetts (represented, for example, by Samuelson, 1987) is discussed. Finally, various models given by many economists to solve these problems are reviewed.

The classical economists' approach to the theory of capital was generally on the basis of Surplus Approach. Profits were explained in terms of surplus product left after making the allowance for requirements of production (see Hunt and Lautzenheiser, 2011). The rate of profit was determined by ratio between social surplus and social capital. They also addressed the problem of theory of value. Ricardo, for instance, encountered the problem of measuring capital in his attempt to explain the profit rate. The classicals conceived the normal rate of profit as the ratio of social surplus to the capital utilized in production. But both of them consist of heterogeneous goods and means of production. A way to proceed could be to use long period prices of production. But the difficulty is that prices of production depend on rate of profit. Ricardo suggested that exchange value of commodities should be related to quantities of labor directly or indirectly used in producing them (Hunt and Lautzenheiser, 2011).

Marx took the theory of Ricardo forward. He said that explanation of profits in terms of surplus approach would be trapped in circular reasoning if value expression of either surplus or capital were to depend on rate of profit. His “labor theory of value” says that measurement of both aggregates in terms of labor values (which themselves are considered to be independent of distribution) will provide non-circular determination of rate of profit. Marx said that labor values can be converted into prices. In labor accounting, exploitation was taken into account and in price accounting, rate of profit is taken into account. In each industry, material cost and exploitation cost constitute the price. For Marx, prices of production could be calculated only after rate of profit had been determined (see Sweezy, 1942).

NEOCLASSICAL METHOD OF MEASURING CAPITAL

Neoclassical economists (see Samuelson, 1962) tried to formulate an alternative theory for the normal rate of profit. As opposed to the classical case where wages were determined prior to profits and rent, neoclassical economists tried to explain all kinds of incomes simultaneously. They were well aware of the fact that in order to be consistent with the concept of a long period equilibrium, the set of given physical amount of produced means of production cannot be conceived as capital equipment of the economy. In the classical theory, capital was not taken as a means of production. Thus the formidable problem for neoclassical economists in attempting to explain the rate of profit was to find the quantity of capital which could be expressed independently of price of service meaning the rate of profit.

Marshall emphasized on a unique stable quantity of capital in the economy. He used demand and supply approach such that there is a given supply of capital and a monotonically decreasing demand function for capital in terms of rate of profit. Neoclassical economists arrived at this demand function because of substitutability of capital for labor in both production and consumption. This means that a rise in rate of profit will increase the price of commodities which are relatively capital intensive and this would

prompt consumers to shift their demand in favour of labor intensive techniques. Moreover cost minimizing entrepreneurs will employ more of labor and thereby reduce the demand for capital. Thus we get a downward sloping demand curve. At the intersection of the demand and supply curves, we get an equilibrium rate of profit. Neoclassicals support the argument of perfect substitutability of capital and labour which later on was criticized by many economists.

Jevons was the first economist to use time as a single measure of capital. According to him,

$$Y=f(T)$$

Where Y is the output per unit of labor. This shows that output is a function of time for which capital is invested:

$$r=f'(T)/f(T)$$

According to Solow, labor supply is allocated in such a way that is equal to the marginal productivity of labor and it is the same in all vintages and output is maximized. In this neoclassical model, there is full employment in short run. Solow says that there is only one viable "best practice" technique at a time and there are no ex-post substitution possibilities for it. Solow used this embodiment hypothesis to discuss the process of "deepening" in a world of non-malleable capital goods (Solow, 1963). This analytical process shows two results: (i) neoclassical method and results can be used; and (ii) short run production functions (with factor substitution limited/nil) are good estimates of long run production functions.

But Bliss (see Hunt and Lautzenheiser, 2011) has argued that there may not be a unique technique under profit maximizing conditions. And Robinson and Sraffa (representatives of Cambridge England) were not satisfied with the neoclassical version of aggregate production and distribution.

DIFFERENT THEORIES OF CAPITAL CONTROVERSY

Robinson's Contribution

She mainly criticized the neoclassicals on their method of measurement of capital. According to the neoclassical school of thought,

$$Y=f(K, L)$$

Where Y=output, K=capital, and L= labour used

Robinson argues that capital used is heterogeneous collection of physical goods, so that it is not correct to add up heterogeneous objects. One more important point that she raises is that labour is measured in man-hours but which prices of capital should be used--book value, present discounted value, or market value? (Robinson, 1953-54). Using different values of capital will give different rates of profit; so, the most important questions is: which prices of capital should be considered?

Her main complaint is that in the aggregate production function, stock of labour and capital and knowledge of how they can be substituted for one another is taken as given. But this ignores forces that determine the growth of capital and how technical progress affects growth, accumulation and income shares.

Robinson further says that there should be a unit in which capital can be measured independent of relative prices and distribution and it should follow the marginal rule so that it can be inserted in the production function. She differentiated between capital to be valued in long run and short run. In the short run, supply of capital goods cannot be changed so that production function can be taken as a function of labor alone. But in the long run when accumulation of capital can be done, this is wrong line of thought. In the long run, we can either measure capital in terms of future earning power or in terms of its past cost (Robinson, 1953-54). To express capital in terms of future earning power, given the future expected rate of output of any capital good along with prices and cost, if the rate of profit "r" is known, we can value the capital good as discounted stream of future profits, but the problem is that the rate of interest needs to be given. And to calculate capital in terms of cost of production, we need to know the purchasing power of money.

Thus to solve the problem of measurement of capital, she proposes to measure capital in terms of labour time required to produce that capital.

$$K = wL(1+r)^t = O - WL/r$$

Where K = capital, w = wage rate, L = labour required to produce unit of equipment 't' years ago, r = rate of profit, O = output of commodities

Here we are able to calculate capital in terms of labour employed. But in the real world labour alone cannot do all the work, and so we can say that labour is never expended in pure form. All kinds of work is done with some kind of assistance from other goods. The cost of capital includes the cost of capital goods and these capital goods must be constructed before they are used. So part of cost of capital is interest over the period of time between the moments when the work was done and the equipment was constructed. To calculate the value of capital, we need to know the wages and rate of profit beforehand. So the problem of circularity still exists. One more problem associated with this is that marginal productivity rule will not apply in this case. And one more criticism of this approach by Champernowne is that "Same physical capital may have different values depending on different levels of wages and profits" (see Pasinetti, 1966). She points to the isocost and indifference curves used by the neoclassical economists in the marginal productivity rule. To find the slope of isocost curve we use the relative prices of labour and capital but this means we are already taking the value of capital into account.

Another important question is about the composition of capital. Here the role of capital accumulation is vital. The process of accumulation consists in refraining from current consumption in order to add to the stock of wealth. We have to consider how much work has been done to construct the capital equipment. For this we have to use labour units, but as the wage rate alters with the ratio of factors, one symbol "K" cannot stand for quantity of product and quality of labour time.

Sraffa's Contribution

Sraffa's major criticism is that amount of capital is partly determined by the rate of profit whereas neoclassical economists say that rate of profit is determined by the amount of capital. The argument is that capital is value of produced means of production. But the value depends on price and quantity of capital. The price of capital in turn is determined by the cost of production and rate of profit. So this means that change in rate of profit will change the value of capital showing that there is absence of standard value of capital.

This dependence of value of capital on rate of profit can also be shown by the relationship of rate of profit and wages. When "r" changes, this will also change the wages "w". Changes in "r" and "w" will lead to change in distribution of income and thus change in demand for capital goods and their price. This means that value of capital will change (Sraffa, 1960). This argument basically shows the problem of circularity in measurement of capital.

Sraffa proposed that there should be an invariable measure of value (created out of the available goods) which he calls as the Standard Commodity. According to him, there is no single good that can be used as an ideal commodity because each commodity is made up of various means of production with different K/L ratios and thus change in rate of profit will affect their prices differently. The price of ideal commodity should be invariant to changes in rate of profit. Thus the ideal commodity needs to have all the means of production with the same K/L ratio so that its price remains invariant to changes in rate of profit. According to Sraffa, the standard commodity will consist of only basic goods (goods which are used directly or indirectly in production of all other commodities of the system). The standard commodity will be such that the ratio of output to input is uniform throughout the backward linkages (Sraffa, 1960).

Sraffa also discusses reswitching of techniques which shows that a particular technique of production may be profitable at more than one rate of profit. This result is important as it shows that choice of technique is not generally a monotonic function of the rate of profit. He also says that this will lead to complicated pattern of price changes with various ups and downs. This is a critique of the perfect substitutability rule laid down by the neoclassical economists (Sraffa, 1960).

Since change in r changes the price of a commodity, the amount of change in price of the commodity depends on the amount of labour and capital used in production of the commodity. When r increases, price of capital intensive goods rises relative to the labour intensive good. It is because payment to capital increases and wages decrease when rate of profit increases. K-intensive technique uses more of capital, thus its cost increases whereas prices of L-intensive goods decrease due to decrease in wages (Sraffa, 1960).

Let us suppose that there are 2 commodities A and B. It is observed that when "r" rises then the price differential (pa-pb) initially increased and then it decreased, after certain range it again increased and then finally became 0. Since initially pa increased more than pb, this means A is more capital intensive as

compared to B. Afterwards when the price differential decreased, this means A is more labour intensive than B and so on. Here there is no change in method of production, there is a monotonic increase in rate of profit and there is a non-monotonic response of relative prices. This shows that only period of production cannot be used as an independent measure of quantity of capital. Capital cannot be measured independently of prices. Suppose that a commodity can be produced using 2 alternative techniques of production. Cost minimizing capitalist will use the technique with minimum cost of production, so initially the first technique may be better, then the 2nd one and once again the first technique may be better. This is in contrast to an inverse relationship of demand for capital with rate of profit.

In neoclassical theory it is shown that supply curve of capital is upward sloping. But it is not clear whether value of capital increases and that is mapped as supply of capital or more of actual capital is coming in due to increase in "r"

Stiglitz's Contribution

This economist pointed to yet another cause of controversy, viz., the determination of savings and investment. According to neoclassicals, saving is a constant fraction of income whereas economists from Cambridge UK argued that saving depends on role of institutions and corporations in determining saving and whether the person is a worker or capitalist (Stiglitz, 1974).

Neoclassicals support the marginal productivity rule. According to them reward to the capital i.e. rate of profit is equal to the marginal productivity of capital. But according to Pasinetti who was an economist from Cambridge UK,

$$r = g/s_p$$

where g = growth rate and s_p = saving propensity of the capitalist class.

Cambridge (UK) economists said that rate of profit is determined by the rate of growth and saving propensity of capitalists.

Garegnani's Contribution

Garegnani (1970) criticized Walras' model of General Equilibrium. According to him, this model requires value of capital to be given exogenously. He derived a complete model to show that to solve the general equilibrium model and calculate prices, value of capital endowments have to be taken as given and constant. But when we take value of capital as given, we need to know prices. Thus he calls the general equilibrium model as incomplete and says that there is a problem of circularity in the model.

SOLOW'S RESPONSE TO ROBINSON

As mentioned earlier, Robinson has criticized neoclassical economists for aggregating heterogeneous capital in the production function. In response to this, Solow argues that labour is also heterogeneous, and so how is that used in production function? Most important aspect is that what part of theory holds true in general cases. For many purposes, it is remarkably useful to assume that there exists only one physical commodity which can either be consumed or used as capital in the production of more of itself. Then output and capital are measured in the same unit except that output is a flow variable and capital is a stock variable (Solow, 1963 and 1957).

He discussed certain conditions under which heterogeneous capital can be aggregated in the production function.

$$Q = f(L, K_1, K_2) = h(L, K)$$

$$K = g(K_1, K_2)$$

It will be possible only when K is an index of the quantity of capital. To check this, calculate the marginal rate of substitution of C_1 for C_2 , i.e. the ratio of their marginal physical productivities.

$MPP_1/MPP_2 = dF/dC_1 \cdot dC_2/dF$ which should be independent of L . The last ratio depends only on C_1 and C_2 . This shows that K can be used as an index of capital if this marginal rate of substitution of one kind of capital good for another must be independent of amount of labour in use.

SOME MORE CRITICISMS OF NEOCLASSICAL THINKING

A criticism concerns malleable capital which refers to physical capital being instantaneously and costlessly transferred into another form. But some economists have argued to the contrary that it is not possible, i.e. perfect substitution is not possible.

Another criticism concerns the embodiment hypothesis which refers to improvements in design or quality of capital goods or intermediate goods. Neoclassicals supported this embodiment hypothesis. Disembodied refers to shift in the production function over time. Disembodied technical change is not incorporated in a specific factor of production. Later on economists argued over the validity of the embodiment hypothesis of neoclassical economists.

Yet another criticism concerns vintage capital. An economy is said to have vintage capital structure if machines and equipment belonging to separate generations have different productivities or face different depreciation schedules. Vintage capital models have different long run properties and short run dynamics for neoclassical models. Productivity gap between new and old vintage capital can increase and then old ones need not be operative forever. This contradicts the neoclassical economists.

MODELS TO SOLVE THE PROBLEM OF CIRCULARITY

We review here two models proposed to solve the problem of circularity.

Swan Growth Model

This model is based on the assumptions of CRS (constant returns to scale), full employment, perfect competition, and marginal productivity rule. According to this model, capital consists of meccano sets which can be costlessly and timelessly transferred into any other form to cooperate with labour in response to changes in factor prices. This means K/L changes with accumulation over time. But the relative prices of products do not change no matter how wages and profits do. Thus aggregation of heterogeneous units of capital is possible in terms of their technical units and it can be included in the production function also (Swan, 1956).

Vaun Neuman Model

This economist used the price system of Sraffa and transformed it to the output system so as to equalize the rate of surplus in each industry. Level of operation will be modified in a way such that its surplus (total output-its requirement) which will be used in generating profit will be invested again and there will be growth.

Here we equalize the new demand divided by the replacement demand which is actually the rate of growth in all the industries.

F_i/A_i is constant in all the industries then there is uniform balanced rate of growth of economy, and there will be no situation of underproduction or overproduction in the economy. Commodities in excess supply will face decrease in price because of which their surplus decreases and hence their supply decreases. Similarly, commodities having low supply will face increasing prices and there will be increase in profits. With this there will be uniform rate of growth and rate of profit in the economy and thus there will be no bottlenecks and no surplus.

This is a general equilibrium model but it does not require value of capital to be given from outside. Rate of profit is determined without knowing the prices and rate of growth is determined without knowing the output, and thus the problem of circularity is resolved.

CONCLUSION

In this paper, capital controversy has been revisited with special attention to its historical genesis. As discussed above, although both the subgroups, i.e. Cambridge England and Cambridge Massachusetts, agreed that reswitching undermines the marginal theory, one fought for revival of classical political economy theory while the other emphasized the meaning of capital and advocated an analysis in historical time. Many find this debate to be purely ideological and not economic; some find it political as well. Whatever happens to the controversy, there is no doubt that this is one of the most challenging problems for future economists as well. It would be best to conclude with Bliss's views on the relevance of the debate today (see Hunt and Lautzenheiser, 2011):

“Mainstream theorizing has taken different directions. Interest has shifted from general

equilibrium style (high-dimension) models to simple, mainly one-good models. (...) Could the old concerns about capital be taken out, dusted down and addressed to contemporary models? If that could be done, one would hope that its contribution could be more constructive than the mutually assured destruction approach that marred some of the 1960s debates."

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