LABOUR'S DECLINING INCOME SHARE

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Abstract

This paper analyses unequal income distribution by extending the neo-classical theory of functional distribution. By amending its restrictive assumptions, while expanding the theory of production beyond perfect competition, it appears that the value of the elasticity of substitution of the factors of production is important in explaining the relation between technical progress and income distribution. Non-neutral technological progress reduces the relative price of capital goods and cheaper capital is easily substituted for labour as the capital intensity and capital's income share increases. The expanding capital escapes diminishing returns owing to capital-using technology and labour's income share follows a declining trend. Policy proposals are aimed at correcting adverse developments in the labour market that encourage unequal income distribution through factor substitution.

Income inequality has been the subject of investigations in economics over a long period with the first systematic exposition, probably, by Ricardo. In recent times interest in the subject has gained momentum as is for, instance, evident from the survey by Atkinson, Piketty and Saez (2011) and the two symposia papers published in the *Journal of Economic Perspectives,* Vols. 27 and 29 in 2013 and 2015 respectively. The recent book by Piketty (2014) that was originally published in French definitely elevated the interest in this subject by stimulating popular public debate on distribution topics. The publications referred to particularly emphasised the world-wide phenomenon of unequal income distribution that has worsened since the 1980s. There is no single satisfactory explanation of this complicated topic. Moreover, the fact that the labour share of income is depicting a long-term declining pattern has sometimes encouraged emotionally and politically laden debates.

Unequal income distribution is an important phenomenon in South Africa and the topic has been extensively researched in terms of regional and racial distribution patterns as well as the effects of the segmented labour market on income distribution. South Africa shares the global pattern of rising income inequality with specific reference to functional income distribution as has recently been described by Burger (2015) and Bruggemans (2015).

This paper concentrates on functional income distribution and accommodates the principle of marginal productivity despite Joan Robinson's (1972) critical observation that its explanation of the real wage rate suffers from circular reasoning. It appears that, although we know what comprises the wage bill, the identification of its components is controversial. A closer look at these various elements of the debate can be helpful in gaining a better understanding of functional income distribution. The purpose of the paper is to demonstrate the limitations of neo-classical analysis in verifying functional income distribution and to present an alternative analytical framework that accommodates the stylised facts.

The neo-classical framework

Factor shares in total output have, conventionally, been explained in terms of production functions within the neo-classical theory of production where behaviour rules have been developed within the framework of the representative firm. The deficiencies of this theoretical framework will be discussed below. Moreover, alternative variables are to be introduced that appear to be successful in explaining the stylised facts.

The neo-classical analysis is based on perfect competition and flexible relative prices that drive market adjustment processes to secure equilibrium solutions to market participants over the long term. The exposition concentrates on real variables without money. In the long term technological progress changes the data. This is achieved through different types of technical progress that could favour a particular factor of production or it could affect the factors of production simultaneously without factor bias. The factors of production are remunerated according to their marginal productivity. The latter is positive but subject to diminishing returns. Markets clear continuously and full employment prevails. The rate of substitution between the factors is described by the elasticity of substitution (σ). As a general rule $\sigma > 0$ and in growth economics it is common practice to consider $\sigma = 1$. If substitution possibilities are absent we have $\sigma = 0$.

Elements of the theory of production

We consider a production function in its general form as, for instance, in Allan (1967) i.e.

(1) $y = f(k, \ell); \ k, \ell > 0.$

Here y denotes the homogeneous "one product" output in real terms. Further, k and ℓ are real units of capital and labour inputs. Technological progress will be denoted by A so that we have neutral technical progress defined by (2). Biased technical progress will be considered later on.

(2) $y = Af(k, \ell) = Ay; \ A > 0.$

The remuneration of the factors of production can be determined through a change in total output owing to increased inputs of the factors of production, thus

(3) $dy = f_k \, dk + f_\ell \, d\ell; \ f_k, f_\ell > 0$

where f_k and f_ℓ denote the marginal products of capital and labour respectively. We recall that the marginal products are positive but subject to diminishing returns, i.e., the second derivative is negative. If we describe the information in (3) in percentage change notation we obtain

(4) $dy/y = f_k \, (k/y) \, dk/k + f_\ell \, (\ell/y)d\ell/\ell.$

The relative shares of the factors are indicated as the total shares k/y and ℓ/y weighted by the respective marginal products, namely

$f_k \, (k/y)$ and $f_\ell \, (\ell/y).$

We can express (4) in terms of the productivity of the factors of production. We indicate y/k and y/ℓ as the units of output produced by one unit of capital and labour respectively. We define

$$\beta = y/k \quad and \quad \delta = y/\ell$$

and obtain

(5) $dy/y = f_k \, (1/\beta) \, dk/k + f_\ell \, (1/\delta) \, d\ell/\ell.$

Within a neo-classical framework of perfect competition where $f_k + f_\ell = 1$, one can derive several secular patterns in factor shares as predicted by the symmetrical distribution pattern. Presently it is in vogue to emphasise one outcome, namely the long-term falling share of labour with a rising δ and falling f_ℓ.

Under these conditions it follows from the neo-classical assumptions that labour's share follows a sustained decline because of the symmetric distribution pattern. Moreover, this condition could be valid within a neo-classical growth model where the elasticity of substitution of the factors of production satisfies the condition that $\sigma = 1$, where σ is the elasticity of substitution of labour for capital, defined as follows:

(6) $\sigma = k/\ell \, d(\ell/k) \, / \, (f_\ell/f_k) \, d(f_k/f_\ell)$

Defining $u = \ell/k$ and $R = \partial y/\partial k \, / \, \partial y/\partial \ell$ we obtain

$$\sigma = du/u \, / \, dR/R; \quad with \, \sigma = 1 => du/u = dR/R$$

An application of this exposition to the real world is subject to important limitations, as will be discussed below.

Important limitations

The assumption of perfect competition supports the outcome of a symmetric income distribution in the sense that

$$f_\ell = 1 - f_k.$$

This simplifies the exposition but introduces analytical constraints. New developments in international economics that emphasise the importance of firms have been critical of this condition in explaining international trade patterns.

The assumption of neutral technological progress appears to be contradicted by factor saving technological progress, particularly labour-saving technologies as has been evident during recent years.

Owing to the assumption of full employment this framework is not very helpful under conditions of high unemployment, particularly in respect of the high levels of unemployment in South Africa. It is misleading to consider $\delta = y/\ell$ as a measure of labour productivity since its rising value that is presently evident, merely reflects rising unemployment. Indeed the analysis does not distinguish between the unemployment effect and productivity advances. The conclusion by the ILO (2014) as well as Burger (2015) regarding the rising labour productivity versus labour's income share appears to be highly controversial.

The neo-classical analysis overlooks the significance of conditions where $\sigma \neq 1$. Once we allow for different values of σ, as suggested by Brown (1966) and Allan (1967), it would appear that non-neutral technological progress features prominently in explaining secular trends in income distribution. For $\sigma = 1$ implies that the proportionate change in the marginal products matches the proportionate change in the factor proportions. The outcome is a relatively stable pattern in the relative shares of the factors of production. As we have indicated above, this neo-classical analysis excludes money. It is a so-called "money-less" world. The application of this analytical framework to derive conclusions regarding the role of financialisation on the likely development of capital's rate of return by the ILO and Burger (2015) appears to be contradicting the feasibility of the analysis.

The elasticity of substitution

The distribution debate can be extended towards new horizons by suspending certain constraints. Critical elements are perfect competition, neutral technological progress and the elasticity of substitution between the factors of production. We follow Brown (1966) and consider a CES production function:

(7) $y = \gamma[\kappa k^{-\alpha} + (1 - \kappa)\ell^{\alpha}]^{\upsilon/\alpha}$; $k,\ell > 0$ with $-\alpha = (1-1/\sigma)$.

The parameter γ is a scale indicator denoting the efficiency of technology; κ denotes the capital intensity of technology and υ is the degree of homogeneity or the magnitude of returns to scale. As above, σ is the elasticity of substitution of labour for capital and it can take on different values as opposed to the Leontief function where $\sigma = 0$ or the Cobb-Douglas function where $\sigma = 1$. Thus we have the expression

   $\sigma = 1/1+\alpha$.

Expression (7) satisfies the condition of positive marginal products that are subject to diminishing returns. As opposed to conventional neo-classical functions that approach a limit when one factor increases while the other is constant, it has been shown by Brown (1966) that (7) has no limit when $\sigma > 1$. When $\sigma < 1$ expression (7) does approach a limit when one factor increases while the other remains constant. This implies that for a rising σ the technology enables the expanding factor to be substituted relatively easily for the constant factor. Conversely, if σ *falls*, the technology constrains substitution of the expanding for the constant factor and although one factor increases, the growth is constrained by the technology scarce, yet constant, factor.

Non-neutral technological progress can be expressed in terms of changes in the marginal rate of substitution of labour for capital

   $R = \partial y/\partial k \,/\, \partial y/\partial \ell$

If R falls $\Rightarrow \partial y/\partial \ell > \partial y/\partial k$ and we have labour-saving technological change. Non-neutral technological changes are associated with changes in the capital intensity parameter κ or with σ. Thus $\partial R/\partial \kappa$ and $\partial R/\partial \sigma$ are important and we concentrate on $\partial R/\partial \sigma$ for which the following holds

   $\partial R/\partial \sigma < 0$ if $u > 1$

   $\partial R/\partial \sigma > 0$ if $u < 1$.

The significance of σ

The importance of *σ* in terms of these expressions is that a rise in *σ*, owing to technological progress, implies that the technology will be capital using (labour saving) when *R* increases. A rise in *σ* will facilitate a substitution of capital for labour, for each labour-capital ratio. For *σ > 1* it appears that the factors of production are easier substituted for each other than when *σ < 1*.

This exposition implies that the factor shares cannot be expressed in terms of a constant ratio. With labour expanding *(ℓ > k)* and *σ* rising (owing to technological expansion) *∂y/∂ℓ* rises relative to *∂y/∂k* and *R* falls. If capital is rising more rapidly *(k > ℓ)* a rise in *σ* will have *∂y/∂k* rising versus *∂y/∂ℓ* and *R* rises. Technology that goes with a rising R permits a larger amount of capital in production for every reduction in labour.

Closely related to the research on the behaviour of the elasticity of substitution is the recent emphasis in the literature on a new stylised fact, namely, the relative decline in the price of investment goods (or capital) that started gaining momentum since 1980. This declining pattern in the relative price of capital has been signalled by Gilchrist and Zakrajsek (2007), Fisher (2006) as well as Eichengreen (2015). This phenomenon is significant in explaining capital-using technical progress.

Karabarbounis and Neiman (2014) research the price pattern of capital goods and the value of σ in 59 countries. They confirmed the secular decline in labour's income share as well as a declining trend in the relative price of capital goods in a large majority of the countries and industries in their sample. It appears that efficiency gains in capital-producing sectors encourage a substitution of capital for labour on such a scale that labour's share in income declines. This confirms the close relation between factor shares, the rate of return on capital and the elasticity of substitution between capital and labour. Labour's share appears to decline more rapidly in countries or industries with a more pronounced decline in the relative price of investment goods. The lower price of investment goods is primarily achieved via the application of new technologies in computer and information technologies. Cheaper investment goods (or capital) encourage firms to substitute capital for labour under conditions of a rising value for *σ*. Capital is substituted for labour, yet the technological progress prevents capital from suffering diminishing returns. Rognlie (2015) criticised the relatively high value of *σ* suggested by this research. Our exposition is not dependent on the specific value of σ since we are concerned with a changing rather than a static *σ*.

Policy implications

Our exposition departed from the typical neo-classical analysis and accommodates the new evidence on the price of capital goods while allowing technical progress in terms of two important parameters. Technological progress, in this exposition, is essentially non-neutral and closely linked to factor substitution. From a policy point of view our exposition appears to be in support of Goldin and Katz (2008). They explained inequality in terms of the race between education and technology. Although their study focused on the US it would appear that similar tendencies are evident in other countries as well. The authors demonstrated the close relation between technological change, education and inequality. During the first half of the twentieth century education in the US expanded more rapidly than technology. Higher real incomes were associated with less inequality. During the second half of that century

technological progress exceeded advances in education, particularly through a slowdown in education and income growth started following an unequal distribution pattern. Technological developments created a strong demand for highly skilled people while education appeared to be lacking in supply. Skills started commanding a premium and highly educated and talented people gained as the income distribution pattern became more unequal. This process probably became more distorted as some individuals were in a position to earn so-called superstar incomes as, for instance, the Superstar CEOs in the critical analysis by Malmendier and Tate (2009).

The advantage of the Goldin and Katz approach is that it is independent of rent-seeking arguments that are often convincing in terms of claims but difficult to analyse systematically. Moreover, the Goldin and Katz intellectual framework can be extended to study distribution problems in an open economy.

Corrective measures should be aimed at the labour market. Measures that would render a more flexible labour market, allowing outsiders to participate, appear to be the appropriate measures to address unequal income distribution. Investment in human capital through training and education appear to be more relevant policy proposals to compensate for declining rates of return on labour. The stylised facts confirm that capital has become relatively cheap and biased technological progress is capital-using. The Policy challenge is to encourage diminishing returns in respect of capital-using technology while encouraging changes in the elasticity of substitution and capital intensity. Investment in quality people will reinstate the supply of skills and it will exert downward pressure on the skills premium while encouraging diminishing returns on capital-using technologies.

Conclusion

We have demonstrated how the conventional explanation of the falling share of labour in total income is based on restrictive assumptions suggested by neo-classical theory. Moreover, these assumptions support a deficient theory of production. By amending some of these restrictive assumptions, while expanding our understanding of the theory of production it appears that the value of the elasticity of substitution features prominently in explaining factor shares that do not adhere to the neo-classical distribution in terms of fixed ratios. These results show that non-neutral technological progress is reducing the relative price of capital goods whereby capital is substituted for labour and k/ℓ rises. In fact k/ℓ rises because capital has become relatively cheap. A rising elasticity of substitution and the induced technological progress prevent diminishing returns to capital while labour's share in income falls.

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