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ON THE AUTOMATION OF PRODUCTION

Some, even leftists, believe that the automation of production will in the long term have as a consequence the continuous reduction and eventually the elimination of the living labour employed and therefore of the number of wage-earners subject to capital, i.e. of the proletariat,¹ as well as of surplus value and profit and that we shall thus pass not in a violently and abruptly revolutionary way but gradually and peacefully into the realm of socialism and communism. This is precisely what Adam Schaff advocates in his recently published paper «Was gibt uns heute der Marxismus» (= What does Marxism give us today?).²

But what is automation of production? Before we can answer this question, we must first describe the system of production of the economy, certain production processes of which can be automated. So, we shall consider an economy³ with three production processes, processes 1, 2 and 3.⁴ Process 1 produces the quantity X_1 of commodity 1, process 2 the quantity X_2 of commodity 2 and process 3 the quantity X_3 of commodity 3. For the production of one unit of commodity 1, an average of l_1 units of living labour are used in production process 1. For the production of one unit of commodity 2, an average of l_2 units of living labour are used in production process 2. And lastly, for the production of one unit of commodity 3, an average of l_3 units of living labour are used in production process 3. Thus, production process 1 uses l_1X_1 units of living labour for the production of X_1 units of commodity 1 which it produces, production process 2 uses l_2X_2 units of living labour for the production of X_2 units of commodity 2 which it produces and, lastly, production process 3 uses l_3X_3 units of labour power for the production of X_3 units of commodity 3 which it produces. Therefore the three production processes together, i.e. the economy in its entirety, use the total quantity of living labour L ,

$$L=l_1X_1+l_2X_2+l_3X_3.$$

The total employment of the economy is consequently equal to L . Each of the three production processes uses, to produce what it produces, apart from living labour also certain quantities of commodities 1, 2 and 3 and at all events certain quantities of commodities as machines, energy, raw materials, etc., part of which is fully consumed. We refer to this latter as used up means of production.

So, each of the three – in total – production processes of the economy uses not only living labour, but also (uses and) consumes means of

production, i.e. produced commodities. We assume, that there is at least one commodity, which directly or indirectly enters the production of all the commodities, including its own production. Commodities, which directly or indirectly enter the production of all the commodities, including their own production, are known as basic commodities. Thus, at least one of the three commodities 1, 2 and 3 is a basic commodity.⁵

Assuming that there is only one basic commodity and that it is commodity 3. Commodity 3 directly or indirectly enters into the production of all three commodities, while commodities 1 and 2 do not enter, either directly or indirectly, into the production of all three commodities.

Assuming, as has indeed been the case up to now, that none of the quantities of living labour l_1 , l_2 and l_3 , which are necessary on average for the production of one unit of commodity 1, of commodity 2 and of commodity 3 respectively, are zero quantities, but are all positive: $l_1 > 0, l_2 > 0$ and $l_3 > 0$.

The quantities of commodities X_1 , X_2 and X_3 , which the three production processes together produce, i.e. which the economy produces, constitute the gross product of the economy. Assuming that the used up means of production of all three production processes together, i.e. of the economy overall, consist of M_1 units of commodity 1 and M_2 units of commodity 2 and M_3 units of commodity 3, where M_1 and M_2 may be positive or zero magnitudes, while M_3 is, because commodity 3 is by assumption the only basic commodity, always a positive magnitude.

Consequently the net product of the economy consists of $(X_1 - M_1)$ units of commodity 1 and $(X_2 - M_2)$ units of commodity 2 and $(X_3 - M_3)$ units of commodity 3. We assume that the economy is viable, i.e. that it produces a net product which contains at least one of the produced commodities in a positive quantity and none in negative quantity.⁶

For the purpose of simplifying matters we assume, that $(X_1 - M_1) > 0$, $(X_2 - M_2) > 0$ and $(X_3 - M_3) > 0$, i.e. that the net product of the economy consists of positive quantities of all three produced commodities.

The net product is distributed to workers and capitalists. Workers get from the net product of the economy their real wages, which consist of D_1 units of commodity 1 and D_2 units of commodity 2 and D_3 units of commodity 3, and the capitalists get real profits, i.e. the surplus product, which consists of U_1 units of commodity 1 and U_2 units of commodity 2 and U_3 units of commodity 3, where

$$D_1 + U_1 = X_1 - M_1,$$

$$D_2 + U_2 = X_2 - M_2$$

and

$$D_3 + U_3 = X_3 - M_3.$$

At least one of the magnitudes D_1 , D_2 and D_3 is positive, while the others may be equal to zero. The same also holds for the magnitudes U_1 , U_2 and U_3 .

Thus, the material recompense, which workers get for one hour of labour power which they sell to the capitalists, i.e. the real wage rate, is D_1/L units of commodity 1 and D_2/L units of commodity 2 and D_3/L units of commodity 3.

The material recompense, which they get for L hours of labour power which they sell in total to capitalists, is the aforementioned real wages D_1 and D_2 and D_3 .

For the labour value V of total wages, i.e. for the labour value of total labour power L , we get

$$V = \omega_1 D_1 + \omega_2 D_2 + \omega_3 D_3,$$

where ω_1 , ω_2 and ω_3 is the labour value of one unit of commodity 1, the labour value of one unit of commodity 2 and the labour value of one unit of commodity 3 respectively.

Thus, for the labour value v of the real wage rate, i.e. for the labour value of one unit of labour power, we get

$$v = \omega_1(D_1/L) + \omega_2(D_2/L) + \omega_3(D_3/L) = V/L.$$

For the surplus value S , i.e. for the labour value of the surplus product, we get

$$S = \omega_1 U_1 + \omega_2 U_2 + \omega_3 U_3.$$

According to the above is

$$S + V = L,$$

where L represents not only the total labour power but also the labour value of the net product of the economy.

For the total wages in money W , the total profits in money K and net product Π reckoned in price terms, we get respectively

$$W = \rho_1 D_1 + \rho_2 D_2 + \rho_3 D_3,$$

$$K = \rho_1 U_1 + \rho_2 U_2 + \rho_3 U_3$$

and

$$\Pi = W + K,$$

where ρ_1 , ρ_2 and ρ_3 are the prices of the three commodities.

For the price w of the real wage rate, i.e. for the wage rate in money, we get

$$w = W/L.$$

Thus the workers, working a total of L hours and producing the net product of the economy, work V hours for themselves producing the real wages which they themselves receive and S hours for the capitalists producing the surplus product which the capitalists receive.

Now we can answer the question «what do we mean by automation of production?» We have automation of a production process when that production process does not use any living labour.

Assuming therefore that there are automated production processes. This automation of production processes is however subject to a limitation. It apparently cannot extend to all production processes. For, if it extended to all production processes, then for the production of the total gross product of the economy we would not require any labour, in which case this latter would not be a produced product but a kind of manna from heaven – and this is impossible and inconceivable. Consequently, automation may extend to some and not all production processes of the economy.

It cannot extend to certain production processes. Which are these latter production processes? In the end it is one and one only: the at least one production process which produces at least one basic commodity of the economy. This production process can never be automated. For, if it were automated, then the labour value of the commodity which it produces, i.e. the living and non-living labour necessary for the production of that commodity, would be equal to zero and the said commodity would not be a produced commodity, but a kind of manna from heaven – something which is impossible and inconceivable.

Assuming therefore that all the production processes with the exception of that one, which produces the only basic commodity, are automated. Thus, in our model, production processes 1 and 2 are automated, i.e. all the production processes with the exception of production process 3, which produces the only basic commodity.

What happens now with the total employed quantity of living labour, i.e. with employment L ? Is it reduced, as maintained by Schaff?

Employment L was before⁷ automation $L^{(\pi)}$,

$$L^{(\pi)} = \ell_1^{(\pi)} X_1^{(\pi)} + \ell_2^{(\pi)} X_2^{(\pi)} + \ell_3^{(\pi)} X_3^{(\pi)}$$

where $\ell_1^{(\pi)} > 0$, $\ell_2^{(\pi)} > 0$ and $\ell_3^{(\pi)} > 0$, and it became after automation of production processes 1 and 2, i.e. after the reducing to zero of ℓ_1 and ℓ_2 , $L^{(\mu)}$,⁸

$$L^{(\mu)} = \ell_1^{(\mu)} X_1^{(\mu)} + \ell_2^{(\mu)} X_2^{(\mu)} + \ell_3^{(\mu)} X_3^{(\mu)}$$

And, because $\ell_1^{(\mu)} = 0$, $\ell_2^{(\mu)} = 0$ and $\ell_3^{(\mu)} > 0$, it is

$$L^{(\mu)} = 0 \cdot X_1^{(\mu)} + 0 \cdot X_2^{(\mu)} + \ell_3^{(\mu)} X_3^{(\mu)} = \ell_3^{(\mu)} X_3^{(\mu)}.$$

Was employment after automation reduced, did it remain steady or did it increase? This apparently depends on the course of demand, i.e. on the course of the net product in demand and produced and on the increase of the average physical productivity of labour which is a consequence of automation.

One thing is certain: automation increases the average material productivity of labour, i.e. it reduces the quantity of living labour L , which is necessary for the production of a given net product, which consists of (X_1-M_1) units of commodity 1, (X_2-M_2) units of commodity 2 and (X_3-M_3) units of commodity 3.

The net product in demand and produced however continuously increases. Thus, when the net product increases as a percentage which is less than, the same as or more than the average physical productivity of labour, then the employed quantity of living labour decreases, remains unchanged or increases respectively.

One could therefore maintain that employment depends on both automation, i.e. on the increase in the productivity of labour which is a consequence of automation, as well as on the course of demand. But for a number of reasons this is not the case. For the increase of productivity of labour which is a consequence of automation, i.e. the reducing to zero of l_1 or of l_2 or of l_1 and l_2 , does not differ in the slightest from the increase in productivity which is a consequence of any other technological progress, which technological progress reduces l_1 , l_2 and l_3 without, as in the case of automation, reducing to zero l_1 or l_2 or l_1 and l_2 .

In view of this, one could maintain that employment depends not only on the increase of productivity of labour (irrespective of its causes, normal technological progress or automation) but also on the course of demand. But this is not correct. For, while demand does not depend on the increase of productivity and consequently neither on normal technological progress nor on automation, the increase of productivity and therefore both normal technological progress and automation, depends on demand. In order for capitalists for the purpose of increasing their profits to satisfy demand, which increases more rapidly than the available labour power of the economy, they develop and use non-automated or automated production processes, which increase the productivity of labour.

It emerges from the above that the automation of production in itself does not reduce employment and consequently nor the proletariat. Employment depends chiefly on demand. And, no matter how strange it may sound, also on the demand for commodities, which are produced in automated production processes. If, for example, in our model, after the automation of production processes 1 and 2 demand increases for commodities 1 and 2, which are produced by the automated production processes 1 and 2, then, even though these processes, having been automated, do not use living labour, the aggregate employed quantity of living labour is increased. The reason for this increase in the aggregate employed quantity of living labour is the following: In order for the automated production processes 1 and 2 to satisfy the increased demand for commodities 1 and 2 which they produce, certain additional quantities are needed of commodity 3 as a means of production,

which they seek and get from production process 3. Production process 3 is not however, for the reasons set out above, automated. Consequently, in order for it to produce these additional quantities of commodity 3 which it produces, it must use additional quantities of living labour. Thus, the increase in demand, even for the commodities which are produced in automated production processes, increases aggregate employed living labour. X_1

Thus, in our example, when there is an increase in the quantities $X_1^{(\mu)}$ and $X_2^{(\mu)}$ of commodities 1 and 2 in demand and produced, the production processes of which are already automated and for which $\ell_1^{(\mu)} = 0$ and $\ell_2^{(\mu)} = 0$ consequently holds, there is also an increase in the quantity $X_3^{(\mu)}$ of commodity 3 in demand and produced, the production process of which is not automated and for which $\ell_3^{(\mu)} > 0$ consequently holds, with the result – c.p. – that aggregate employment $L^{(\mu)}$, $L^{(\mu)} = \ell_3^{(\mu)} X_3^{(\mu)}$ increases.

What remains to be seen is whether automation, while reducing employment, i.e. employed aggregate living labour, reduces surplus value. Wage earners subject to capital work, working L hours, V hours for the production of commodities, which they receive as recompense for the sale of L hours of labour power to the capitalists, and S hours for the production of the surplus product, which they produce for the capitalists. That is they perform, working L hours, V hours of «necessary labour» and S hours of «surplus labour» (Marx). How living labour L is shared between «necessary labour» and «surplus labour» depends on the correlation of forces between workers and capitalists, i.e. on the class struggle.

However, we know that the automation of production increases the average physical productivity of labour. Therefore it entails the possibility – for given L – of a reduction of V and an equivalent increase of S. This possibility is a given, when the real wage rate remains steady or increases, but at a percentage rate which is less than that of productivity of labour.

Thus, in the end, the distribution of the produced new value (= of the labour value of the net product) L to value V of labour power L and to surplus value S, which is produced by the expending of this labour power L, depends not only on the increase of productivity of labour which is a consequence of automation (or some other technological progress) but also on the class struggle. But the increase of productivity of labour as a consequence of automation does not in itself reduce the surplus value S, which is produced by the quantity of living labour L, but on the contrary it entails the possibility of – even for an increased real wage rate – an increase in the surplus value S, which is produced by a given quantity of living labour L.

The conclusion of the above analysis is the following: Anyone who invests his hopes for a human, communist society in the automation of production (or in some other form of technological progress) will be

disappointed, not because there can be no automation of production, but because, although it can exist, automation (as all technological progress) does not in itself entail either the reduction of employment and of the proletariat or a reduction of surplus value.

NOTER

- 1) This is how Marx defines in principle the proletariat.
- 2) Adam Schaff, «Was gibt uns heute der Marxismus», *Zeitschrift für Marxistische Erneuerung*, Nr. 25, März 1996, pp. 97-109.
- 3) For the sake of simplification we do not take into consideration state economic activities and the economic relations between this economy and other economies. Also for reasons of simplification, we assume that aggregate employed living labour belongs to the category of wage labour. That is, we leave outside our reckoning not only non-wage labour (the self-employed, etc.) but also wage labour which does not fall under this category (the labour of domestic help, etc.).
- 4) For the sake of simplification we assume that there are only three and not n , $n > 1$, production processes.
- 5) It is impossible for there to be no basic commodity. For, if there were no basic commodity, the economy would split into at least two completely independent segments, i.e. at least two completely independent segments, each of which is supplied absolutely nothing from the other and which therefore would not constitute an economy based on the social division of labour.
- 6) We regard an economy as being viable when it is capable of reproducing itself at a given level in each of the subsequent periods. A 'closed' economy, such as the one given here, i.e. an economy which has no relations with other economies, is clearly not viable, if its net product contains even one commodity in negative quantity. For this latter would mean that such an economy lacks, in order to be able to produce the gross product which we assumed that it produces, exactly as many means of production as the negative quantities of commodities which are contained in its net product. An exception is the case in which the aforesaid 'closed' economy has stocks of those commodities, which are contained in negative quantities in its net product. But even in this case, the said economy would be rendered non-viable as soon as even one of those stocks runs out.
- 7) The only basic commodity in our economy is commodity 3. Assuming ω_3 to be its labour value. For ω_3 by definition $\omega_3 = l_3 + \omega_3 + \alpha_{33}$, $\alpha_{33} < 1$ holds, where, because commodity 3 is the only basic commodity, α_{33} is necessarily the quantity of used up means of production comprised of commodity 3 necessary for the production of one unit of commodity 3. Thus, when $l_3 = 0$, then clearly $\omega_3 = 0$.
- 8) The superscript indices ' (π) ' and ' (μ) ' denote magnitudes before and after automation respectively.