The rule of robots in Stiglitz and Marx

It is always instructive to speak to Joe Stiglitz. In a conversation in Paris which we had after his talk at the INET conference, he pointed out that the elasticity of substitution between capital and labor greater than 1 (which is often assumed by Piketty in his "Capital in the 21st century"), combined with technological progress which does not fall like manna from heaven but develops in response to the existing factor prices, would lead to an explosive process that would end only with capital owning the entire net income of a country. How?

Suppose that we have a given r (you can imagine that it is 5% as is often mentioned by Piketty) and a given wage (w). Suppose also that at this ratio of factor prices, it is profitable to invest in more capital-intensive processes (that is, they reduce unit cost of output). So capitalists will replace labor by capital and K/L and K/output ratios will both increase. Since elasticity of substitution between K and L is greater than 1, r will only slightly decrease while wage will only slightly increase. Although factor prices, being sticky, will not have budged much they would have moved ever slightly further in making capital intensive processes even more attractive. So there would be another round of increased capital investment, and again K/L and K/output will go up with only minimal effects on prices.

This will continue round after round until the entire output is produced practically only by using capital and perhaps just an infinitesimal quantity of labor. Both r and w will remain almost as they were at the beginning, but instead of (say) 100 machines and 100 workers, we will, at the end, have 100 robots and 1 worker. Almost all output will belong to the owners of capital. Piketty's alpha will be close to 1.

This is why, in my interpretation, Stiglitz argues that the elasticity of substitution greater than 1 combined with endogenous technical progress leads ultimately to an explosive equilibrium. Now, this interpretation is, to repeat, mine and it is quite possible that Stiglitz might not agree or that I got something wrong.

But, after talking with Joe, on the way back to the hotel, I thought of something else. Isn't this in some ways almost the reverse, and in some ways, very similar, to Marx's process of increased "organic composition of capital" eventually leading to the euthanasia of a capitalist (to use Keynes' term in a Marxist framework)? In Marx, the assumption is that more capital intensive processes are always more productive. So capitalists just tend to pile more and more capital and replace labor (very similarly to what we have seen they do in the Stiglitz example). This in Marxist framework means that there are fewer and fewer workers who obviously produce less (absolute) surplus value and this smaller surplus value over an increased mass of capital means that the rate of profit goes down.

The result is identical if we set this Marxist process in a   neoclassical framework and assume that the elasticity of substitution is less than 1. Then, simply, r shoots down in every successive round of capital-intensive investments until it practically reaches zero. As Marx writes, every individual capitalist has an interest to invest in more capital-intensive processes in order to undersell other capitalists, but when they all do that, the rate of profits decreases for all. They thus work ultimately to drive themselves "out of business" (more exactly they drive themselves to a zero rate of profit).

What are the similarities and differences between the two outcomes? In both cases, labor will be replaced by capital to an extreme degree, so in both cases, production will be conducted mostly by robots. Employment will be negligible. In Marx, the ultimate equilibrium would be with r at almost zero, and wage (by assumption in Marx) at the subsistence—with of course a huge "reserve army of the unemployed". In the Stiglitz case, capitalists will end up with an unchanged r and with pocketing the entire net product. In the Stiglitz equilibrium, that sole remaining worker will have a higher wage, but again, no one else would be employed.

Net income, in Marxist equilibrium, will be low because only labor produces "new value" and since very few workers will be employed "new value" will be low (regardless of how high capitalists try to drive the rate of surplus value). To visualize Marxist equilibrium, imagine thousands of robots working in a big factory with only one worker checking them out, and with the useful life of robots being one year so that you keep on replacing robots continuously and thus run enormous depreciation and reinvestment costs every year. The composition of GDP would be very interesting. If total GDP is 100, we could have consumption=5, net investment=5 and depreciation=90. You would live in a country with GDP per capita of $500,000 but $450,000 of that would be depreciation.

(To see how this works, imagine having income of $1100 per year and in order to earn it needing to have a laptop which costs $1000 and whose useful life –everybody would agree on that—is one year. So every year you just use most of your income to replace the laptop and your net disposable income remains small. To make the situation worse, assume that every additional year, as you are competing with other guys with laptops, you need to increase the number of laptops you own by 5%; your net income will keep on decreasing although you would live in a cornucopia of laptops.)

The Stiglitz equilibrium, in some ways, looks very similar: there would the same immense factory halls with thousands of robots but their net marginal product will be high and the entire net product will be appropriated by the capitalists.

For labor, in either case, there is almost nothing—simply because practically no one will be employed. Quite a negative utopia either way, one could say. But not quite: in the Stiglitz case, you could tax the capitalists and use that income to keep potential workers happy enjoying lots of leisure, watching TV and playing funny games on their laptops. In the Marxist equilibrium, net income will be low although we would live in a world full of complicated machines. So, there would not be much income to redistribute. Your pick?