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**THE INEVITABLE DEPENDENCE OF INVESTMENT ON EXPECTED DEMAND:
IMPLICATIONS FOR NEOCLASSICAL MACROECONOMICS**

1. The purpose of this paper is to point out a weakness, so far unnoticed, of the neoclassical argument in support of Say's Law – that is, of the thesis that investment *is determined by savings*¹, and that therefore aggregate demand poses no obstacle to selling at cost-covering prices the aggregate supply of goods whatever the forces determining the latter. The neoclassical argument, relying upon an assumed negative interest elasticity of investment derived from the demand-for-capital function, neglects the problems with the marginalist or neoclassical conception of capital: as pointed out by the late Pierangelo Garegnani (1983, 1990) the discovery of reverse capital deepening undermines the foundations of Say's Law, because it undermines the belief in a negative interest elasticity of the demand for (value) capital, but then also the belief in a negative interest elasticity of aggregate investment; Garegnani concluded that the 'neoclassical synthesis' criticism of Keynes could not be accepted, and that aggregate demand had to be considered the determinant of employment and growth not only in the short period but also in the long run. In Petri (2004, ch. 7) I reinforced Garegnani's contention by showing that the attempts, after Keynes, to derive a negative interest elasticity of investment without relying on the traditional neoclassical conception of capital are all indefensible². Here I intend to point out that the neoclassical argument meets grave difficulties even conceding the traditional neoclassical conception of capital-labour substitution³ – and for a reason different from the ones adduced so far (such as 'malfunctioning' of financial intermediaries or irreducibly subjective expectations and animal spirits).

The reason is a fact hidden from sight in most current presentations of investment theory, the *inevitable* dependence of investment on desired capacity (and hence on expected demand and its variations) even in a neoclassical framework. I will point out that the marginalist, or neoclassical, approach to investment needs the continuous full employment of labour in order to arrive at a determinate influence of the interest rate upon investment; since the full employment of labour cannot be *assumed* as a starting point of the analysis (it can only be, if at all, a *result* of the analysis), labour employment must be considered variable, but then a given rate of interest leaves investment indeterminate even accepting the marginalist conception of capital-labour substitution, because the rate of interest can only determine the

¹ Of course I am not denying the possibility of a mutual influence (e.g. the propensity to save might depend on the rate of interest); but the basic idea of the theories I intend to criticize is that the aggregate amount of saving may well be given independently of investment, and then investment will adapt to it, while the converse (given investment, and savings adapting) does not happen; to insist on mutual determination misses this fundamental asymmetry.

² A brief summary of my arguments is available in Petri (2003, section 5).

³ I will not consider the attempts to defend a tendency of aggregate demand to adjust to aggregate supply on the basis of the Pigou (or 'real balance') effect: even Patinkin conceded that this effect is uncertain and anyway too weak. Cf. Petri (2004, Appendix 7A2, pp. 292-95) for a confirmation of Patinkin's scepticism, based on recent estimates of the wealth effect.

desired *ratio* of capital to labour, which leaves the capital to be invested in new plants indeterminate and to be determined by desired productive capacity. As I will remember, some neoclassical economists (Jorgenson, and Dornbusch and Fischer) implicitly admitted it by having investment determined by expected demand, but did not see that then extremely serious problems arise concerning the capacity of wage flexibility to bring about the full employment of labour. What follows explains and expands on these points.

2. After Keynes it has become common to consider investment a function of the rate of interest *only*. Even when an influence of other variables is admitted, e.g. of income, it is generally seen as *additional* to the influence of the rate of interest, in the sense that the latter would suffice to determine investment if the other influences were very weak or absent. On the contrary a correct grasp of the neoclassical conception of capital-labour substitution implies that the rate of interest alone is unable univocally to determine investment, unless the full employment of labour is *assumed*. To see why, it is necessary to remember the traditional derivation of investment from the schedule of the demand for capital (conceived in the traditional marginalist way as a single factor, an amount of value)⁴. The connection—often only implicit—between investment and demand for capital in J. B. Clark, Böhm-Bawerk, Wicksell, Marshall, Knight etcetera has been described by Garegnani with a clarity that can hardly be surpassed (Garegnani, 1983: 34-37; 1990: 59-60). Investment was seen by these authors as the *flow* corresponding to the *stock* demand for capital, given that capital wears out and therefore needs a continuous flow of new capital goods for its stock to remain equal to the demand for it.

"The traditional theory implies that the delayed adjustments in the wages, rents, and prices of products do not fundamentally alter the terms of the question ... Hence the significance of the demand and supply functions for capital as a stock, which would exhibit the basic tendencies destined to emerge from the multiplicity of forces acting at any given moment in the savings investment market. ...

⁴ I briefly remember and criticize here the two main attempts *before* Keynes to derive a negative interest elasticity of investment without having recourse to capital-labour substitution. In Walras future rentals of capital goods are treated as independent of the rate of interest, so the demand price of new capital goods (the discounted value of the given future rentals) rises when the rate of interest decreases, and this stimulates their production; but these given future rentals are an obviously indefensible assumption since the interest rate is one of the distributive variables and its changes alter the rentals of all other factors; as standard microeconomic theory teaches, product prices tend to minimum average costs, but then if the rate of interest decreases the rate of return on investments will tend to decrease too: the rentals of capital goods will decrease relative to their supply prices. The same objection applies to Irving Fisher, who assumes for each saver/investor a given series of alternative income streams among which the investor chooses – for each rate of interest – the one with the highest present value; prices are treated as given independently of the rate of interest, like in Walras. Thus Alchian (1955 p. 942) writes that Fisher's "exposition ... is based on the supposition that one merely changes the rate of interest and holds other prices fixed", and correctly accuses such a procedure of logical inconsistency. Actually Fisher admits that changes in the rate of interest alter relative prices, but he dismisses the need for further discussion of the issue by writing that this influence is "a factor which, after all, is more intricate than important" (*The rate of interest*, p. 168), a statement for which no support is supplied.

... the traditional analyses of the demand and supply for capital were in effect intended to be an analysis of the demand and supply for savings, abstracting from the complications likely to operate at each particular moment of time in the savings-investment market" (Garegnani 1990 p. 59-60).

Those authors had to admit of course that in a concrete economy any adjustment to a change in the data of equilibrium (e.g. labour immigration, or technical progress, or changes in the propensity to save) would also present the 'complications' Garegnani mentions, 'complications' due e.g. to differences in the age structure of fixed capital and connected irregularities of need for replacement of scrapped plants, redistributions of purchasing power among social groups due to changes in the interest rate, possible interference of financial intermediaries, possible convenience of anticipated scrapping of fixed plants, mistaken expectations, slowness in adjustments of factor rentals, and so on; the effects of these 'complications' were to be studied if necessary at a second level of approximation; the demand-for-capital curve was believed to supply "the basic tendencies", the ones emerging once the irregularities of the behaviour of prices owing to accidental or transitory disequilibrium phenomena had time to be sufficiently compensated or corrected, and therefore product and factor prices had become sufficiently close on average to their new normal levels, a process enforced by competition: e.g. even without any change in optimal technologies a reduction in the rate of interest cannot but push freely competing firms to try and undercut their competitors by lowering product prices relative to money wages since average costs have decreased; if they don't, it will be new firms – whose birth will be stimulated by the persistence of prices higher than average costs – that will do it to gain market shares.

3. It is opportune to stress a number of important aspects of the determination of the marginalist *long-period investment function*, as I call the investment function generated by such an approach. The demand for capital is determined as the persistent demand for capital goods – aggregated in value terms – implied by the persistent demand for a given net product; this net product being the one produced when labour is fully employed; production methods, output composition and prices being the normal ones associated with the income distribution determined by the full-employment marginal productivities of labour and capital (following general practice, I assume land is free, because land is not important for the issues to be discussed). Since at each given moment the endowment of 'capital' is crystallized in specific capital goods adapted to a specific productive method, a change (induced by a change in income distribution) in the desired i.e. normal capital-labour ratio in an industry can only be realized by replacement of the old durable capital goods with new ones of a different type, or for brevity, can only be realized in new plants (only in new plants can the marginal productivity of capital be determined, since only there the normal K/L ratio can be varied); if industry output is unchanged, the new plants will only be built to replace the older plants that reach the end of their economic life and are scrapped, the less old plants continuing in operation as long as they earn nonnegative residual quasi-rents. Changes in the output of an industry, whether due to changes in consumer choices or to changes in production methods in

industries using that output as an input, will mostly be accommodated, in the short period, by changes in the degree of utilization of existing plants, but if perceived as persistent will induce a desire to change productive capacity, and this will be the other main influence on gross investment (per unit of labour employed in new plants), affecting its composition through the desired composition of new capacity. The composition effect due to change of methods is part, in the traditional marginalist approach, of the overall operation of the so-called direct factor substitution mechanism, which changes the desired K/L ratio in the subsystem producing a given final good; the composition effect due to changes in consumer choice constitutes the indirect factor substitution mechanism. In either case, since in most cases a utilization is impossible of existing productive capacity for the production of goods different from those for which that capacity had been planned, generally the change in industry capacity can only be realized through the building of new plants where demand expands, and non-renewal of the scrapped older plants where demand contracts. Thus both the direct and the indirect substitution mechanism between capital and labour can only operate by affecting the type and sector allocation of the *new* durable capital goods to be combined with the flow of labour gradually released by the scrapping of the durable capital goods that reach the end of their economic life. It is only through the replacement of the existing capital goods with capital goods adapted to produce different goods or adapted to a different technical method, i.e. it is only through a change of the 'form' of capital, that the average economy-wide capital-labour proportion can change and a sufficiently elastic demand curve for factors can be obtained. For this reason Hicks (1932, pp. 18-21) expressed strong doubts on the meaningfulness of a *short-period* demand curve for labour, and considered the notion of a demand curve for labour to be meaningful only if one allowed the 'form' of the given capital endowment of the economy to have the time to adapt to the changed real wage.

An implication of this view is that the process of change of the 'form' of capital brought about by a change in the rate of interest is necessarily *slow*, taking – in order to operate completely – the many years required for renewal of the entire stock of fixed plants of the economy: much longer, generally, than necessary for the new rate of interest to determine a gravitation to the new normal relative prices, a gravitation that only requires that the first plants built according to the new optimal factor proportions be capable of imposing a price equal to their lower average cost, obliging the older plants to accept that price and be content with residual quasi-rents. But economic conditions will seldom remain unchanged for a number of years great enough for complete adaptation of *all* plants to an unchanging rate of interest; therefore it is implicit in this approach that in any concrete economy the rate of interest must be seen as determined, not so as to equalize the capital-labour ratio in factor demand to the ratio of the existing *total* endowment of capital to *total* labour supply, but rather so as to equalize the desired average ratio of capital to labour *in new plants* to the ratio between the flow of 'free' capital (savings) and the flow of labour 'freed' or 'released' by the gradual shutting down of old plants, a ratio that would coincide with the 'total' one only when and if the *entire* labour force were employed in plants embodying methods optimal for that income distribution, and generating productive capacities adapted to the composition of consumer demand. But since most gross investment would be generally motivated by

unaltered replacement of used-up circulating and fixed capital, the implicit view of traditional marginalist economists was that the demand-for-capital schedule and its shifts would give a sufficient indication of the tendencies of the investment function. Any nonnegligible difference of actual investment from the long-period investment function would be part of those transitional or irregular ‘complications’ mentioned by Garegnani⁵. The most important aspect of the long-period investment function, its negative interest elasticity, could anyway be argued certainly to hold for the actual investment function too, since the K/L ratio employed on average in new plants would certainly tend to decrease with rises of the interest rate, while the flow of gradually ‘freed’ labour as well as the speed of completion of changes in industry dimensions would hardly increase.

4. It should now be clear that the long-period investment function crucially depends on the assumption of full employment of labour. If for simplicity we assume ‘investment’ I to indicate only the part of total investment whose ratio to labour and to output will respond to changes in distribution, that is, to consist only of gross investment going to new plants⁶, and if L^{\wedge} stands for the flow of labour employed in new plants, the optimal K/L ratio determined by the rate of interest determines I/L^{\wedge} , but I remains indeterminate unless L^{\wedge} at the denominator is given. The long-period investment function assumes L^{\wedge} to correspond to the flow of labour gradually ‘freed’ by the closing-down of the oldest plants in a situation of continuous full employment of labour. It is this given L^{\wedge} that allows the K/L ratio corresponding to the given rate of interest to determine investment.

If the possibility of labour unemployment is admitted, then a given average K/L ratio in new plants does not suffice to determine investment, because new plants can employ less, or (if there already is some unemployment) more, labour than the flow ‘released’ by the closure of old plants, correspondingly gradually reducing or increasing employment. A given rate of interest, without some assumption fixing L^{\wedge} , leaves investment indeterminate.

5. A very simple model, that stresses only the direct factor substitution mechanism, can give concreteness to the above considerations. Assume an economy where a single good is produced by labour and putty-clay capital; production within each period adapts to the demand forthcoming in that period (the analysis is in discrete time); the output can be consumed, or it can be invested i.e. costlessly transformed into capital, but the newly

⁵ Investment must anyway be determined over not too short a period, to avoid its being relevantly influenced by transitional phenomena like, for example, a *decrease* of the rate of interest inducing an expectation of a further decrease in a few months’ time, and inducing therefore a postponement, i.e. a *decrease*, of investment; or anticipated scrapping of new plants induced by the change in prices due to a *rise* of the rate of interest, that may induce a temporary *increase* of investment.

⁶ The rest of gross investment – partial replacement, without alteration, of durable capital components of existing plants that are not scrapped, plus purchase of raw materials to be used in already existing plants – will be generally rigidly determined by intended outputs and by the technology embodied in the plants, and will therefore be independent of changes in income distribution except in so far as these affect the composition of demand; accordingly, it can be taken as given (and for this reason it is permissible to neglect it) as long as normal utilization of existing plants is assumed.

produced capital becomes productive only at the beginning of the following period. The capital-labour ratio must be chosen at the moment of transformation of output into capital, from the possibilities determined by an ex-ante production function $Y=F(K,L)$, and the resulting capital good allows only one output-labour ratio, which is constant as labour employment per unit of capital varies from zero up to a maximum corresponding to the capital-labour ratio originally chosen. (Thus there may be less-than-full capacity utilization of some or all capital goods.) Capital goods last 10 periods with constant efficiency, independently of the K/L ratio chosen at the time of their creation and of the level of utilization of the capital good during its life. I abstract from technical progress.

The economy is initially in stationary full-employment equilibrium with capital goods fully utilized: at the end of every period the oldest 1/10 of the capital goods is scrapped and replaced by new capital goods of the same type, produced during the period; the newly installed capital goods utilize in the following period the 1/10 of the labour force which is 'freed' by the scrapping of the oldest capital goods. The real wage equals the marginal product of labour in new plants; once the real wage is fixed, the real rate of interest (I neglect risk) is univocally determined (by – owing to the presence of fixed capital – rather complicated equations into which we need not enter).

Then, let us assume, at the beginning of one period the real wage unexpectedly rises (trade unions or political decisions impose this rise, without a change in labour supply) and it is expected to remain at the new level for many periods, and the real interest rate adapts rapidly, so the optimal K/L ratio in new plants rises; the quantity of output destined to investment, let us assume, does not change (this allows us to consider the quantity of capital as not changing); from the subsequent period onwards, part of the 1/10th of the labour supply 'freed' by the scrapping of the oldest plants remains unemployed; the other 9/10ths of the labour force remain employed by the already existing plants, which I assume still yield positive quasi-rents because the wage increase is small. Assume (i) that savings keep translating without difficulty into investment, (ii) that the amount of output destined to gross investment does not decrease in subsequent periods in spite of the decrease in labour employment, so the stock of capital (in the physical sense of total amount of output from which it was created) does not change, (iii) that the real wage does not change. Then after 10 periods the total physical capital K_{Tot} of the economy, measured in physical terms as the sum of the given-up consumption that allowed its creation, has not changed, and labour employment (which is less than labour supply) corresponds to the new lower L/K ratio multiplied by the aggregate capital measured as indicated. All employed labour now produces output at the new Y/L ratio. The final labour employment as a function of the real wage is indicated by a labour demand curve that traces the marginal productivity of labour when the given physical supply K_{Tot} of capital is introduced into the economy's production function $F(\cdot)$. This is the labour demand function that, as Hicks requested, allows the 'form' of the given quantity of capital to become adapted to the real wage.

(It would not be unrealistic to interpret the length of the period of this analysis as at least a year – fixed plants often last much longer than 10 years –, so the wage change would take at least 10 years to exert its full effect on employment. The slowness of the adjustment

implicit in this theory is seldom fully perceived, so its important consequences escape general recognition. One consequence is that, in order to avoid implausible enormous falls of wages whenever unemployment were to arise, the theory must admit the presence of social forces that render wage decreases very slow (Petri 1991: 272-73). But then it is unclear why those same social forces – custom, solidarity, feelings of fairness, aversion to accepting reductions of wage relativities as stressed by Keynes, bargaining power of trade unions, threat of violence, etc. – might not be capable of totally preventing falls of wages even in the presence of unemployment, thus constituting the basis for a determination of wages alternative to the neoclassical tendency toward a supply-and-demand equilibrium, and very much in line with the views of the first attentive observer of capitalism, Adam Smith. Another consequence is that even the neoclassical economist has little reason to presume that the *negative* effect, to be discussed later, of a decrease of real wages on employment through its negative effect on aggregate demand will be slower and weaker in its action than the positive effect on the demand for labour coming from capital-labour substitution.)

The assumption that production takes one period (with all productions started at the beginning of a period and ending at the end of the period) means that in each period t the output $Y_t = C_t + I_t$ cannot include the output of plants created by I_t . So Y_t is the result of the full utilization of the plants that the economy has *at the beginning* of the period, each vintage producing and employing labour depending on the amount of capital good of that vintage and on the K/L ratio chosen for that vintage. Thus in order to determine the demand for labour the reasoning takes Y_t in each period as given, determined by the full utilization of beginning-of-period capacity. (Changes of the real wage at the beginning of the period have no effect on labour employment in that period, at least as long as the wage change does not cause anticipated scrapping of plants.)

Let us now remember the considerable elasticity of the output of the several industries in real economies, in response to variations in demand (the elasticity that makes the working of the Keynesian multiplier possible). Variations of demand will be met at first by variations of inventories and then by variations of output levels tending to bring inventories to normal – and, in manufacturing industry, generally with little or no change in prices. The premises of this elasticity are not represented in the above model, which lacks inventories, but this elasticity should nonetheless be admitted. And it is well known that firms plan productive capacity for a level of utilization which is considerably less than the technical maximum level (and is nonetheless esteemed to be optimal for the reasons pointed out in the literature on optimal capacity utilization: Marris, Betancourt and Clague, Winston, Heinz Kurz etc.), so that not only underutilization of plant, but also above-normal utilization is a possibility. Therefore what in paragraph 5 was called the *maximum* output/capital ratio corresponding to the chosen K/L ratio must more realistically be reinterpreted as the *normal* output/capital ratio, which can be exceeded if demand is particularly high. And ‘full-capacity output’ must be interpreted to mean *normal*-utilization output, not an upper limit to actual output.

Once this elasticity of output in response to demand is admitted, then there is no obstacle to admitting an autonomous influence of investment upon output, in either direction. An investment less than normal-capacity savings will encounter no obstacle in causing Y to be

less than normal-capacity output even if initially there was full employment of a rigid labour supply. An investment greater than normal-capacity savings will cause Y to be greater than normal-capacity output as long as an increase in labour employment is possible⁷. Savings will adjust to investment via the variation of Y induced by the multiplier.

6. Once the basic intuition is grasped, it is convenient to abandon the picture of production as consisting of rigidly separate cycles and to admit, more realistically, continuous production and continuous scrapping. The scrapping of old plants causes a flow of ‘freed’ labour, new plants absorb a flow of new employment. The moment the possibility of unemployment is admitted, even with a constant employment in the already existing plants that go on being utilized the second flow can be smaller than the first, causing a gradual rise of unemployment, or greater than the first, with a gradual reduction of unemployment. The indeterminacy of labour employment in new plants implies that a given K/L ratio in new plants leaves investment indeterminate, as stated at the end of paragraph 4. The conclusion is confirmed that even conceding the neoclassical conception of capital-labour substitution, income distribution is insufficient to determine investment, but then employment too. A given real wage (and corresponding real interest rate and normal relative prices) determines only the ratio K/L in new plants, it does not suffice to determine investment (and labour absorption) in new plants. As for employment in already existing plants, the rigid output-labour ratio implies that an assumption of decreasing marginal product of labour cannot be accepted, hence employment cannot be considered determined by the real wage⁸; more realistically, employment will depend on output which will be determined by sales, and therefore, through the multiplier, by investment. And since the desired K/L ratio in new plants leaves investment indeterminate, there seems to be little alternative to considering investment determined by the desire to reach normal capacity utilization, i.e. by the expected level and variations of demand⁹.

But before examining some implications of this view of investment, let us note how the above considerations destroy the neoclassical demand curve for labour. What emerges is that no incompatibility exists between a rise of real wages and a constant or increasing labour employment, *even accepting the neoclassical conception of capital-labour substitution*. Capital-labour substitution can operate only in new plants, and a greater K/L ratio in new plants implies a lower absorption of labour in new plants and no increase in employment elsewhere only if investment and the other autonomous components of aggregate demand remain constant or decrease; but there is no need why they should, the elasticity of output makes an increase of employment in existing plants perfectly possible if e.g. public expenditure, or investment, increases (in fact, I argue later that investment *will* increase). As I

⁷ I.e. as long as normal-capacity output, the one associated with the normal utilization of existing productive capacity, is less than necessary to employ the entire labour supply.

⁸ On this issue it is worth noticing the agreement between the empirically-based criticism by Dunlop and Tarshis of the decreasing marginal productivity of labour in Keynes, and the earlier theoretically-based rejection of a short-period decreasing demand curve for labour by Hicks (1932).

⁹ Of course innovation will be another fundamental determinant of investment, but its effects do not seem relevant for a discussion of the validity of Say’s Law.

have written elsewhere (also cf. Petri 2004, p. 320):

the flexibility of production in response to changes in demand implies that there is no necessary influence, in the short as well as in the long period, of changes in real wages on the demand for labour. In existing plants, where capital already has a given ‘form’, higher real wages will bring about little or no change in output per unit of labour: employment will depend on capacity utilization which will depend on aggregate demand. In new plants, the flexibility of production of capital goods industries will generally pose no problem with obtaining the inputs required by the adoption of the new most profitable methods of production on the scale suggested by the expected level of aggregate demand, even if the latter is increasing considerably. Thus (apart from political reactions) there generally is no incompatibility between more employment and higher wages, all that is required is that the higher wages be accompanied by a stimulus to aggregate demand. This will be so even when it were the case that a higher wage implied a shift to more value-capital-intensive techniques and therefore required more savings: the increase in savings will be brought about by the increase in aggregate output. (Thus one might say, in neoclassical language, that owing to the adaptability of production to demand, relative factor proportions adapt to income distribution rather than the other way round.) (Petri 2011, p. 411, and footnote 36, p. 416)

Because of the above, empirical enquiries confirming that in most industries wages equal the marginal revenue product of labour would be no confirmation that the marginal product of labour *determines* real wages, because the causality must be understood to go the other way: owing to the adaptability of production to demand it will be prices and methods of production (i.e. the capital goods utilized by firms) that will adapt to a given real wage, so as to render the marginal revenue product of labour equal to the wage.

7. But—the neoclassical economist will object—all the above is based on *not* assuming the full employment of labour, and this can be at most a transitory state if the labour market is competitive: the decrease of real wages will increase the demand for labour. But will it really? I have just argued that the neoclassical decreasing demand curve for labour is destroyed by the analysis developed so far. So the effect on employment of a tendency of real wages to decrease in the presence of non-frictional unemployment must be examined anew¹⁰; and a readiness of workers to accept wage decreases as the normal answer to the emergence of unemployment will not be credible if—as I will argue—such decreases do not generally bring about an increase in employment even accepting neoclassical capital-labour

¹⁰ Keynes objected that, unless investment increases and absorbs the increased saving associated with the increased output brought about by the greater employment, the decrease in real wages and increase of employment will not happen, because workers can only reduce *money* wages, and the insufficient aggregate demand will cause prices to decrease in step with money wages. This argument rests on an assumed decreasing marginal product of labour in the several plants, so if real wages were capable of permanently decreasing, the demand for labour *would* rise; I wish to question the robustness of the neoclassical argument *even conceding* a decrease of real wages. Below (§9) I discuss money wages.

substitution.

In existing plants, I have argued that labour employment depends on sales, not on the real wage; an increase of employment requires an increase of sales i.e., leaving government intervention and changes in the propensity to consume aside, an increase of investment. In new plants, conceding the neoclassical conception of capital, the decrease of real wages reduces the K/L ratio. Assume that investment is motivated by desired productive capacity and that the economy has been stationary for some time so initially entrepreneurs have little reason to expect anything but the same demand also for the next few years. Assume initially that already existing plants keep being normally utilized. Then the new plants can only aim at satisfying the same demand that was satisfied by the scrapped plants they are replacing. Let us initially consider only the direct substitution mechanism. The decrease of the K/L ratio in new plants planned for a given output corresponds to a shift on a given isoquant toward using more labour and less capital, hence *it reduces investment*. If aggregate demand did not decrease, this would not prevent an increase in the demand for labour in new plants (although a smaller increase than if I remained constant, see below) and a constant employment of labour in existing plants, and hence some increase in the total demand for labour; but *the decrease of investment reduces aggregate demand*; then the assumption that the already existing plants keep being normally utilized comes out to be illegitimate, because the reduction of sales has a negative effect on employment in existing plants; thus even though the *flow* of employment in new plants increases, the overall *stock* (the level) of employment *decreases*¹¹. Furthermore sooner or later the planned investment in new plants will be further revised downwards as expectations of unchanged sales come out to be too optimistic; this further reduction of investment may well be small or even absent initially, but since Y remains lower than initially (its rise would need a rise of investment, while there is no incentive to such a rise) this will gradually persuade firms that they do indeed need a smaller productive capacity. Thus the decrease in wages starts a reduction of investment *and employment* that can go on for a long time¹².

Now let us consider the indirect factor substitution mechanism. It is well known that this mechanism may not work in the direction needed by neoclassical theory, but neglecting for the sake of argument the possibility of ‘perverse’ income effects, the decrease of real wages changes the composition of consumption demand in favour of labour-intensive goods. The traditional derivation, from this change, of an increased demand for labour rests on an assumed unchanged total employment of capital, which in our framework where capital is putty-clay must mean an unchanged total investment. Like for the direct substitution mechanism, this assumption has no justification in view of the freedom with which

¹¹ Consider the following rough example. Suppose I/Y is constant, the average life of plants is 10 years, and the reduced K/L ratio causes L/Y in new plants to rise by, say, 5%; the first year the increased hiring of labour in new plants as a percentage of previous labour employment is 5% of 10% i.e. one half of one percentage point. If investment decreases by, say, 4%, this causes a reduction of Y (and plausibly of employment in existing plants) by 4%, i.e. about a 3.5% reduction of labour employment.

¹² This conclusion is reached without considering the negative effect on Y due to the generally admitted rise in the average propensity to save caused by the decrease of the share of wages in national income, an effect which, if admitted, would strengthen the argument.

investment can be decided. Like in the other case, there is no reason for firms to expect future aggregate demand to be the greater one connected with *more* labour employment and an *unchanged* capital stock, since current aggregate demand is forthcoming from the income of the given capital and the not yet increased labour employment, only its composition is changing. The more plausible assumption is that the total value of expected demand for consumption goods is equal to the total current expenditure on them, and its changed composition corresponds therefore to a greater demand for labour and less demand for capital, that is, like in the direct-substitution case, less investment. Then the effect is the same as in the other case, a reduction of aggregate demand that causes a reduction of labour employment, with a likely subsequent further discouragement of investment.

8. I am not the first to argue that even neoclassical theorists should admit an influence of expected sales on aggregate investment (in other words, a role for the accelerator broadly intended). This influence was indeed admitted in the first (1963) version of Jorgenson's 'neoclassical' approach to investment¹³, and it became the basis of the theory of investment in the popular macroeconomics textbook by Dornbusch and Fischer.

The basic idea of the approach of these economists was precisely, in accord with what I have argued, to take as given (expected) aggregate demand instead of labour employment in order to determine the desired capital stock and hence investment. Output is treated as if homogeneous and homogeneous with capital; then only the direct substitution mechanism can be explicitly formalized. The rate of interest selects the average capital-labour proportion on the aggregate isoquant corresponding to the planned level and composition of aggregate output; the desired capital stock changes if either the rate of interest, or planned output (i.e. expected demand), or both, change. Thus the desired capital stock is determined by the neoclassically determined capital/output average ratio, *and by the level of aggregate output*. A lower interest rate raises the desired K/Y ratio; with expected Y initially unchanged, the desired capital stock increases, although by less than if L , rather than Y , were kept fixed; the increase of the desired capital stock causes an increase of investment. Thus in the 3rd edition (1984, pp. 206-208) of their macro textbook Dornbusch and Fischer argue that, assuming a Cobb-Douglas aggregate production function $Y=L^{1-\gamma}K^\gamma$, the rental of capital (indicated as rc) causes a demand for capital K^* that depends on expected sales Y :

$$K^* = g(rc, Y) = \frac{\gamma Y}{rc}. \quad (\text{eq. 1})$$

The role both of income distribution, and of Y , explains Dornbusch and Fischer's use of the term 'flexible accelerator' as an alternative denomination for what they also call the 'neoclassical approach' to investment. The approach needs of course the traditional and unacceptable marginalist conception of capital-labour substitution, and furthermore it is left with the problem of the speed with which the desired capital stock is reached when it changes discontinuously owing to a jump of the rate of interest¹⁴; but at least it avoids the frequent

¹³ On the difference between Jorgenson's 1963 and 1967 approaches cf. Petri (2004 pp. 287-290).

¹⁴ This speed is determined by Dornbusch and Fischer through a 'gradual adjustment hypothesis' that states that the larger the gap between the existing capital stock and the desired capital stock, the

grave mistake, found in many current textbooks, of a derivation of the negative interest elasticity of the investment function from a given downward-sloping marginal-productivity-of-capital curve, forgetting that the marginal-productivity curve of capital needs a *given* labour employment, while the investment function is needed for the IS-LM model where labour employment is *variable*¹⁵. However, the avoidance of that mistake pays a price: the consequences I have started to point out in §7, and will now explore further.

9. The view of Dornbusch and Fischer appears to have been that, since (if expected Y is given) the negative interest elasticity of desired capital and hence of investment obtains in their approach too, the ‘neoclassical synthesis’ criticism of Keynes is valid, a flexibility of money wages would ensure a tendency toward full employment. The well-known ‘Keynes effect’ mechanism at the heart of the ‘neoclassical synthesis’ relies on decreases of money wages in the presence of unemployment; this according to Keynes brings about some increase of employment in firms that initially expect to be able to sell more at a negligibly lower product price; this causes an excess of aggregate supply over aggregate demand since investment for the moment has not increased; the consequent decrease of the price level causes a decrease of the demand for money, hence a decrease of the rate of interest, hence an increase of investment. The same picture of how the tendency toward full labour employment operates if money wages are flexible downwards is obtained from Dornbusch-Fischer’s textbook.

But their different approach to investment opens the road to a number of objections even without questioning the neoclassical conception of capital-labour substitution.

First objection. The presence of an accelerator influence upon investment makes consideration of what has been happening to Y important. If, starting from a situation of desired capital-output ratio equal to the actual one, Y decreases for any reason (e.g. because of a decrease of exports, or of state expenditure) and remains low, then desired K is lower than actual K , and investment is discouraged; and this, through the multiplier, causes Y to decrease further, stimulating further decreases of desired K . The decrease of the rate of interest brought about by the ‘Keynes effect’ must then supply a *very* strong stimulus to investment to reverse this downward process. Such a strong stimulus cannot be expected, for two reasons. The first one is that the increase of desired K is smaller than the one derived from the standard demand-for-capital curve, because the latter determines desired capital on the basis of a given employment of labour, while here firms move along a given (K,L) isoquant: this is shown in Fig. 1, where the isoquant corresponding to a given Y is shown, and a change in distribution that changes the optimal K/L ratio from α to β causes an increase of desired capital from K_1 to K_3 if labour employment is fixed at L_1 , but only from K_1 to K_2 if output is fixed. The second reason is that the increase in the K/L ratio can be realized only in new plants, so it concerns only a very limited portion of productive capacity in every year. (The slowness of the change

more rapid a firm’s rate of investment. Empirical evidence is then referred to in order to estimate the speed of adjustment.

¹⁵ This is just one of the many grave mistakes to be found in the arguments for a negative interest elasticity of aggregate investment after Keynes, cf. Petri (2004, p. 271-81).

in the K/L ratio pointed out in §5 should not be forgotten: it is generally underestimated, owing to a mistaken tendency to conceive capital as putty-putty. Therefore the influence of Y on desired productive capacity and hence on investment has sufficient time to manifest itself.) Therefore even a neoclassical economist has little reason to expect the ‘Keynes effect’ to be more powerful than destabilizing multiplier-accelerator interactions.

(Intl. 17pt)

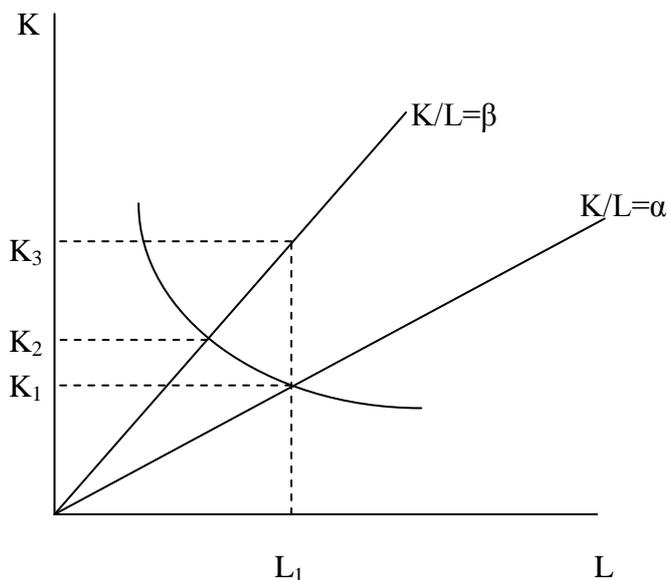


Fig. 1

Second objection. The approach of Dornbusch and Fischer implicitly recognizes – in accordance with standard microeconomics – that the marginal products of the two factors labour and capital are tied together in such a way that if one marginal product increases, the other one decreases, and that factor prices adjust to marginal products so that normal competitive extraprofits net of risk must be assumed to be (close to) zero when one studies investment¹⁶. This means that an increase of the desired K/L ratio will be associated with a change of relative factor prices consisting of a decrease of the real interest rate and an *increase* of the real wage. In order for the marginalist factor substitution mechanism to stimulate investment by raising the K/L ratio in new plants, the real rate of interest must decrease i.e. *the real wage must increase*. On the contrary, the first stage of the ‘Keynes effect’ mechanism supposed to raise employment if money wages decrease consists of a *decrease* of real wages: firms raise employment and production because money wages decrease relative to prices that have not decreased yet; once prices start decreasing, since plausibly they decrease with some lag relative to the decrease of money wages, the real wage perhaps stops decreasing but remains lower than initially for all the deflationary period. As pointed out in §7, then investors have an incentive to adopt a *lower* K/L ratio in new plants,

¹⁶ Without this reciprocal adjustment of factor prices, the desired K/L ratio would not be given by equation (1). Obviously the extraprofits to be considered are the ones on new plants, existing plants earn quasi-rents. (I use ‘extraprofits’ to mean what standard microeconomics calls ‘profits’, in order to avoid confusion with the classical meaning of ‘profits’.) On the need for such assumptions for the study of investment cf. Garegnani (1983, p. 36 and fn. 25 p. 46), also Petri (2011b p. 67).

and this causes a *decrease* of investment. To avoid this result, it would seem necessary that the decrease of real wages be strictly temporary, soon reversed by an *even greater* decrease of the price level (caused by prices rapidly adjusting to average costs including not only lower money wages but now also a lower rate of interest); then because of the rise of real wages the desired K/L ratio in new plants increases; this will hopefully stimulate investment, and Y , to the point of raising the demand for labour *in spite of* the rise of real wages. But note how one will be then admitting the possibility and indeed *necessity* of raising at the same time employment and real wages! Then it becomes difficult to deny that it must be the task of public intervention to secure such a result without the slowness and uncertainties of leaving it to the spontaneous working of the market, which would anyway not guarantee at all to work in the needed direction, because there is little reason to expect the necessary greater decrease in the price level to be sufficiently fast – firms are notoriously hesitant to decrease prices –, and furthermore it is well known that price decreases raise the weight of debts with possible negative effects on production and investment. (To all this one can add the well-known negative effect on the propensity to consume, and hence on the multiplier, associated with a decrease of real wages.) It is anyway striking that the rise of employment will have to be associated with a rise, not a decrease, of real wages. (Is this perhaps the reason why the Dornbusch-Fischer approach was not more widely adopted and was subsequently totally forgotten?)

10. These considerations should suffice to show how little one can trust that a downward flexibility of money wages will reduce unemployment, even neglecting the Cambridge capital-theoretic criticisms, the moment one more consistently develops, when the full employment of labour is not assumed to start with, the implications 1) of the importance of durable capital, 2) of the inevitable influence of expected demand on investment, and 3) of the multiplier, and of possible multiplier-accelerator interactions broadly conceived.

To the above one must then add (i) the empirical evidence that consistently contradicts the presumption of a significant interest elasticity of investment; and (ii) the Cambridge results in capital theory, in particular the possibility of reverse capital deepening, that undermine the neoclassical conception of capital-labour substitution and show that the *theoretical* presumption of a negative interest elasticity of the demand for value capital per unit of labour has no solid foundation, so the lack of *empirical* support for such a presumption is not surprising. The conclusion must be that there is no reason at all to believe in a spontaneous tendency of market economies toward the full employment of labour.

11. Two important implications of this conclusion can be pointed out.

The first one is that the assumption that in the presence of unemployment money wages will decrease becomes implausible, and the Friedmanite thesis, that if in the presence of unemployment wages do not decrease then unemployment is voluntary, loses its analytical foundations. If reductions of wages have little or no effect on labour demand and can even have a negative effect, cumulative historical experience will have taught this fact to the labouring classes, ways will have been found to teach this knowledge and the consequent

appropriate rules of conduct to the young, and it is then perfectly understandable that an unemployed worker will not, apart from exceptional circumstances, try to obtain a job by undercutting others. The generalized reduction in wages that wage undercutting would bring about would not reduce unemployment, it would only worsen the incomes of employed workers – who often are the relatives of unemployed workers, from whose income the living of the latter may depend. In such a situation it would be mistaken to define *unemployment* as voluntary: the absence of wage reductions is voluntary, but not unemployment. The unemployed worker by refusing to accept a lower wage is *not* choosing the alternative “no wage reduction, no job” over the alternative “wage reduction, job”.

The second implication is the need to reconsider the theory of growth. The elasticity of output with respect to demand pointed out in para. 6 strongly suggests a view of economic growth and capital accumulation as dependent on the evolution of the autonomous components of aggregate demand, because it implies that *aggregate* production can quickly adjust not only to decreases of aggregate demand, but also – within limits rarely approached – to *increases* in aggregate demand, so that it is generally possible, even in economies very close to full employment, to raise at the same time consumption *and* investment, if aggregate demand increases¹⁷. Hence investment is hardly ever constrained by savings; capital accumulation will result from the demand for additions to capital stocks due to increases in desired capacity, in turn due to increases of aggregate demand. A growing literature is developing these insights.

12. I conclude by briefly pointing out the relevance of the above analysis for the currently fashionable foundation of macro theory upon Dynamic Stochastic General Equilibrium models, where the problems for Say’s Law pointed out in this paper are pushed out of sight by an *assumption* of continuous full employment of the labour supply and of investment determined by savings. This assumption is generally justified by reference to the ‘rigorous’ microfoundations supplied by general equilibrium theory: the models are argued to be simplified renditions of the results one would derive from completely disaggregated intertemporal general equilibrium models, possibly made more realistic by the admission of adjustment costs, imperfect competition, and so on. The claimed premise of these models is therefore that intertemporal general equilibrium theory is a robust descriptive theory.

The curious thing is that the claimed consistency of this type of macro models with infinite-horizon General Equilibrium theory is announced with pride, as supporting the trustworthiness of these models, while on the contrary more and more often general equilibrium specialists advance strong reservations on the descriptive validity of GE theory. One can mention Michio Morishima, Stephen Marglin, Duncan Foley, Alan Kirman as at one time convinced neoclassical theorists who have decidedly rejected GE theory. An implicit rejection or at least an agnostic attitude also emerge in the fact that the problems with uniqueness and stability have

¹⁷ Labour constraints are usually not binding in the short run because of visible or hidden unemployment and underemployment, and over the longer run there are migrations, and structural social adaptations e.g. changes in the participation of women.

led many microeconomists to forsake the general equilibrium conceptualization altogether. As a result, microeconomic theory has, by and large, been reduced to a collection of techniques and tricks for resolving narrow, isolated microeconomic problems and the study of, also narrow and isolated, strategic behaviors. (Katzner, 2006, p. ix)

One can also mention the frequent denunciation, e.g. with Frank Hahn or Franklin Fisher, of the sterility of stability studies based on adjustments that do not allow the implementation of disequilibrium decisions; but if time-consuming adjustments are allowed, the equilibrium becomes indeterminate because the data relative to the endowments of the several capital goods are no longer data, being altered by production. Also, many theorists are very uneasy with the utterly unrealistic assumption of complete futures markets or correct foresight; but the alternative of temporary equilibria without correct foresight, explored in the 1970s and early 1980s, is nowadays in total disrepute (as evidenced by its complete disappearance from advanced micro textbooks) owing to the problems it encountered; which explains why Lucas, real business cycle theories, or DSGE models only refer to intertemporal equilibria as their ‘rigorous’ microfoundation.

One might then reject the DSGE approach in macroeconomics simply as a consequence of the rejection of intertemporal General Equilibrium theory as a positive theory, a rejection motivated by this theory’s need for the untenable assumption of complete markets or perfect foresight, by its lack of uniqueness or stability even granting the auctioneer, and by its inability to say anything on the distance between equilibrium paths and the behaviour of economies not continually perfectly in equilibrium (Petri 1999, p. 50)¹⁸.

But, as I have argued elsewhere (Petri 1999, pp. 53-54), it is difficult to understand the acceptance of intertemporal equilibria as descriptively valid without a more or less conscious belief that the undeniable occurrence, in actual economies, of disequilibrium and time-consuming adjustments does not destroy the neoclassical theses as to the *trend* the economy follows, which is reasonably approximated by the intertemporal equilibrium path. Only an idiot would deny that in actual economies there is no auctioneer and no complete futures markets, but rather time-consuming trial-and-error adjustments, mistakes, disequilibria, imperfect foresight; so DSGE theorists must believe that there are persistent forces that cause these disequilibria to be sufficiently corrected or compensated so that the trend the economy actually follows is not too far from the path described by their models¹⁹. But then the reference to disaggregated intertemporal equilibrium with perfect foresight as the ‘rigorous’ microfoundation of the models is only a smokescreen, behind it there is in fact a belief in the

¹⁸ A survey of these and other criticisms is in Petri (2011b).

¹⁹ Some such view is for example implicit in the numerous admissions by Lucas, Sargent and others that rational expectations make sense only for situations sufficiently persistent for agents to have had the time to learn how correctly to form their expectations – with the implication that during the learning mistakes are inevitable; but some learning is going on all the time, because of the continuous emergence of novelties (in each industry there may be technical progress, changes in tastes, etc.), hence those admissions imply that most markets are most of the time in disequilibrium, which can only be neglected if one looks at trends of the averages and one assumes that time-consuming adjustments operate which cause the trends to be sufficiently close to the equilibrium path.

time-consuming adjustment mechanisms on whose basis the marginal approach was born and accepted, and that after Keynes were rehabilitated by monetarism carrying forward from the criticism of Keynes initiated by the neoclassical synthesis. Without some such belief the reference to intertemporal equilibria would be devoid of any justification, given that by themselves neo-Walrasian equilibria and their sequences tell us *nothing at all* about the actual path a market economy not continuously in equilibrium will follow.

For this reason, the arguments of the present paper are relevant criticisms of DSGE models too, as well as of the whole development of neoclassical macroeconomics after Keynes. The characterization of contemporary neoclassical macro models as simplified intertemporal general equilibrium models would, if taken seriously, deprive these models of any pretence to descriptive validity; such a pretence can only rely on traditional neoclassical macroeconomic tendencies, that is, on the same time-consuming adjustment mechanisms on which J. B. Clark or Wicksell or Pigou or Hayek, or the ‘neoclassical synthesis’ and monetarism, based their analyses. The relevance of the argument of the present paper lies then in its pointing out that, the moment the continuous full employment of labour is not assumed to start with, those adjustment mechanisms will not work as normally presumed, and Say’s Law loses credibility even before one questions the neoclassical conception of capital-labour substitution: this was not realized because the correct implications of that conception for investment theory when labour employment is not given were not grasped. The recuperation of pre-Keynesian views initiated by the neoclassical synthesis and carried forward by monetarism, which is what lies behind the current faith in DSGE models, was made possible by a theory of investment which was mistaken not only in its foundation on an untenable conception of capital, but even if that conception is not questioned.

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