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INVESTMENT DEPENDS ON OUTPUT EVEN CONCEDING TRADITIONAL NEOCLASSICAL CAPITAL THEORY: IMPLICATIONS FOR SAY'S LAW

1. Although this paper[1] is mostly about investment theory, its motivation is the plausibility of Say's Law and thereby of mainstream macroeconomics. By 'Say's Law' I mean the thesis that aggregate demand adjusts to aggregate supply; in other words, that (in a closed economy) investment adjusts to savings, *is determined by* savings[2], and therefore aggregate demand poses no obstacle to selling at cost-covering prices the aggregate supply of goods, however the latter be determined[3]. In current mainstream macroeconomics, this thesis is taken for granted to the point that some 'New Keynesian' authors find it possible to present their differences from Real Business Cycle theories in models where there is no investment: by so doing they implicitly take it for granted that, were the presence of investment admitted, aggregate demand would anyway pose no obstacle to the sale, at cost-covering prices, of the output associated with the full employment of the supply of labour. In this paper I argue that, to the contrary, the support for Say's Law is extremely weak *even if* one leaves aside the fundamental inconsistencies of the notion of capital as a single factor of production pointed out by Sraffa, Garegnani and others[4].

To support this thesis I will rely, not upon a 'malfunctioning' of financial intermediaries, but upon the *inevitable* dependence of investment on desired capacity and hence on expected demand and its variations even in a neoclassical framework, a fact hidden from sight in most current presentations of investment theory. I will argue 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;

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[1] This is a considerably abridged version of a longer paper that will be soon made available as a Working Paper of my Department.

[2] 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.

[3] I am leaving aside in this paper the problems deriving from maladjustments of the *composition* of supply to the composition of demand.

[4] 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 Patikin 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.

if (as after Keynes it seems inevitable to admit) labour employment depends on aggregate demand and hence on investment, and if as a consequence the tendency to 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), then a given rate of interest leaves investment indeterminate even accepting the marginalist conception of capital-labour substitution; even neoclassical economists, it will be argued, should admit a dependence of investment upon desired productive capacity—and therefore an accelerator influence upon investment—as indispensable for the determination of investment, but then extremely serious doubts arise on the capacity of wage flexibility to bring about the full employment of labour.

2. After Keynes it has become very 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. To see why such an investment theory is wrong even accepting the neoclassical conception of capital-labour substitution, it is necessary to remember the indispensable role of the assumption of full employment of labour in 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). 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 the late Pierangelo Garegnani with a clarity that can hardly be surpassed (Garegnani, 1978: 352; 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. ...
> ... 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).

These 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 'release' of 'free' workers, 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[5].

4. Let us then highlight the importance of the assumption of full employment of labour for the determination of the *long-period investment function*, as we may 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

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[5] The attempts to derive a negative interest elasticity of investment without having recourse to capital-labour substitution are all indefensible. For a criticism of the ones after Keynes, cf. Petri (2004, ch. 7). Here I briefly remember the two main ones before Keynes. In Walras we find a demand for savings which is decreasing in the interest rate because 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 ditributive 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. In fact 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): no argument in support of such a view is supplied.

labour is fully employed; production methods and prices being the 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 not important for the issues to be discussed). And since at each given moment the endowment of 'capital' is crystallized in specific capital goods, a change (induced by, for example, a change in income distribution) in the desired i.e. normal capital-labour ratio 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), and therefore it can only concern the durable capital goods or plants that absorb the flow of labour gradually released by the scrapping of the plants or durable capital goods that reach the end of their economic life. For this reason Hicks (1932) 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[6]. According to this approach then, in any concrete economy normal income distribution is determined, not by the ratio of the existing total endowment of capital to total labour supply, but rather by the ratio of the flow of 'free' capital (savings) to the flow of labour 'freed' or 'released' by the gradual shutting down of old plants, a ratio that would coincide with the first one only when and if the entire labour force were re-employed in new plants embodying that ratio. (Gross) investment connected with normal plant utilization is then fundamentally determined by (i) the K/L ratio employed on average in new plants[7], a ratio determined by income distribution, *and* (ii) the flow of gradually 'freed' labour. If I stands for investment going to new plants (the remainder —partial replacement, without alteration, of durable capital components of plants that are not scrapped— being rigidly determined by the needs imposed by the technology embodied in old plants) and if $L^{\wedge}$ stands for the flow of gradually 'freed' labour, 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. It is the given $L^{\wedge}$, corresponding to the continuous full employment of labour, that allows the K/L ratio corresponding to the given income distribution to determine investment.

Thus, this determination of investment is based upon the continuous full employment of labour. If there is labour unemployment, a given K/L ratio in new plants does not suffice to determine investment, because new plants can employ more, or less, labour than the flow 'released' by the closure of old plants, correspondingly gradually

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[6] Cf. Petri (1991, pp. 270-72) for the relevant quotation from Hicks (1932, pp. 18-21).

7 Plus, of course, renewal of the circulating capital utilized in existing plants, whose amount per unit of ouput can be taken as given, determined by the technology embodied in the fixed plant.

reducing or increasing unemployment.

5. A simple model may 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 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 among the ratios compatible with[8] a differentiable 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.

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 determined (by rather complicated equations due to the presence of fixed capital, 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 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

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[8] The Inada conditions, that assume that marginal products are always positive, are of course deeply unrealistic; it is much more realistic to assume that outside certain factor proportions the marginal product of one of the factors is zero.

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[9].

6. 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.

But is there a solid justification for such a full-utilization assumption? Let us 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

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[9] It would not be unrealistic to interpret the period of this analysis as at least a year long (fixed plants often last much longer than 10 years), so the wage change would take at least 10 years to exert its effect on employment. The slowness of the adjustment implicit in this theory is not often 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 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 different from the marginalist/neoclassical one. Another consequence is that in all likelihood the *negative* effect (discussed later in the text) of a decrease of real wages on employment through its negative effect on aggregate demand will be faster and stronger than the positive effect on the demand for labour coming from capital-labour substitution.

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 par. 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 greater than normal-capacity savings will cause *Y* to be greater than normal-capacity output as long as an increase in labour employment is possible. 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 is full employment of a rigid labour supply. Savings will adjust to investment via the variation of *Y* induced by the multiplier.

We reach the indeterminacy conclusion enunciated at the end of para. 4. Even conceding the neoclassical conception of capital-labour substitution, income distribution is insufficient to determine investment and employment. A given real wage (and corresponding real interest rate) determines *K/L* in new plants, but does not determine the labour employed in new plants – nor in existing plants (where a decreasing marginal product of labour is not generally observed, up to overfull capacity utilization[10]). And since the change in desired *K/L* when the rate of interest, or the real wage, changes is caused by the tendency of competition to enforce the normal prices corresponding to the changed income distribution, i.e. to render the rate of return on investment equal to the rate of interest (due account being taken of risk, which here I neglect), what determines investment cannot be (except at most transitorily) extraprofits at normal capacity utilization; it must be the desire to *reach* normal capacity utilization, i.e. the expected level and variations of demand[11]. Then the multiplier will determine aggregate output and employment.

Then no incompatibility arises between a rise of real wages and a constant (or even increasing) labour employment, even accepting the neoclassical conception of capital-labour substitution. A greater *K/L* ratio in new plants will imply a lower absorption of labour in new plants only if investment does not increase; but the elasticity of output makes an increase of investment perfectly possible (and without the need for a decrease of consumption). As I have written elsewhere (also cf. Petri 2004, p. 320):

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[10] Cf. below, fn. 12??

[11] 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.

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. (Attached footnote: 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)

It is worth noting that, 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 the 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. The tendency of prices and production methods toward the long-period cost-minimizing ones does not need the full employment of labour, it only needs a given real wage (or a given rate of profit) plus competition.

Another implication is that there is no necessity for countercyclical real wages: it is only in new plants that the wage can equal the marginal product of labour, and, as shown, different amounts of new plants – different levels of investment and hence of aggregate output and employment – are compatible with a constant real 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. To this one can oppose Keynes's objection 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. But I wish to question the robustness of the

neoclassical argument *even conceding* a decrease of real wages. (Of course this conceding the decrease of real wages is only for the sake of argument, because to assume such a decrease as the normal answer to unemployment is not credible if—as I will argue—such a decrease does not generally bring about an increase in employment; cf. §10 below.)

My argument goes as follows. In existing plants, I have argued that labour employment depends on sales, not on the real wage. In new plants, conceding the neoclassical conception of capital the decrease of real wages reduces the *K/L* ratio, but this is certain to raise the demand for labour in new plants only if investment (the numerator of the fraction) does not decrease. But it is highly plausible that investment be motivated by desired productive capacity which is determined by expected demand. We know that in market economies most production is of products that are at least slightly differentiated, so nearly no entrepreneur feels he faces a horizontal demand curve[12]; it is then plausible that firms decide their productive capacity on the basis of their expected sales at normal prices. Consider then a stationary economy where an increase in the supply of labour causes a fall of wages. The stationariness of the economy up to then gives entrepreneurs 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. The decrease of the *K/L* ratio in the new plants corresponds therefore to a shift on a given isoquant toward using more labour and less capital, hence it *reduces* investment; but then the assumption that the already existing plants keep being normally utilized comes out to be illegitimate, because through the multiplier the reduction of investment reduces *Y*: this will have a negative effect on employment that will easily more than counterbalance the small increase in employment in new plants; furthermore, the decrease of *Y* risks inducing a further (and, given the putty-clay nature of capital, possibly a drastic) reduction 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). This influence was indeed admitted in the early (1963) version of Jorgenson's 'neoclassical' approach to investment[13], and it became the basis of the theory of investment in the popular textbook by Dornbusch and Fischer (e.g. 1984). However, it

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[12] The markets of undifferentiated products are generally markets where the price is not known in advance (e.g. agricultural products whose supply depends on the climate; minerals whose price depends on speculation in forward markets) so again for most of them one cannot determine supply decisions on the basis of a horizontal demand curve for the individual firm.

[13] Contrary to usual presentations, Jorgenson's 1967 approach is very different from his 1963 one: the influence of expected sales disappears, and highly criticisable assumptions take its place, cf. Petri (2004: 287-290).

never achieved great popularity and nowadays appears totally forgotten. I suspect that one reason for this neglect was the unconventional implications, troublesome for the neoclassical theorist, and not made explicit by Dornbusch and Fischer.

The basic idea of the approach was to take as given (expected) aggregate demand instead of labour employment. 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 will change 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 e.g. 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

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

This 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 interest([14]); but at least it avoids the frequent mistake of assuming a given marginal-product or demand curve for capital, a mistake found in many current textbooks that derive the negative interest elasticity of the investment function from a downward-sloping marginal-product-of-capital curve, forgetting that that curve needs a *given* labour employment while the investment function thus derived is to be used in the IS-LM model where labour employment is *variable*.

This approach admits the presence of three main influences on investment: the desired K/L ratio, the variations of Y, and the determinants of adjustment speed.

The latter speed is, to use neoclassical terminology, a disequilibrium phenomenon, necessarily including accidental and transitory elements different from entrepreneur to entrepreneur and from situation to situation. Therefore little precise and general can be said on how fast firms will want to realize new plants or other investments. It will depend on construction and delivery times, on the importance of being first in an expanding or new

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[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 more rapid a firm's rate of investment. Empirical evidence is then referred to in order to estimate the speed of adjustment. Like in Jorgenson (1963), there is little theoretical justification for this hypothesis apart from some hints on the importance of construction lags. As I argue below in the text, I do not think that on this issue one can go much farther anyway.

market, on the opportunity to wait to make sure that the change in demand is persistent, on the expectation of changes in some relevant market variables, on observation of what the competitors are doing, all inherently variable and transitory elements. The approach based on adjustment costs and optimal control eliminates this variability and unpredictability through assumptions of correct foresight that are clearly implausible, so the results of the approach, even apart from its other deficiencies, cannot pretend to superiority relative to more common-sense reasonings[15]. In this field, as in many other ones, what economic theory can try to determine is only the trend that one can expect to emerge from a multitude of decisions influenced by specific, transitory and accidental causes. (Perhaps empirical evidence can suggest some aggregate regularity, but purely empirical regularities are liable to exceptions, and to disappear.)

Thus it seems best to take the speed of adjustment as given, and one is left with the first two influences, the more persistent ones. Their combined presence 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.

9. The presence of an accelerator-type influence upon investment in this approach raises the possibility of instability due to multiplier-accelerator interaction. Multiplier-accelerator models are easily unstable, and at least Hicks judged instability to be indeed the likely case (with a fixed capital-output ratio): overall stability would require then that there be some strong stabilizing influence, and this is not easily obtained. I will concentrate on whether one can presume a tendency toward full employment when there is unemployment. The view of Dornbusch and Fischer appears to have been that one could rely on the same mechanism as in the other contributions of the 'neoclassical synthesis', since the negative interest elasticity of desired capital and hence of investment obtains in their approach too. This well-known 'Keynes effect' mechanism relies on decreases of money wages in the presence of unemployment, which according to Keynes will bring about some increase of employment in firms initially expecting to be able to sell more at a negligibly lower product price; but this causes an excess of aggregate supply over aggregate demand since investment has not increased initially; the consequent decrease of the price level causes a decrease of the demand for money, hence a decrease of the rate of

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[15] So, little is gained relative to pre-existing literature. For example, anticipating current option-based approaches, Dornbusch and Fischer had sensibly noted: "Because investment is undertaken for the long run and often requires several years to complete, there is flexibility in the dates on which the actual investment is undertaken. For example, suppose a firm wanted to have some machinery in place within 3 years. Suppose that it knew the investment tax credit would be raised substantially a year from now. Then the firm might be wise to delay the investment for a year and to make or acquire the machinery at a faster rate during the next 2 years, receiving the higher investment tax credit as the reward for waiting the extra year." (1984 p. 217). Analogous sensible considerations are in Ackley (1978, chs. 18 and 19).

interest, hence an increase of investment. The same picture of how the tendency toward full labour employment operates if money wages are flexible 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.
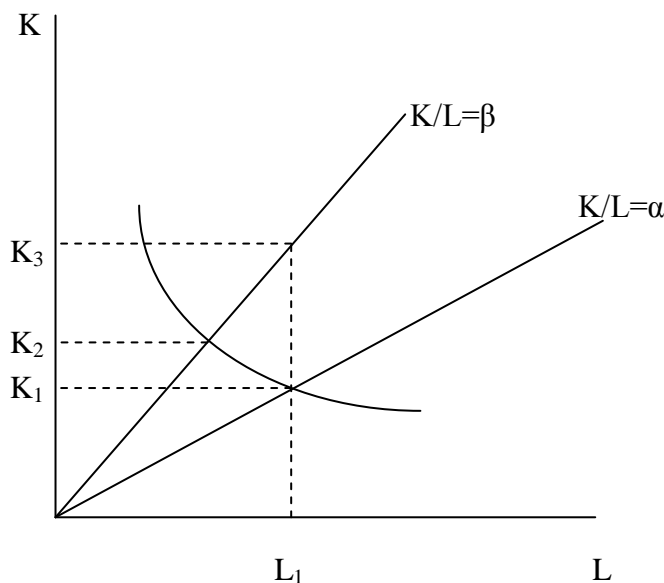
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Fig. 1

First, the presence of an accelerator influence upon investment makes consideration of what has been happening to *Y* important. If *Y* has recently decreased (e.g. because of a decrease of exports or of state expenditure), desired *K* decreases, and investment decreases; and this, through the multiplier, causes *Y* to decrease further, stimulating further decreases of desired *K*. The decrease of the rate of interest 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 isoquant, hence *L* decreases: 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, from K_1 to K_2 if output is fixed. The second reason is that the increase in the *K/L* ratio is going to operate only for new plants, so it concerns only a very limited portion of productive capacity in every year. (The slowness of the change in the *K/L* ratio pointed out in §5, cf. especially footnote 9, should not be forgotten: it is generally underestimated, owing to a mistaken tendency to conceive capital as putty-putty.) Therefore even a

neoclassical economist has little reason to expect the 'Keynes effect' to be more powerful than destabilizing multiplier-accelerator interactions.

Second, the approach of Dornbusch and Fischer implicitly recognizes – in accord 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 (leaving risk aside) must be assumed to be (close to) zero when one studies investment[16]. 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. This means that investors have an incentive to adopt a *lower K/L* ratio in new plants[17]. If expected *Y* has not increased, this causes a *decrease* of investment – as already pointed out in §7 – that may start a downward multiplier-accelerator interaction, and that anyway through its multiplier effect on *Y* has a negative effect on the demand for labour.

10. These considerations should suffice to show how little one can trust that decreases in money wages will reduce unemployment the moment one more consistently develops the implications of the importance of durable capital, and of the inevitable influence of expected demand on investment, even if one neglects the Cambridge capital-theoretic criticisms.

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

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[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'.)

[17] The initial increase of employment and output envisaged by Keynes when money wages decrease relied on a regularly decreasing marginal product of labour in existing firms which is generally found implausible, as finally conceded by Keynes himself after the objections of Dunlop and Tarshis.

value capital per unit of labour has no solid foundation, so that the lack of *empirical* support for such a presumption should not be surprising[18]. 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.

Two implications of this conclusion can now be pointed out.

The first one is that the thesis, that if in the presence of unemployment wages do not decrease then unemployment is voluntary, loses its analytical foundations. If reductions of money or even of real wages have little or no effect on labour demand, 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 would be voluntary, but not unemployment, because the refusal to offer one's labour at a lower wage does *not* mean that the unemployed worker remains unemployed *because* he does not accept a lower wage. The unemployed worker by refusing to accept a lower wage is *not* preferring the alternative "no wage reduction, no job" to the alternative "wage reduction, job". (This of course means that the standard textbook analysis of consumer choice between work and leisure needs replacing.)

The second implication is the need totally 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[19], 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 increases[20]. Hence investment is

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[18] The Cambridge criticisms and the Shaikh-Felipe criticisms (cf. Petri 2004, ch. 9, Appendix) undermine the empirical estimates of the elasticity of aggregate production functions by undermining the notion itself of aggregate production function. Furthermore, a very limited effect of even considerable differences in real wages on technical choice is suggested by the observation of very small differences in technical choices among plants producing the same good located in nations differing widely in real wages; car production, for example, does not seem to be influenced in its technical choices by the wage differences between Germany and Brazil.

[19] Cf. e.g. Garegnani and Palumbo, 1998; or Petri, 2003; and the vast literature on growth depending on aggregate demand, only partially there mentioned.

[20] Labour constraints are usually non-existent in the short run because of visible or hidden unemployment and underemployment, and over the longer run there are migrations and structural

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.

11. Space reasons oblige me to be very brief on the relevance of the above observations for the currently fashionable so-called Dynamic Stochastic General Equilibrium macromodels. These models are argued to be simplified renditions of the results one would derive from completely disaggregated intertemporal general equilibrium models, in which one inserted the peculiarities of these models such as adjustment costs in investment, or imperfect competition. The premise is therefore that intertemporal general equilibrium theory is a robust descriptive theory, into which one can insert additional elements of realism.

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. Michio Morishima, Duncan Foley, Alan Kirman, all at one time convinced neoclassical theorists, have rejected GE theory as a good theory of the working of market economies and have looked for very different approaches. The problems with uniqueness and stability have

> "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).

The unreality of the auctioneer-guided tâtonnement itself coupled with the impossibility to admit more realistic, time-consuming disequilibrium adjustments[21] have also contributed considerably to the disaffection. And many theorists are very uneasy with the utterly unrealistic assumptions of complete futures markets or perfect foresight. But the alternative of temporary equilibria without perfect foresight, explored in the 1970s and early 1980s, is nowadays in total disrepute (as evidenced by its complete disappearance from advanced micro textbooks); which explains why neoclassical macro theorists can only refer to intertemporal equilibria as their 'rigorous' microfoundation.

One might then reject the DSGE approach in macroeconomics simply as a

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social adaptations, e.g. changes in the participation of women, that suggest that in the longer run labour supply, like capacity, adapts to demand.

[21] Frank Hahn has denounced again and again the inability of GE theory to deal with the actual working of the 'invisible hand'.

consequence of the rejection of intertemporal General Equilibrium theory as a positive theory, a rejection motivated by this theory's need for untenable assumptions, by its difficulties with uniqueness and stability even granting complete futures markets and the auctioneer[22], 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: 50).

But, as I have argued elsewhere (Petri 1999: 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 is of little relevance because the economy follows anyway an *average* path reasonably approximated by the intertemporal equilibrium path. In other words, only an idiot would deny that in actual economies one finds no auctioneer and no complete futures markets, but rather time-consuming trial-and-error adjustments, mistakes, disequilibria, imperfect foresight; but evidently DSGE theorists believe that there are persistent forces that cause these disequilibria to be sufficiently corrected or compensated so that the economy follows on average, with acceptable approximation, the path described by their models[23]. This means that they must be believing in *persistent* forces capable of correcting and guiding disequilibria so that the economy tends toward a full-employment path with factor rentals reflecting marginal products; but then the use of models of continuous intertemporal equilibrium is only a façade, behind it there is in fact a continuing belief in the traditional time-consuming adjustment mechanisms on whose basis the marginal approach was born and accepted: the long-period factor substitution mechanisms *based on the treatment of capital as a single, somehow homogeneous factor*. Without some such persuasion 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 (Petri 1999: 53).

For this reason, the arguments of this paper are relevant criticisms of DSGE models

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[22] It must be noticed that without complete futures markets even the auctioneer-guided tâtonnement becomes an extremely fuzzy notion, because the auctioneer can only announce prices for current markets, and how these announced prices and their changes during the tâtonnement are going to influence expected prices remains mysterious and inevitably arbitrary: for example there is no reason to presume that expectations may be able to converge to the uniform ones required by a Radner equilibrium. It is not by chance that the stability of temporary equilibria, with or without perfect foresight, is never discussed. (The notion itself of perfect foresight is not easily reconcilable with the need to *find* the equilibrium.)

[23] Some such view is clearly implicit in the admissions by Lucas, Sargent and others that rational expectations make sense only for situations in which agents have had the time to learn how correctly to form their expectations – with the implication that during the learning (and some learning clearly is going on all the time, because of the continuous emergence of novelties), the agents make mistakes, hence there is disequilibrium. The more extended version of this paper reports some quotations.

too. The declarations of accord of these models with 'rigorous' micro theory (general equilibrium theory) would, if taken seriously, deprive DSGE 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 Clark or Wicksell or Pigou or Hayek or the 'neoclassical synthesis' based their analyses. Then the argument that those mechanisms are unpersuasive even before one gets to the inconsistencies of the traditional notion of capital has obviously relevance.

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