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**Bringing sense back to the theory of aggregate investment**

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**ABSTRACT:**

Part I argues that marginalist theory before Keynes implicitly determined an investment function decreasing in the interest rate as the *flow* demand for the newly produced capital goods necessary to keep intact the optimal *stock* of capital, determined by income distribution and the full employment of labour (Garegnani 1978(1964)). Keynes objected that the full employment of labour could not be *assumed*, it had to result, if at all, from an analysis where unemployment was possible; but the implications of the absence of full labour employment for investment theory were not discussed by him, nor afterwards; there resulted a lack of theoretical rigour in investment theory, still evident in current textbooks. A number of textbook presentations are remembered and criticized. This part relies upon, and extends with further examples, the argument in Petri (2004, §4.3 and ch. 7).

Part II notes that, in the recent fashion of real-business-cycle or New-Keynesian macroeconomic models, full employment is again simply assumed, on unclear foundations apart from an indefensible appeal to general equilibrium theory (which makes assumptions, eg. complete futures markets and the auctioneer, which cannot be made in a positive theory of the functioning of market economies, and – not least because of this reason – is undergoing a deep crisis of credibility). One aspect of the claimed foundation of contemporary mainstream macro models upon general equilibrium theory is specifically criticized: there seems to be a widespread belief that an assumption of stock equilibrium eliminates aggregate demand problems; but the reaching of a stock equilibrium cannot be separated from the reaching of flow equilibrium the moment it is admitted that there is no auctioneer and equilibrium can only be reached, if at all, by time-consuming trial-and-error adjustments. The need for a theory of aggregate investment where the full employment of labour is not assumed cannot be avoided. It seems then inevitable to admit a role for the accelerator, with the consequence that neoclassical macroeconomists should adopt the Dornbusch-Fischer approach: the rate of interest determines the desired capital-labour ratio, but desired K results from applying this ratio to the production of (expected) Y, not to full-employment L. This considerably weakens the neoclassical argument for a significant elasticity of investment with respect to the rate of interest, and opens the door to multiplier-accelerator interactions, with further implications for the effects of wage decreases that radically undermine the argument of the ‘neoclassical synthesis’ against Keynes. Thus the refusal to consider the Cambridge criticisms does not provide neoclassical economics with a convincing argument for a tendency to full employment in any case. A rigorous reconstruction of investment theory, since it must drop the neoclassical conception of capital-labour substitution, is left essentially with accelerator-type influences on investment, and therefore with a central role of aggregate demand in determining growth.

**PART I**

1.

As is only appropriate for a theory that, being based on the indeterminable notion of capital as a single somehow homogeneous factor of production ‘embodied’ in heterogeneous capital goods, caused problems even to its founders when they tried to formulate it rigorously, pre-Keynesian marginalist treatments of the connection between demand for capital and investment are hard to find.

One must reconstruct this connection as rigorously as possible from the logic of the theory. It seems then possible to say, with Garegnani (1978(1964)), that the demand for capital conceived as somehow a single homogeneous factor was determined in traditional marginalist economics as the persistent demand for capital goods implied (by the production methods associated with the given income distribution) by the persistent demand for a given net product; this net product being the one produced *when labour was fully employed*. But since at each given moment the endowment of ‘capital’ would be crystallized in specific capital goods, a change in the desired capital-labour ratio induced by, for example, a change in income distribution could only be realized in new plants (only in new plants could the marginal product of capital be considered a function of the K/L ratio adopted), and therefore it could only involve the flow of labour gradually released by the closure of the plants reaching the end of their economic life. In any concrete economy, income distribution would therefore be determined, not by the ratio of existing total endowment of capital to labour supply, but rather by the ratio of the flow of ‘free’ capital (savings) to the flow of labour ‘freed’ by the gradual shutting down of old plants, a ratio that would coincide with the first one only when the entire labour force were re-employed in new plants embodying that ratio. (Gross) investment was then determined by the K/L ratio employed on average in new plants, a ratio determined by income distribution, *and* by the flow of gradually ‘freed’ labour.

This determination of investment requires the 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 reducing or increasing unemployment.

Thus, the moment with Keynes the possibility of *persistent* unemployment is admitted, the marginalist determination of K/L does not suffice to determine investment. Keynes, helped by Marshall’s empiricism on investment, did not squarely tackle the problem, remaining content with a reference to a short-period role of increasing supply price (which was soon noticed to be empirically unsupported, and is anyway insufficient for a theory arguing the possibility of *durable* unemployment), and to a longer-period role of decreases of the yield of a capital good as its supply was increased, an argument made illegitimate by the possibility to increase the employment of capital goods *and* of labour. Thus Garegnani (1978 fn. 44 p. 59-60) noted, “Keynes’s use of the marginal efficiency of capital also presents difficulties. In particular, it is not clear in what sense decreasing returns to increases in the stocks of the different capital goods can be assumed, as is done by Keynes (p. 136), when, there being unemployment, additional equipment be used together with additional labour.”<sup>[1]</sup>

2.

I have suggested in Petri (2004, ch. 7) that this problem largely explains the evolution of mainstream investment theory since Keynes, as well as the striking lack of rigour generally to be

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<sup>1</sup> The corresponding Italian text is livelier.

found in the current presentations of investment theory, *even apart* from the problems with the treatment of capital as a single factor highlighted in the Cambridge controversies.

For example, a striking characteristic of many modern presentations of investment theory is that its negative elasticity vis-à-vis the rate of interest is explicitly attributed to the decreasing marginal-product-of-capital curve, which causes the desired capital stock to be a decreasing function of the interest rate, *without* clarifying what is assumed about labour employment when this argument is advanced. In my 2004 book I remembered as examples the 1982 book on rational expectations by Begg, and the macroeconomics textbook by Farmer. I can add that an analogous treatment is in the textbook by Burda and Wyplosz, and – with only a little more caution – in the one by Mankiw<sup>[2]</sup>. In Burda-Wyplosz, as in Farmer, capital is assumed to be entirely circulating capital (its demand is determined by setting its gross marginal product equal to  $1+r$ ), so gross investment *coincides* with the demand for capital, and the need for an assumption of given labour employment should be glaring but is nowhere mentioned. Perhaps this is in order to hide the subsequent contradiction with the use of the investment function thus derived in the IS-LM context, where labour employment is variable and therefore the basis for a decreasing marginal product of capital is absent.

### 3.

Let me now use D. Romer, *Advanced Macroeconomics*, II ed., as an example of the miseducation students undergo even in more advanced courses when they are introduced to investment theory by mainstream textbooks<sup>[3]</sup>. Romer starts his discussion of the determinants of investment (p. 367) with a ‘baseline model’ of a single firm which produces a single product and can rent capital at a price of  $r_K$ . Capital is treated like a single good with price 1, the same price as output. Capital can be obtained in any quantity the firm desires. The firm’s profits at a point in time are given by  $\pi(K, X_1, X_2, \dots, X_n)$  where  $K$  is the amount of capital the firm rents and the  $X$ ’s are the variables that the firm takes as given; for example if the firm is perfectly competitive they include the price of the firm’s product and the costs of other inputs. The function  $\pi(\cdot)$  is a value function that indicates the maximum profit the firm can achieve for the given prices, as a function of the amount of capital rented. If for simplicity we assume that production requires only capital and labour, the relevant prices are the product price, the nominal wage, and the rental price of capital  $r_K$ . The first-order

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<sup>2</sup> Mankiw’s macro textbook is only apparently less incorrect: in the chapter on investment almost at the end of the book, Mankiw admits that the marginal product of capital depends on labour employment, but when two pages later he connects investment to the difference between  $MP_K$  and cost of capital he avoids mentioning that dependence and represents graphically investment as a function of the rate of interest  $r$  alone. And in the earlier chapter on the IS-LM model he had assumed the standard investment function  $I(r)$ , omitting any mention of the need – implied by the dependence of  $MP_K$  on employment – to admit shifts of the IS curve as employment varied. Perhaps Mankiw hoped that students would not notice the contradiction although the elements for noticing it were supplied (at the end of the book).

<sup>3</sup> The considerations to be advanced on Romer apply to his textbook the arguments against the adjustment-cost theory of investment in Petri (2004, ch. 7), to which the reader is referred for a more detailed critical discussion of the evolution of mainstream investment theory.

condition for the profit-maximizing choice of  $K$  is  $\partial\pi/\partial K=r_K$ .

At this point Romer does not discuss whether this first-order condition yields a definite solution. Only later, after arguing the need to introduce adjustment costs, he considers the possibility of – in fact, he assumes – constant returns to scale (p. 371) and then in a footnote he admits that in this case in the absence of adjustment costs the firm’s demand for capital is not well defined. But he can avoid discussing how traditionally the problem was dealt with, because at that point he has already argued that adjustment costs must necessarily be introduced. So he does not explain that, if as he now assumes the firm is part of an industry facing a *given* downward-sloping demand curve, and the single firm’s profit is a decreasing function of the *industry’s* total capital stock  $K$  (the firm’s own capital is now indicated as  $k$ ), then no problem arises in determining the *industry’s* demand for capital in the absence of adjustment costs, because the product price will tend to minimum average cost and industry supply will adjust to the demand forthcoming at that price. Nor does he explain that the same holds true even if firms have U-shaped average cost curves, because even in this case prices will tend to minimum average cost because of *entry*. But entry is not discussed by Romer. That the possibility of positive profit should stimulate the birth of new firms is nowhere remembered (we will later understand why). The number of firms is explicitly taken as given (p. 371: “Consider an industry with  $N$  identical firms.”), an incredible assumption in an analysis aiming to determine aggregate investment: isn’t investment often aimed at creating new firms? (One might answer that the possibility of a discrete jump in demand for capital – see below – is not eliminated by the Marshallian approach to industry long-period supply; but Romer should have discussed entry anyway, because as we will see it is a problem for his own theory.)

Anyway, at this point Romer has already explicitly introduced the need for adjustment costs, on the basis of the observation that otherwise one would be unable to obtain an investment *function*, since any discrete change in some exogenous variable would cause the demand for capital to change discretely, implying an infinite rate of investment. In this way he introduces at the level of the single firm the issue which originates the approach to investment theory that in Petri (2004, ch. 7, p. 271) I have called the ‘two-stage problem’: the theory, having obtained in a first stage of the analysis a *discrete* change in the desired stock of capital due to some discrete change in some exogenous variable, must then generate a *finite speed* of adjustment to the new desired capital stock. But to locate the analysis at the level of the single firm, or even of the industry, is only misleading. Changes that alter the desired capital stock will also necessarily alter the demand curves<sup>4</sup> of industries (think for example of the demand curve faced by an industry producing a specific capital good). The change in the demand for capital when, for example,  $r_K$  changes must therefore result from an economy-wide analysis that includes changes in the composition of demand and in prices.

This is particularly easy to see with *external* adjustment costs, but Romer in spite of duly admitting them (p. 370) appears unable to realize the problem. External adjustment costs are what used to be called rising supply prices of capital goods, resulting from short-period Marshallian

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<sup>4</sup> For the sake of argument I am conceding the existence of definite demand curves.

upward-sloping supply curves – the main reason in the short period according to Keynes for the decreasing shape of the marginal-efficiency-of-capital schedule. They entail adjustments of capital-goods prices, and therefore of *output* prices for the firms that produce them<sup>5</sup>. But even for industries producing consumption goods, the change in input price will bring about a change in the output price that will change relative prices of consumption goods and therefore will shift demand curves. But Romer never discusses this issue.

Let us come to how Romer determines the investment of a ‘representative’ firm in the given industry. He restricts the analysis to internal adjustment costs (with no mention of the several critical comments on their empirical relevance<sup>6</sup>). He then assumes that the representative firm maximizes the integral up to the infinite future of the present value of ‘profits’<sup>7</sup>  $\pi(K_t)k_t - I_t - C(I_t)$ , where  $K$  is the *industry’s* capital stock,  $k$  is the *firm’s* capital stock,  $C(I)$  is the (strictly) convex adjustment-cost function so that  $I+C(I)$  is total investment cost, and profits apart from investment cost,  $\pi(K)k$ , are assumed proportional to  $k$  but decreasing in  $K$ . The latter assumption is intended to reflect price taking and constant technological returns at firm level plus the fact that if industry supply expands, the product price decreases<sup>8</sup>. But the amazing thing is that Romer assumes that each firm takes the time path of the industry-wide capital stock  $K_t$  as given (p. 371), and proceeds to determine the optimal path of the firm’s own capital, and then to obtain aggregate investment by summation of the firms’ decisions, forgetting that the moment firms realize what the other firms in the industry are doing the path  $K_t$  can no longer be taken as given in the single firm’s maximization. The adaptation of expectations to observation cannot but imply that one should treat the entire industry and not the single firm as the object of analysis. But at the industry level microeconomics reminds us that there

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<sup>5</sup> This escapes Romer, cf. his footnote 11 p. 380.

<sup>6</sup> E.g. Nickell (1978, p. 37-39) or Hamermesh and Pfann (1996) or Ackley ?? are very critical of the assumption of convexity of the adjustment cost function. It is striking how continued adherence to a theory contradicted by empirical evidence is often preferred to attempts to look for different theories, and then the objections based on empirical evidence are simply no longer mentioned. Not a very commendable scientific attitude, I would argue. But it is not a matter of empirical evidence only. The approach implies that, the slower the adaptation to the new optimal capital stock, the smaller the adjustment costs. This cannot be accepted. Too slow a construction of new plants would imply that these start rusting before being put to use. A cost-minimizing speed of adaptation must be accepted, and at this speed to speak of adjustment costs *additional* to the cost of purchase of capital goods makes no sense, the costs of investment at this speed are simply the normal costs required by the production of the output due to that investment, the costs that enter the determination of minimum average cost. Some authors assume for example that  $C(I)=0$  when  $I$  simply replaces depreciation so that  $K$  does not change, but it is unclear why the building of a new plant, to replace a plant which has reached the end of its economic life and is closed down, should cost less than half the building, on the same occasion, of two identical plants.

<sup>7</sup> This is a very unusual definition of profits, because it does not include payment of interest on initial capital among the costs. Also, over any finite time period the cost of investment in the final period should not be subtracted from revenue in order to obtain the usual definition of profit.

<sup>8</sup> That firm profits are proportional to the firm’s capital for a given  $K$  clearly reflects the traditional assumption that the firm is so small relative to the industry that the firm has the right to neglect the influence of its own capital upon  $K$ ; but traditionally this was justified by U-shaped average cost curves that limited firm size, while Romer has assumed constant returns to scale.

will be a powerful tendency toward equality between product price and average cost, with the position of the demand curve determining the quantity to be produced at that price. This is also due to entry, but to deny the possibility of entry as Romer implicitly does is simply ridiculous. Then, two big problems arise for the analysis when the question is the effects upon investment of changes in the rate of interest.

First, even if the speed of change of the capital stock could be determined univocally for each firm, investment would also depend on whether there is birth of new firms: whenever it were convenient for existing firms to expand their capital, it would be also convenient for new firms to enter; assuming a well-defined optimal investment could be determined for a newly born firm, the flow of entry of new firms would remain undetermined (potentially infinite!) and so investment too<sup>9</sup>. Thus, internal adjustment costs do not yield a determinate investment function the moment entry is admitted (and one understands better why entry is never admitted in the presentations of investment theory based on adjustment costs).

Second, the position of the demand curve of an industry cannot be considered independent of changes in the rate of interest, for the already mentioned reason that relative prices will change (tending to the new minimum average costs – the interest rate is a cost, and a different share of total cost in different products), therefore demands will change too, for example there will be changes in optimal methods of production that may imply drastic changes in the capital goods demanded. Nothing can be concluded from the analysis of a single industry as to what is going to happen to investment at the economy-wide level. Only from an analysis at the economy-wide level can one conclude, for example, as to whether a decrease in the rate of interest changes relative prices such that consumers shift their demand in favour of capital-intensive rather than labour-intensive goods, inducing an increase in the demand for capital and hence an increase of investment – the question traditionally answered affirmatively by marginalist/neoclassical authors and shown on the contrary to have an indeterminate answer by the results of the Cambridge debates.

Thus Romer's reference to an industry demand curve rather than – as more explicitly done by earlier presentations of the adjustment costs approach – to a given product price does not avoid the grave problems of the approach; the complicated mathematics, Euler equations, transversality conditions etcetera appear to have the sole role of obscuring the need to take into account the interrelations between costs, prices, demands for final products, and demand for factors; in the end one finds that nothing has been gained relative to previous simpler analyses that were less marred by arbitrary assumptions (e.g. did not forget that changes in interest rate alter relative prices and demands) and were clearer on the economic insights supporting the analysis. The structure of the analysis is still that of the two-stage problem: the neoclassicals need to prove: A) that as the rate of interest decreases the demand for capital increases, B) that an increase in the demand for capital (the stock) causes a well-defined increase of investment (the flow). Assuming stage A delivers the desired result, the attempt to base stage B on internal adjustment costs (rather than, for example, on delivery

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<sup>9</sup> This has been admitted e.g. by Söderstrom (1976, p. 386).

lags) founders on the absence of empirical support for the needed strict convexity of adjustment costs, on the indeterminacy created by entry, and on the impossibility to take industry demand curves, or product prices, as given. In the meanwhile, students have been miseducated to forget all these problems. A disaster.

4.

Others adopt an approach dubbed by Ackley (1978) the “array of opportunities” approach: Blanchard’s macro textbook, for example, or the one by Krugman and Wells, justify the decreasing investment schedule by reference to a series of possible investment opportunities which offer the prospect of different rates of return, concluding that it is convenient to start all investment projects which offer the prospect of a rate of return higher than the rate of interest; then a lower rate of interest will make it convenient to start more investment projects. It is disconcerting that such an approach should continue to be considered tenable after the destructive and crystal-clear criticism by Ackley (1978, pp. 620-625), which points out the illegitimacy of considering the returns from investment projects as independent of the rate of interest.

So, if a decrease in the rate of interest is to increase investment, it can only be – Ackley lucidly concludes – “by selectively favoring the production of more capital-intensive products as opposed to labor- or land-intensive products” and “by favoring more capital intensive methods of production as opposed to less capital-intensive ones” (p. 620); “the original classical basis for the declining investment schedule ... clearly lies in consideration of aggregate ‘factor proportions’ for the entire economy” (p. 625 fn. 15). However, besides the problems pointed out in the Cambridge controversies, there is the problem of what to assume about labour employment.

The latter Gordian knot is cut by recent mainstream macroeconomic modelling by assuming the full employment of labour even in the short period. I pass to discuss the foundations of this development.

## PART II

5.

Internet allows some exploration of what kind of macroeconomics is taught in other universities. A survey of the web pages of economics departments that allow access to course contents strongly suggests that, if one leaves aside the very few places known for their ‘heterodox’ faculty, nowadays the teaching of macroeconomics at graduate level consists of (i) neoclassical endogenous growth models when the emphasis is on growth, (ii) Real Business Cycle / New Keynesian models (Christiano-Eichenbaum-Evans, Smets-Wouters, et similia) when the focus is on monetary policy. (Nothing in the teaching programs seems to have been changed by the economic crisis that started in 2007 with the consequent considerable increase of unemployment.)

The treatment of investment in all these approaches is that investment is assumed to adapt to full-employment savings. The models are models without involuntary unemployment; a representative household determines how much labour to supply, and this labour supply is fully

utilized; the wage rigidities admitted in some New Keynesian models only cause labour supply to be somewhat different from what it would be with complete wage flexibility. Savings determine the growth over time of the capital stock, which is demanded by firms because the rate of interest equals the marginal product of capital, treated as a single good. Adjustment costs – usually assumed to have the form of the Hayashi (1982) version of Tobin’s q theory – are admitted, but their main effect is, that a somewhat lower rate of interest than in their absence is required in order to cause investment to absorb net savings; a second, minor effect is that they cause the increment of the capital stock brought about by a given level of savings to be a little less than in the absence of adjustment costs, owing to the resources these absorb; the consequent lower return on savings may also have a small effect on the amount of savings; but the main message is not altered, it is not variations of income that bring about the equality of savings and investment, Keynes’s principle of effective demand is flatly rejected. While the possibility of rigidities of nominal or real wages is admitted (although attributed to workers’ own decisions so that unemployment is still voluntary), Say’s Law is taken for granted to such a degree that it is often felt that the main characteristics of the approach can be illustrated in models without capital or investment (e.g. Galì, or the first chapters of Woodford 2003).

Thus, behind the complications created by the stochastic elements introduced in the modelling<sup>[10]</sup>, the central theoretical novelty relative to the period of debates between Keynesians and monetarists is a simple one: the turn to a version of the pre-Keynesian marginalist approach which is even more extreme than the historical pre-Keynesian versions, because Say’s Law and equilibrium on the labour market are assumed *even in the short period*.

One senses here an influence of the modern, neo-Walrasian versions of general equilibrium theory, that determine very-short-period equilibria which, as Garegnani in his contribution has noted, must aim at describing the *actual* path followed by the economy, and therefore can be considered acceptable only if one accepts that real-world economies can be assumed to be continuously in equilibrium.

## 6.

I suspect that some role in this development was played by that same “desire to bring consistency back into economic theory” mentioned by Garegnani in “Notes on Consumption Investment and Effective Demand”, Part II, fn. ‡ p. 78 of the 1978 CJE version (fn. 44 p. 60 of the 1983 reprint) as part of the explanation of “the attempts to confine the implications of Keynes’s theory strictly to short-period analysis”. In the first two decades after the publication of the *General Theory* the background theory of value and distribution was still essentially the long-period (traditional) marginalist one, based on capital the single factor, and admitting short-period

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<sup>10</sup> Sometimes with very little justification except the possibility of nice statistical tricks: this is the case, for example, of Calvo-type staggered price adjustments, where it is assumed that prices can be altered by firms only when a random process allows them to do so by ‘lighting a green light’ – while in reality there is no exogenous impediment randomly preventing firms from changing prices whenever they want to.

fluctuations around the long-period position (essentially full-employment) trend. Since then the Cambridge controversies have forced the defensive retreat of neoclassical economists into claiming that the foundation of their approach is the neo-Walrasian versions of general equilibrium theory. Then the desire for theoretical consistency with the accepted theory of value and distribution obliges the economist still clinging to neoclassical theory to admit continuous equilibration, and hence the continuous validity of Say's Law and equilibrium on the labour market even in the short period. Woodford 2008: "It is now widely agreed that macroeconomic analysis should employ models with coherent intertemporal general-equilibrium foundations."

The need for consistency with the accepted theory of value and distribution (that is, with general equilibrium theory) is claimed with particular clarity in the writings of Lucas; and the achievement of this consistency is often presented as an element in favour of this type of macroeconomics; for example the latest advanced-macroeconomics textbook states with evident pride: "Modern macroeconomics seeks to explain the aggregate economy using theories based on strong microeconomic foundations. This is in contrast to the traditional Keynesian approach to macroeconomics, which is based on ad hoc theorizing about the relations between macroeconomic aggregates." (Wickens 2008 p. 1), where the microeconomic foundations are clearly meant to be the ones of general equilibrium theory, as the subtitle of Wickens's book makes clear in case any doubts were to arise.

## 7.

However, neither of the two main versions, in which neo-Walrasian general equilibrium theory comes, intertemporal or temporary GE, is capable of supporting current mainstream macroeconomics.

Intertemporal equilibrium theory needs complete futures markets or perfect foresight, and neither assumption is acceptable for descriptive analysis (as opposed to the benchmark role sometimes attributed to general equilibrium analyses based on such fairy-tale assumptions). The moment one admits that complete futures markets do not exist and cannot exist and that perfect foresight makes no sense (Petri 2009)<sup>[11]</sup>, some kind of temporary-general-equilibrium analysis appears to be the only avenue left for a supply-and-demand approach to prices and quantities. Actually, temporary equilibrium theory seems to be at present in a state of disrepute (it has disappeared from advanced microeconomics textbooks), which suggests a general pessimism on the possibility to obtain useful results in that direction<sup>[12]</sup>. But this only shows that the persuasion of mainstream macroeconomists that their models have "strong microeconomic foundations" rests on a dogmatic faith in the neoclassical approach, a faith unsupported by the opinions of the general

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<sup>12</sup> There has been a series of negative results on the possibility to prove the existence of a temporary equilibrium under sufficiently general assumptions. But no doubt the arbitrariness of the assumptions necessary to render the system of equations definite (e.g. assumptions on how firms take decisions when the share owners have different expectations) has also contributed to the disillusionment with temporary equilibrium theory.

equilibrium specialists themselves. In fact the entire theory of general equilibrium is at present in a state of crisis. As one neoclassical economist has perceptively noticed, “the Walrasian theory of market behavior or, as it is more commonly referred to, general equilibrium theory, has increasingly been abandoned by microeconomists... an appropriately acceptable analysis of the uniqueness and global stability of Walrasian equilibrium has yet to be found... The persistence of this gap along with the seemingly hopelessness of filling it has, to a considerable extent, 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 contents of many graduate microeconomic courses have indeed been evolving precisely in the direction indicated by Katzner, and avoid discussion of the theory of value and distribution. The paradoxical result – given that generally no alternatives are presented – is to leave students prisoners of the unrigorously presented neoclassical ‘vision’ of the functioning of market economies they absorbed as undergraduates, and ignorant of the existence of alternative schools of thought. Obviously this prepares students to have little qualms about claims that general equilibrium theory must be accepted, since from what they are taught it seems to be the only theory around and no one seems to have any alternative to offer.

## 8.

Any general criticism that results in the rejection of general equilibrium theory as a positive theory of the functioning of actual market economies will therefore imply a rejection of the way of doing macroeconomics I am now discussing. Reasons for such a rejection have been listed on many occasions, for example by myself in Petri (2009). But it may be useful to focus attention on one aspect of the Real Business Cycle or New Keynesian models that connects specifically with investment, so as to make the implications of the criticisms more concrete.

This aspect is that in these models there is no autonomous investment function. Investment is assumed to adjust to savings, on the basis of an argument which remains partly implicit but that it seems possible to describe as follows: at the beginning of each period (at each moment, if the analysis is in continuous time) there are given endowments of produced goods which, being now in existence, must be sold and *are* sold at whatever price this may require; whatever part of output is not bought for consumption purposes must be bought as capital goods, and a sufficient decrease of their prices will ensure that they will be bought by savers (or by firms to which savers lend their savings) as assets that will yield an expected return justifying their demand price to which supply price adapts. Thus all capital goods available at time  $t$  are bought or rented and hence find employment. The reaching of stock equilibrium (that is, sale of consumption goods and full utilization of factor supplies including all capital goods available) at date  $t$  determines production and hence the quantities of goods that will constitute the endowments at  $t+1$ , and the reaching of stock equilibrium at  $t+1$  ensures that again the full employment of all factors at  $t+1$  is established, so the

new capital goods that come out at  $t+1$  do find employment. The sole problem is to guarantee that the prices at which the produced goods coming out at  $t+1$  are sold are cost-covering price. This is solved by determining equilibrium simultaneously for all future periods. So, as Wickens (2008) puts it:

“The economy is viewed as being in continuous equilibrium in the sense that, given the information available, people make decisions that appear to be optimal for them, and so do not make persistent mistakes. (p. 1)

....the only sense in which the economy can be in disequilibrium at any point in time is through basing decisions on the wrong information.(p. 4)

....The correct concept of equilibrium, which eluded Keynes, is that of stock equilibrium..... In DGE [dynamic general equilibrium] macroeconomic models individual preferences relate to consumption (a flow variable), but equilibrium in the economy is defined with reference to capital (a stock). There are an infinite number of possible flow equilibria—sometimes called temporary (or short-term) equilibria—but only one of these is consistent with the stock equilibrium. The problem is how to obtain this flow equilibrium. (We show that this is usually the unique saddlepath to equilibrium.) It is common in DGE macroeconomics to start by deriving the stock equilibrium. (p. 6)

... In the basic model the focus was on obtaining the optimal levels of consumption and the capital stock. As the change in the stock of capital equals gross investment net of depreciation, this also implies a theory of net investment. We saw that following a permanent change in the long-run equilibrium level of capital, it is optimal if the actual level of capital adjusts to its new equilibrium over time along the saddlepath. The adjustment path for capital implies an optimal level of investment each period.” (p. 32)

Thus the basic idea seems to be that at each moment newly produced capital goods add themselves to the already existing capital goods, and supply and demand are able to ensure that the total supply of capital goods finds employment at a rental rate equal to the marginal product of capital while labour finds employment at a wage rate equal to the marginal product of labour, just like in an economy where factors are only labour and land. The fact that demand for capital enters aggregate demand because it is demand for produced goods is argued to be irrelevant because stock equilibrium is reached every period and thus, as long as the economy is on a path of intertemporal equilibrium, firms need not worry about whether they will be able to sell the capital goods they produce, because their sale is ensured by the reaching of stock equilibrium at each date and therefore also at the date when they will come out. In other words, the implicit argument is that Say’s Law is ensured by the reaching of stock equilibrium at each date.

Sargent (Macroeconomic Theory, I ed., 1979; the second edition is identical in this part) traces back this idea to Tobin’s (1955) model of growth with money. In that article Tobin proposes a growth model where, period after period, there must be equilibrium between supply and demand for assets, the supply of assets consisting of capital  $K$  and of the supply of money  $M$ . This equilibrium implies the desire to hold the full supply of both assets, and thus the absorption of any production of capital goods, the flow of new capital goods simply being a gradual alteration of the total stock of capital which is continuously fully demanded owing to that equilibrium. Relative to a standard Keynesian macro model, this equilibrium condition replaces the investment=savings condition where

investment is a function of the rate of interest. Thus Tobin's approach implies the disappearance of an investment function from the macroeconomic model. Sargent (cf. the Appendix at the end of the present paper) recognizes this fact and admits that in this way investment is assumed to adapt to whatever the level of full-employment savings, through the condition that at time  $t+1$  the rental of total capital and the rate of interest will be such that produced capital goods are sold at cost-covering prices: in other words, the assumption is that the economy will follow a time path of prices and rentals that ensures the continuation of stock equilibrium at the same time implying cost-covering prices.

9.

I wish to argue that the above picture replicates what happens in an intertemporal equilibrium but is untenable as a positive theory of how actual economies function, because in actual economies there is no auctioneer-guided tâtonnement and no system of futures markets able to establish equilibrium instantaneously and simultaneously on present and future markets<sup>[13]</sup>, and lacking this simultaneous determination there is no guarantee that the time path of prices will be the one needed for continuous equilibrium – with implications for the behaviour of firms that reinstall a role for an investment function.

Absent the auctioneer who stops every exchange and production and ensures ex-ante adjustment of supplies and demands, this adjustment must be reached via trial and error. A firm cannot know the demand for its product before producing it, because demand will depend on price which will depend on supply which depends on what other firms are deciding to do. If firms decide supply in Marshallian fashion by equating marginal cost to price, which price is that to be? The observed, current price? but that will most probably not be the equilibrium price when production will come out. Expected price? but that can be mistaken. Mistakes and corrections are inevitable, and they will often imply undesired accumulation of inventories, because for non-perishable goods it is often more convenient not to accept the very low price that would allow selling the entire production immediately; it is more convenient to reduce the flow of production below the flow of demand at an unchanged or nearly unchanged price, and to eliminate in this way the undesired excess inventory<sup>[14]</sup>. Undesired inventory accumulation brings about inventory decumulation, hence fluctuations of output. If this happens simultaneously in a high proportion of industries, one has economy-wide fluctuations of output.

But output adjustments also imply adjustments in input demands. A firm cannot know the

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<sup>13</sup> As far as I know, no renowned general equilibrium specialist argues that actual economies are continuously in equilibrium, as if there were an auctioneer ensuring absence of disequilibrium exchanges and productions. Frank Hahn is well-known for his statements to the effect that general equilibrium theory is unsatisfactory because it has no theory of how the 'invisible hand' actually works. Also cf. fn. 29 below.

<sup>14</sup> As noted e.g. by Ciccone (1999), Marshall gave great importance to the 'fear of spoiling the market' as a reason for firms to avoid trying to sell what they produced at whatever price was necessary to get rid of it. Then the behaviour I have sketched appears highly likely.

value marginal product of labour or of capital unless the product price is known. So reaching an equilibrium between supply and demand for labour or for capital goods must be simultaneous with establishing equilibrium prices for produced goods. It can only be the result of a tendency toward a flow equilibrium on product markets. Therefore the idea that one can reach a stock equilibrium (i.e. equilibrium on factor markets) independently of the attainment of a flow equilibrium on product markets is untenable. But flow equilibrium on product markets requires consideration of demand for newly produced capital goods, coming from firms which are (or can logically be made to be) different from the first group of firms that are deciding how much to produce. This second group of firms can be treated in a way similar to the first group only if one assumes the existence of markets where flow equilibrium for *their* products is reached – futures markets. Reaching equilibrium on these markets would in turn require introducing a third group of firms, and farther futures markets, and so on endlessly – nonsense on stilts, as Joan Robinson would have put it. The reference to demand is ineliminable, however far into the future one tries to remove it. And since the only way to remove it to some future period is by assuming futures markets and thus patently to contradict reality, the thing is impossible from the start. Conclusion: demand for products enters inevitably into the determination of stock equilibrium. And since the part of this demand for products that is demand for capital goods depends on decisions which can be as tentative and erroneous as the decisions of existing firms as to how much to produce, one cannot do without an investment function that determines the actions of firms as functions of current variables, actions then to be corrected depending on how current variables change, but that cannot be assumed to be the equilibrium ones to start with. Hence, an investment function is ineliminable.

10.

The conclusion just reached implies that the problem I started from, the difficulty of justifying on the basis of marginalist-neoclassical premises an investment function that makes investment depend on the rate of interest alone, is still there to be faced – unless the full employment of labour is pre-supposed, which is an untenable assumption after Keynes.

The only neoclassical way to surmount this problem that I am aware of is the early (1963) version of Jorgenson's 'neoclassical' approach to investment. It even made it to textbook level: it was adopted by Dornbusch and Fischer. However, for unclear reasons (but perhaps not so unclear, see below) it has never achieved great popularity and nowadays appears totally forgotten. The basic idea is to take as given (expected) demand instead of labour employment. The rate of interest selects the 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 in the 3<sup>rd</sup> 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  $K^* = g(rc, Y) = \frac{\gamma Y}{rc}$ . This approach needs of course the traditional marginalist conception of capital-labour substitution, and 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<sup>(15)</sup>; but at least it avoids the indeterminacy of the marginal product of capital connected with the variability of labour employment.

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.

On the latter speed, personally I cannot see why so much fuss is made about the need to determine it precisely. It is, to use neoclassical terminology, a disequilibrium phenomenon, necessarily including accidental and transitory elements, such as expectations on how prices will evolve, which are inevitably vague, different from entrepreneur to entrepreneur, and subject to quick correction<sup>[16]</sup>. Therefore it seems evident to me that 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 a 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<sup>[17]</sup>, all inherently variable and transitory elements. 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.

Thus 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.

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<sup>15</sup> 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.

<sup>16</sup> Interestingly, the attempts to study the speed of adjustment via calculus of variations or optimal control cannot make room for these elements, and must assume given constant expected prices, an extremely debatable assumption that deprives the results of the analysis of any pretence to superiority relative to more intuitive and more flexible reasonings.

<sup>17</sup> Anticipating somewhat current option-based approaches, Dornbusch and Fischer sensibly note: "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." (DF 1984 p. 217). Analogous sensible considerations are in Ackley (1978, chs. 18 and 19).

11.

The term ‘flexible accelerator’ admits the presence of an accelerator-type influence upon investment. The possibility then arises that this influence may cause a tendency to instability due to multiplier-accelerator interaction (that this interaction would generally cause instability was argued e.g. by Hicks to be the more plausible outcome), an instability that the ‘neoclassical’ mechanism may be unable to overpower. This danger is made very real by the fact that the ‘neoclassical’ influence is considerably diminished in its strength (relative to the pre-Keynesian assumption of full labour employment) by the endogenous adjustment of labour employment. For a given level of aggregate demand, the elasticity of the desired capital stock (and hence of investment<sup>[18]</sup>) to the rate of interest is less – possibly considerably less – than if the denominator of the K/L fraction were given: 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  $\alpha$  to  $\beta$  causes an increase of desired capital from  $K_1$  to  $K_3$  if labour employment is fixed at  $L_1$ , from  $K_1$  only to  $K_2$  if output is fixed.

So assume that, from an initial situation of full employment, for some reason (for example, a decrease of state expenditure) Y decreases. Then desired K decreases, investment decreases, through the multiplier this causes Y to decrease further, labour employment decreases, and the decrease of Y causes a further decrease of investment. The neoclassical factor substitution mechanism can counteract this tendency toward a grave fall of output and employment only if there is a fall of the real interest rate that raises the desired K/L ratio (in new plants, the ones where there is technical choice). Considering the nominal interest rate to depend on the (given) supply of and the demand for money, the decrease in interest rate may be brought about by the decrease of Y, possibly helped by a decrease in nominal wages and hence in prices<sup>[19]</sup>; however, the decrease of prices, that is, the negative rate of inflation, requires a big fall in the nominal interest rate in order to prevent the real interest rate from rising, and the increasing lender risk due to uncertainty about debtors’ capacity to repay debts in a situation of decreasing Y and prices may well prevent a fall of nominal interest rates. For example now Central Bank interest rates are extremely low, but interbank lending rates remain

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<sup>18</sup> The convenience of keeping existing plants in operation as long as quasi-rents are non-negative still holds, so if output does not change investment will be again an opportune reduced-scale copy of the demand for capital.

<sup>19</sup> This mechanism can be criticised with arguments based on uncontrollable endogeneity of money supply (Basil Moore), or on the role of central banks in determining the interest rate. This latter role would not disturb the argument if it could be argued that changes in the rate of unemployment always affect the rate of inflation such that (i) a reaction of the central bank to the rate of inflation is essentially a reaction to the rate of unemployment, (ii) the central bank’s reaction would have qualitatively similar effects on the interest rate as Keynes’s mechanism. Thesis (i) is what the notion of natural rate of unemployment implies, but this notion has been vigorously contested even by otherwise mainstream economists, e.g. Ray Fair (??), who have argued that there is no convincing evidence in support of such a notion nor of a vertical Phillips curve (Petri 2003). The implication is that there is no justification for the use of a mechanical Taylor rule. For the argument I am developing, the implication is that central bank determination of the nominal interest rate cannot be assumed to operate in the way needed for the ‘neoclassical synthesis’ argument against Keynes.

high. And even if nominal interest rates decrease down to almost zero, the experience of Japan in the 1990s and of the current crisis should induce the neoclassical economist to admit that the neoclassical factor substitution mechanism may be unable to surmount the depressing influence upon investment of a downward multiplier-accelerator interaction. The neoclassical-synthesis mechanism that should push toward full employment becomes highly doubtful independently of the criticisms that can be advanced against the marginalist notion of capital.

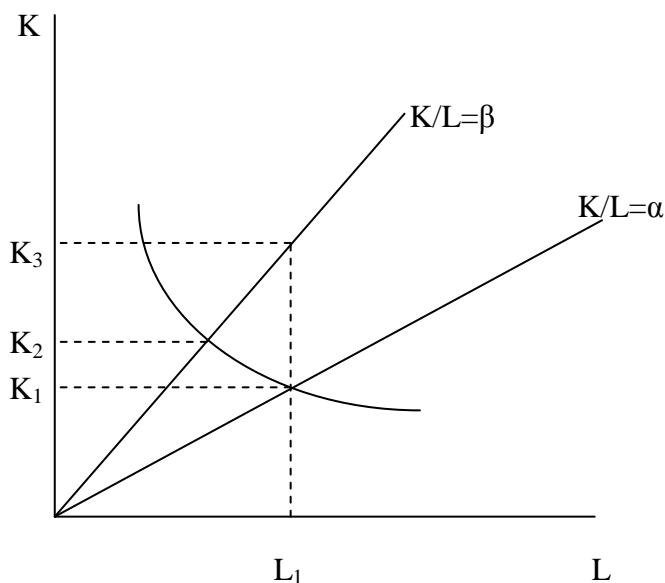


Fig. 1

Perhaps this implication of the approach helps to explain its limited diffusion in a period when a majority of macroeconomists preferred to believe in a great stability of market economies: the approach is too open to the possibility that the influence of the rate of interest be weaker than the influence of output variations, with a concrete possibility of instability. Dornbusch and Fischer do not place great stress on these implications of their approach; nor do they recognize that it seriously questions the central role of the IS-LM model in their textbook<sup>[20]</sup>. But the implication is there, and it means that the neoclassical-synthesis argument that the responsibility for the absence of a tendency toward full employment rests with the downward rigidity of nominal wages, becomes considerably less convincing, as I proceed to show. In fact the approach has consequences on the effects of wage decreases which are rather unconventional.

12.

It is perhaps useful, for some of the younger readers (nowadays it is not part of the usual curriculum of graduate students to study Keynes, or the history of macroeconomic theory), to remember the neoclassical-synthesis argument against Keynes. In Ch. 14 of *The General Theory*

<sup>20</sup>The relevant influence of *variations* of output on investment would make the IS curve a construction of little significance, thus undermining the IS-LM model.

Keynes had pointed out that once income variations had made savings equal to a given investment level, the traditionally assumed mechanism (disequilibrium between savings and investment, reflected in a disequilibrium on the 'loanable funds' market) supposedly pushing the rate of interest toward the full-employment equilibrium level could not operate, because there was *equilibrium* between savings and investment. He had then added, in Ch. 19, that a lowering of the *money* wage (the sole wage that workers could directly affect) risked having a depressing effect on investment by lowering expected revenues from investment in consumption-goods industries, and, even if the decrease in investment did not happen<sup>(21)</sup>, the lower money wage would anyway not result in an increase in employment because any attempt to increase employment would result in an aggregate supply exceeding aggregate demand, and hence in a lowering of money prices. Thus a lower *money* wage would simply bring about a proportionally lower price level, leaving the *real* wage and hence the demand for labour unchanged<sup>(22)</sup>: workers could well be willing to accept a reduction in real wages, but they were unable to bring such a reduction about.

The quick reply of a number of economists (Hicks, Meade, Haberler, Modigliani, etc.<sup>[23]</sup>) was that Keynes had no right to assume that the level of investment would remain unchanged when money wages decreased, because, according to Keynes' own analysis, the lower price level would imply:

- a lower demand for money for transaction purposes,
- hence a downward shift of the money demand function (in the IS-LM model, a shift of the LM curve to the right),
- hence (on the basis of Keynes's own liquidity-preference theory of the interest rate as

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<sup>21</sup> Keynes also argued that investment might be discouraged by the decrease in wages.

<sup>22</sup> Keynes accepted that an increase of employment required a decrease of real wages. Reasons to doubt this thesis will be presented shortly.

<sup>23</sup> Hicks 1937; Meade 1937; Modigliani 1944. Neither Hicks nor Meade explicitly said that the responsibility for persistent unemployment was with the rigidity of money wages (the first one to say so in print appears to have been Modigliani), but this conclusion was implicit in their analyses because they explicitly noted the influence of the money *wage* level on the position of the LM curve or more generally on the demand for money. Haberler wrote a letter to Keynes on May 16, 1938, asking him: "Would you agree that an equilibrium with involuntary unemployment is incompatible with perfect competition in the labor market? If namely competition there were perfect, money wages would fall all the time so long as unemployment existed and any conceivable desired level of liquidity could be reached?"; Keynes replied on May 25, 1938: "If a decline in employment is associated with an increase in the quantity of money in terms of wage units *ad infinitum* a compensatory factor comes into force: though even so it does not follow that involuntary unemployment can be avoided any more than it can be avoided by increasing the quantity of money indefinitely, keeping money wages unchanged. If classical economists have always meant that a sufficient increase of money in terms of wage units would be a compensatory element, well and good. I am not aware of any passage written before the publication of my book, in which anyone in the classical tradition had said this or anything remotely resembling it. I have always understood that they favoured a reduction in money wages because they believed that this would have a direct effect on profits, and not one which operated indirectly through the rate of interest." (Keynes Collected Works, XXIX, pp. 272-73). Also cf. Garegnani (1978(1964), p. 52, fn. 32).

determined by the equilibrium between supply and demand for money) a lower interest rate,

- hence (on the basis of Keynes's own admission of a negative elasticity of investment with respect to the rate of interest) a higher level of investment.

It could thus be argued, on the basis of Keynes' own analysis<sup>(24)</sup>, that a lowering of money wages was capable of inducing an increase of employment, albeit through the indirect route of the effects of the price level on the interest rate (the so-called 'Keynes effect'). Indeed, the neoclassical economist might have thanked Keynes for clarifying the mechanism which, in neo-classical orthodoxy, had to be considered responsible for guaranteeing increases in employment in response to decreases in (money, but then also real) wages.

The remaining reasons which could still prevent the tendency to full employment – the 'liquidity trap'; an insufficient elasticity of investment with respect to the rate of interest; the discouragement of investment due to the initial decrease in demand caused by the lower purchasing power of workers – could be argued to be either due to mistaken expectations which experience would gradually correct<sup>(25)</sup>, or due only to the temporary delay between money wage reductions and price reductions. On this basis it was argued that Keynes's analysis did not offer convincing reasons to deny the tendency to full employment in the long run, if money wages were not rigid in the presence of involuntary unemployment<sup>(26)</sup>.

13.

What remains of this argument in the approach of Dornbusch and Fischer? This approach implicitly recognizes 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. Given the putty-clay nature of capital, a neoclassical economist who considers income distribution determined by marginal products must admit that it will be the marginal products in new plants that will be relevant. An increased investment, in order to be brought about by an increase of the desired K/L ratio, must therefore be associated with a decrease of the real interest rate and an *increase* of the real wage (an implication already in sharp contradiction with the usual thesis that real wages must decrease in order for employment to increase). The sole way a decrease of money wages can bring about an increase in

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<sup>24</sup> Cf. especially point (5), p. 263 of *The General Theory*.

<sup>25</sup> The 'liquidity trap' was understood to be due to a general persuasion, based on past experience, that the rate of interest would not stay below a certain 'minimum normal' level for very long; as the rate of interest went below that level, everybody would prefer to turn non-monetary assets into money, in the expectation of an impending rise of the rate of interest that would bring down the price of all fixed-coupon securities; and further decreases of the rate of interest would not be possible. But if the rate of interest remained for a sufficient length of time below the 'minimum normal' level, that persuasion would be shaken, bringing about a downward revision of the level considered the 'minimum normal' one. Thus, albeit slowly, the liquidity-trap level of the rate of interest would move downwards. As to the insufficient elasticity of investment, the acceptance of the marginalist approach to distribution – based as it was on the premise of a considerable elasticity of long-period factor demand curves – made it natural to restrict this possibility to the short period only.

<sup>26</sup> Cf. Appendix 7A3 for a discussion of the 'Pigou effect' or 'real balance effect'.

investment and thus in aggregate output and employment is therefore by causing such a decrease of the demand for money, as will cause such a decrease of the nominal interest rate as will induce – by decreasing costs – a greater fall in prices than in money wages.

Now, the first, impact effect of a decrease in money wages is in all likelihood a decrease of real wages too. It is in fact plausible that there be some lag between the decrease in money wages, and the decrease in prices caused by the decrease in costs. If money wages keep decreasing, the lag will persist and the lower real wages will cause a decrease of the average propensity to consume, if – as is generally accepted – the propensity to save out of wages is lower than the propensity to save out of property incomes. This will tend to depress aggregate output and therefore to discourage investment by decreasing desired productive capacity. Furthermore the lower real wage will tend to lower, rather than raise, the K/L ratio in new plants, further discouraging investment. A downward multiplier-accelerator interaction will be set in motion.

That the real wage may remain lower than initially, and the real interest rate higher, for a long time, is also suggested by what will be happening to the nominal interest rate. The decrease in prices caused by the decreasing money wages means a negative rate of inflation: in a liquidity-preference theory of the rate of interest, a negative rate of inflation raises the demand for money by lowering the opportunity cost of keeping money idle<sup>(27)</sup>; this works against the decrease in the demand for money due to the lower price level. This confirms that the likelihood is high that the decrease in money wages may start a recession, then aggravated by accelerator-multiplier interaction.

Further little-noticed consequences of the approach arise when the decrease in money wages finally succeeds in bringing about such a decrease of the nominal and real interest rates<sup>(28)</sup> as will cause an increase of the desired K/L ratio in new plants. Given the recessionary tendency of the economy until then, the increased K/L ratio may be able only to prevent output from falling further. Then the higher K/L ratio in new plants means that new plants employ less labour than the older plants they replace. That is, employment decreases and keeps decreasing as the replacement of old plants with new plants proceeds, unless investment rises so much as to cause a rise of Y sufficient to counterbalance this negative effect on employment. A very long time might pass before the economy showed any tendency of employment to increase.

These considerations should suffice to show how indeterminate the effects of decreases in money wages become, the moment one more consistently develops the implications of the existence of labour unemployment for investment, even in an otherwise marginalist framework.

The point is that as long as there is labour unemployment, the presence of an accelerator component in investment demand appears inescapable even in an otherwise neoclassical approach. This is what Jorgenson 1963 implicitly admitted. Even Romer admits it (ch. 8, pp. 381-83). To repeat, the reason is that the rate of interest, or more generally income distribution, only determines

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<sup>27</sup> In an IS-LM diagram with the real interest rate on the vertical axis, the LM curve shifts upwards.

<sup>28</sup> This decrease will of course be the more difficult to achieve, the more the supply of money is endogenous.

the K/L ratio, and the demand for capital (and hence investment) requires a further condition in order to be determined. If labour employment is not given, the only alternative would appear to be to take as given the level of intended sales, that is, Y; and then net investment will depend on the variations of Y.

14.

Summing up, after Keynes the attempts to consider investment a function of the interest rate alone have always suffered from grave weaknesses and contradictions even accepting the marginalist conception of capital-labour substitution. The need to prove, rather than simply assume, the tendency to the full employment of labour requires a theory of investment that does not assume the full employment of labour and this is not made clear in the current presentations of investment theory, which are amazingly unrigorous and contradictory, with the result of spreading disastrous habits of superficiality and lack of rigour among younger economists. The only way to decrease this lack of rigour while accepting the marginalist-neoclassical conception of capital-labour substitution would be to admit an accelerator-type influence upon investment, but this would further undermine the neoclassical-syntesis anti-Keynesian arguments, already debatable because of endogenous money, Central-Bank-determined interest rate, possible perverse effects of decreases of wages upon aggregate demand and expectations, etcetera. The modern macroeconomic RBC or New Keynesian models which are claimed to have strong microfoundations in fact have *extremely weak* microfoundations, because they assume continuous equilibrium, which amounts to assuming the existence of the auctioneer and instantaneous equilibration, assumptions which no serious general equilibrium theorist has ever claimed to be acceptable for positive economics<sup>[29]</sup> (and in fact general equilibrium theory is nowadays in a deep crisis).

My invitation then to younger economists is to pretend rigour, remembering that rigour, in

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<sup>29</sup> For example an article that includes Alan Kirman among the co-authors (Colander et al., 2008) implicitly denies the legitimacy of the auctioneer by criticizing harshly the assumption of a representative agent and insisting that “*Any meaningful model of the macro economy must analyze not only the characteristics of the individuals but also the structure of their interactions*”, an issue to be studied for example by developing agent-based models which have the great advantage that “equilibrium is a potential outcome rather than an imposed requirement.” Arrow 1959 is known to have argued that competition requires time to operate and is inseparable from “considerable short-run monopoly powers in transitory situations”, thus denying continuous equilibration. Malinvaud is also known for denying the applicability of general equilibrium theory to macroeconomic events.

Possibly, strictly continuous equilibrium might not be claimed to be really necessary to the validity of the macroeconomic theories I am discussing, on the basis of the misunderstanding pointed out in Petri (1999, p. 53-54), and argued at length in Petri (2004), according to which it is in fact a continuing faith in the traditional notion of capital that motivates “a more or less conscious belief that things work out *as if* capital could be treated in the traditional marginalist way”, and it is only because of such a belief that it is also believed “that sequences of neo-Walrasian equilibria describe with acceptable approximation the behaviour of market economies”. But admitting that this is how things really stand would imply that equilibration processes take time, and this is all that my argument of §9 needs.

economics, does not require only that deductions from assumptions be correctly derived, but also and even more importantly that the assumptions be plausible, mutually consistent, and in accord with empirical evidence and with analytical advances. On the accord with empirical evidence: that, in the face of the resistance and despair of fired people, a macroeconomic theory be built on the assumption that when unemployment increases it's because people prefer to work less, is an insult to intelligence and to the people who get fired. As to the analytical advances, these have definitively shown that capital cannot be conceived in the traditional marginalist-neoclassical way; this is, in more than one sense, a liberation: because it makes sense of the empirical evidence that consistently contradicts the presumption of a significant interest elasticity of investment<sup>[30]</sup>; and because by undermining the neoclassical approach to income distribution and by giving legitimacy to the assumption of given income distribution when one studies the determinants of employment and growth, it opens the way to simpler analyses of what may determine investment.

The central purpose of this paper was critical; a positive theory of investment is something else and will not be attempted here. Still, it seems clear that bringing sense back to the theory of aggregate investment requires admitting the influence of demand, of possible constraints from fund availability, of government support, and of technical progress or more generally innovation. I only add one observation on the role of demand, which may be useful for the same young economists of prevalent mainstream formation for whom I summarized the 'neoclassical synthesis' argument.

I have argued that the moment the continuous full employment of labour is not assumed, even neoclassical economists are obliged to admit a relevant influence upon investment of accelerator-type mechanisms. Since the neoclassical conception of capital-labour substitution is illegitimate, the

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<sup>30</sup> I add two more quotations to this effect to the ones in Petri 2004, ch. 7. Dixit and Pindyck (1994, p. 419): "The explanation of aggregate and sectoral investment spending has been one of the less successful endeavors in empirical economics. For the most part, econometric models have not been very useful for explaining or predicting investment spending. The problem is not just that these models have been unable to explain and predict more than a small portion of the movements of investment. In addition, constructed quantities that in theory should have strong explanatory power — such as Tobin's  $q$ , or various measures of the cost of capital — in practice do not."

Shapiro (1986, pp. 111-12): "One of the best-established facts in macroeconomics is that business fixed investment and output move strongly together over the business cycle. By contrast, investment and the cost of capital are either uncorrelated or only weakly correlated. These relationships might appear to suggest that business fixed investment can be best explained by an accelerator model of investment, whereby investment responds to changes in the desired capital stock, itself determined by the demand for output. The theory behind the accelerator model is akin to the man-on-the-street view that firms have little incentive to invest when current prospects for selling the output produced by the new capital are relatively poor. .... That investment cannot be explained by the cost of capital has not gone unnoticed. The nation's best-selling macroeconomics text includes the following passage: 'At least on evidence through 1979, it seems that the cost of capital empirically does not much affect investment and that accordingly the simple accelerator model does as well as the neoclassical model at explaining investment.' The authors of the textbook, Rudiger Dornbusch and Stanley Fischer, speculate that the large changes in the cost of capital experienced in the early 1980s might help identify the effect of the cost of capital on investment. Unfortunately, this has not been the case."

neoclassical element in the ‘flexible accelerator’ must be dropped, and one is left with the accelerator, that is, the influence of demand upon desired capacity, as a starting point for a reconsideration of investment theory. What one needs here is to get rid of the mental straitjacket imposed by the neoclassical paradigm, which makes it more difficult to perceive, or to admit the importance of, certain aspects of reality because it has difficulty with fitting them into its theoretical framework. The dominance of this paradigm, with its tendency to an equilibrium based on given and fully utilized factor supplies, has obscured the flexibility of aggregate production in response to changes in aggregate demand, with its radically anti-neoclassical implications for growth theory.

When one asks what determines the quantities of capital goods, their tendency to adapt to the demand for them at supply prices is the obvious answer. But this adaptation assumes a variability of the quantities produced of them, whose implications are not always fully grasped. The variability of the quantities produced of capital goods is part and parcel of that considerable capacity of production quickly to adjust to demand, that characterizes most markets of produced goods and without which our society would be very different. Without a quick adaptability of the flow supply of capital goods to demand, the adaptability of supply to demand would be non-existent for most produced goods: a flexible supply of flour is indispensable for the supply of bread to adapt to demand without frequent and large changes in the price of bread, changes that would enrage consumers and shake the smooth functioning of society. Competition contributes: firms *want* to be able to guarantee a quick adaptation of production to demand, in order to maintain customer goodwill and not to lose market shares. Thus they maintain some ‘slack’ in the normal utilization of their available quickly mobilizable resources: spare capacity, inventories, some unused potential supply of labour services. Part of this ‘slack’ is also ensured by cost minimization: the need to pay higher wages for night shifts induces firms not to use fixed plants 24 hours a day; but increases in the utilization of fixed plant remain possible if demand increases. Inventories (usually neglected in general equilibrium theory) of raw materials and of parts to be assembled ensure the possibility of rapid increases of production; the consequent run down inventories are rapidly reconstituted by the increased production of the industries producing them. Capitalist economies add to this flexibility by maintaining a considerable amount of unemployment; but even employed labour can generally supply an increased amount of labour services if asked to do so. Without this ‘slack’, the absence of short-period factor substitutability would make it very difficult to vary production by simply transferring some variable factors, e.g. labour, from one industry or firm to another; the observed generally quick adaptation of supplies to demands would not be possible. (This ‘slack’ was implicitly conceded as a positive element of capitalist economies in the Western literature that criticized the ‘tautness’ of planning in the USSR.) The flexibility of production must be expected to be even greater than average in the durable capital goods industries, where firms know that they must stand ready to face strong swings in demand (for the well-known reasons that gave birth to the term ‘accelerator’).

This generalized ‘slack’ strongly suggests a view of economic growth and capital accumulation as dependent on the evolution of aggregate demand<sup>[31]</sup>, because it implies that

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<sup>31</sup> Cf. e.g. Garegnani and Palumbo, 1988; or Petri, 2003; and the vast literature only partially there mentioned.

*aggregate* production too 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<sup>[32]</sup>. Hence investment is almost never 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. The implications are being discussed by a literature which is rapidly growing (my small contribution is in Petri 2003).

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<sup>32</sup> Most plants can usually produce much more than ‘normal’ production, by having recourse to multiple-shift production or full-pace production 24 hours a day. Labour constraints are usually non-existent in the short run because of visible or hidden unemployment and underemployment and because of the frequent readiness of employed workers to do overtime if it is paid sufficiently, and over the longer run there are migrations and structural social adaptations, e.g. changes in the participation of women, that suggest that in the longer run labour supply, like capacity, adapts to demand.

## Appendix – Sargent’s Keynesian and Tobinian models

Sargent 1979 p. 8: ‘ruling out trading of existing stocks of capital is a fundamental feature of the class of “classical” and “Keynesian” models that we shall be describing. It is the feature that makes flow aggregate demand play such an important role. In contradistinction, in Tobin’s “dynamic aggregative model”, which we study in Chapter III and in which there *is* a perfect market in which firms trade *stocks* of capital, flow aggregate demand plays no role in determining the level of output at a point in time.’

Keynesian model:

$$Y = F(K,N)$$

$w/p = F_N(K,N)$  real wage equals marginal product of labour

$C = C(Y-T-\delta K-(M+B)\pi/p, r-\pi)$  consumption function depending on after-tax income and on the real interest rate ( $r$  is nominal interest rate,  $\pi$  rate of inflation)

$$I = I(q(K,N,r-\pi,\delta)-1) \text{ where } q = \frac{F_K - (r + \delta - \pi)}{r - \pi}$$

$$C+I+G+\delta K = Y$$

$$M/p = m(r,Y)$$

(differs from “classical” model in that  $w$ , nominal wage, is given while in the “classical” model it is a variable and there is an additional equation  $N = N(w/p)$  that establishes the full employment of labour.)

Tobinian model:

the investment equation is replaced by the following equation:

$$(r+\delta-\pi) = F_K(K,N).$$

p. 88-89: ‘the economy’s rate of net investment is determined as a “residual” in Equation (VI) [equation  $C+I+G+\delta K = Y$ ] ... saving intentions are realized and ... these, together with the government’s fiscal policies, govern the economy’s rate of capital accumulation. In this sense investment is determined entirely on the “supply side”, i.e., by the flow of resources that consumers and the government are willing not to consume. Notice also that the model contains a device for reconciling firms to whatever rate of investment is determined by this process. The rate of investment determines subsequent levels of the capital stock. The model will generate time paths of prices, the interest rate, and output which guarantee that firms are content to hold just the existing capital stock at each moment of time.’