

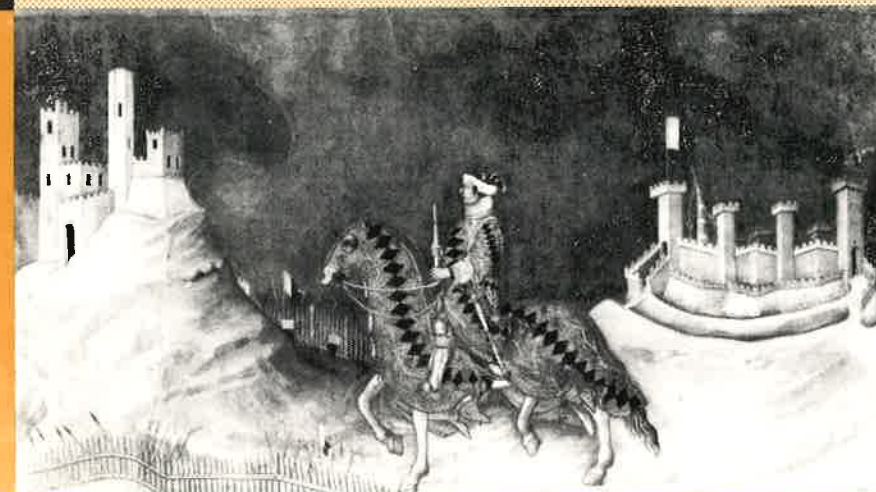
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QUADERNI DEL DIPARTIMENTO
DI ECONOMIA POLITICA

Mauro Caminati

ON THE STABILITY OF LONG-PERIOD POSITIONS:
AN INTRODUCTORY NOTE



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1. Alternative views on gravitation.

Central to the classical view of competition is the notion of capital mobility¹: in its search for maximum profitability, capital flows from sectors where the rate of profit is lower, to sectors where the rate of profit is higher. Hence, rates of accumulation across industries depend, *ceteris paribus*, on (rates of) profit differentials².

Closely related to this view of competition, is the notion of a long-period position (LPP hence-forth) of the economy³. A classical LPP is defined as a given productive technique, a given state of distribution (a given real wage rate), and an associated set of relative commodity prices, such that the rate of profit is uniform across industries. The definition must also include a set of given industry outputs, namely, those outputs consistent with the use of the given technique⁴. Long-period prices corresponding to the given data of the theory (technology and distribution) define a state of the system where the driving forces of classical competition are at rest.

If the above definition seems to be generally shared by economists close to the classical tradition, opinions concerning relevance are not so uniform.

According to a first view, existence, and nothing more, is required for the relevance of LPPs, and, as is well known, LLPs can be shown to exist. The idea is that the pre-eminence accorded to classical competition, makes the notion of LPP necessary in order that the economic process be intelligible. If we abstract from aggregation problems, technology and distribution are indeed given at any given

¹ Cf. Eatwell [16].

² If the economy is stationary, a slightly weaker proposition holds true in a fixed capital environment with irreversible investment.

³ Cf. Garegnani [25].

⁴ Cf. Sraffa [47], Garegnani [24] and [26].

time instant, and the corresponding long-period prices can be computed⁵. The long-period nature of such prices should not (and could not) be identified with their persistence, or with the property of attracting market prices; hence, the issue of their stability is misplaced. Within this interpretation such questions as: "what makes prices change? what are the assumptions on returns to scale?" do not even arise. Although some existence proofs use theorems of linear algebra, the assumption of constant returns to scale is not necessary to the proof, if all changes in industry output are interpreted in a notional sense⁶.

According to a second view, a LPP must be also regarded as the rest point (*i. e.* equilibrium point, in the language of dynamical systems) of a dynamic adjustment process starting from arbitrary conditions, sufficiently close to it. It is argued that this adjustment process must be shown to meet some minimum stability requirement, before any relevance can be attached to LPPs.

In this way, economic behaviour out of LLPs cannot be abstracted from, with two immediate consequences.

In the first place, since adjustment involves changes in quantities, returns to scale cannot be ignored; here, the need for mathematical tractability leads almost invariably⁷ to the assumption of constant returns to scale, which is sometimes justified, in this context, on the ground that the analysis is local: *i. e.*, the system is assumed to be close to its LPP, at the initial date.

In the second place, a stability proof requires that the underlying adjustment process is specified in every detail. Unfortunately, as we shall partly see below, the choices to be made involve a risk of arbitrariness, if they are not

⁵ Cf. Roncaglia [42].

⁶ The irrelevance of returns to scale in Sraffa [44] has been argued in Punzo [40] on the (quite different) ground that Sraffa's existence arguments would follow a constructive approach.

⁷ For an exception Cf. R. Arena and C. Froeschle, "Formes de progrès technique, séquences d'équilibres temporaires et stabilité économique", *Economie appliquée*, tome XXXIX 1986 N.3, pp. 415-447.

sustained by a consistent and realistic theory of adjustment, which includes also the formation of expectations.

This extent of arbitrariness, and other problems that we shall mention below, have convinced some authors that it will be extremely difficult to provide a general, rigorous mathematical foundation to the idea of gravitation. In as far as gravitation is necessary to the relevance of LPPs, it is suggested that it should be taken as an *axiom*⁸, possibly sustained by a significant amount of empirical and theoretical results.

So far, we have implicitly supposed that the formation of LPPs (*i. e.* the process through which long-period magnitudes come to be what they are), and their stability, can be dealt with separately, that is, in different parts of the theory. Correspondingly, in most gravitation models, LPPs are characterized as the *unique* and *unchanging* rest point of the dynamic process of adjustment. This conception implies two strong assumptions⁹: a) *endogenous* changes in the long-period magnitudes are sufficiently slow, if compared with the speed of convergence of the short-period magnitudes; hence, gravitation is concerned only with short-period phenomena; b) *exogenous*, *drastic* changes in the same magnitudes are unfrequent, and do not *normally* interfere with gravitation.

It is worth noticing that, even in the presence of assumptions a) and b), the rigid dichotomy between short-period and long-period analysis requires that the idea of gravitation is interpreted in the strong sense of convergence (see below, paragraph 2.1.).

Real-world conditions provide relatively abundant evidence of the endogenous changes referred to above. Endogenous technical progress is a case in point; but one may think of other simple cases that are consistent with the assumption

⁸ For an explicit statement in this sense, cf. Schefold [43] and [44].

⁹ Cf. Garegnani [25].

of given technical knowledge. For example, if one admits adaptive forms of learning, desired stocks per unit of output are not independent of the observed pattern of output, with quite obvious consequences.

If we allow for this type of phenomena, and assumption a) does not hold true, LPPs become *path dependent*: the same adjustment process may give rise to different *locally stable* LPPs, depending on the initial condition. Exogenous data, which (in force of assumption b) are invariant throughout the analysis, are no longer sufficient to define the centre of gravitation of economic magnitudes. A thoroughly dynamic and quite *global* analysis is required. The same conclusion applies *a fortiori* if parametric changes in exogenous data are also considered¹⁰.

The paper is organized as follows: section 2. deals very briefly with some preliminary difficulties faced by dynamic analyses of gravitation. Section 3. describes what is regarded in the literature as the typical classical adjustment process, and considers the main formal specifications thereof; the brief overview of stability results, which follows, is largely motivated by the need to help economic intuition. Section 4. is concerned with composite forms of adjustment, where the typical classical reactions coexist with reactions of a Keynesian type.

2. In search of a general foundation.

2.1.

A preliminary difficulty, facing mathematical models of gravitation, is that it is not completely clear which of the mathematical stability concepts¹¹ should be chosen as the *necessary and sufficient* foundation of the notion of gravitation of market prices around production prices.

¹⁰ Cf. Pasinetti [39].

¹¹ Cf. Guckenheimer and Holmes [28], Lasalle [33].

If *dynamic stability* is the relevant concept, one is asked to show that—in the absence of accidental disturbances—market prices will *always* stay arbitrarily close to production prices, provided they are sufficiently close to them at the initial date.

If the notion of *attractor* is the relevant one, then all market prices near production prices, at the initial date, must *eventually converge* to the latter; in this case, market prices may still, *initially*, diverge; hence, the condition on the speed of convergence, imposed by assumption a) of section 1., is more difficult to meet, than it would be if production prices were both dynamically stable and an attractor. This stronger stability concept defines the notion of *asymptotic stability*.

It should be noticed that dynamic stability alone, does not reflect the idea of convergence; if LPPs are stable, but not asymptotically stable, market prices, initially close to production prices, may end up indefinitely far, after the system has been repeatedly perturbed by accidental disturbances¹². This remark suggests that the mathematical foundation of the idea of gravitation of market prices around production prices should be sufficiently robust to allow for accidental disturbances.

One may suggest that even strongly unstable LPPs can provide a sufficient foundation, if they lie inside an asymptotically stable closed orbit, or if the deviations of prices and quantities from their long-period magnitudes can be shown to be bounded. In both of these cases, recurrent deviations from long-period magnitudes should not be "too large"; hence, one is left with the additional task of providing economic criteria to decide upon the meaning of "too large", in this context.

It would seem that *boundedness of deviations* can provide a foundation to the dichotomy between short-period and long-period analysis only if the bounds are so narrow (i. e.,

¹² Cf. Lasalle [33].

despite local instability, the system is always so close to its LPP) that endogenous changes in technical conditions, and/or in the real wage, can be abstracted from. In this perspective, the distance corresponding to concepts like "sufficiently narrow" or "sufficiently close" depends upon the speed of those endogenous changes. If one takes into account the speed of phenomena like *learning by doing*, the above condition appears to be quite demanding.

2.3.

The problem of gravitation is generally understood to refer to the dynamic properties of relative magnitudes: relative prices and relative quantities. For this reason, the adjustment process referring to absolute magnitudes is usually modified by the addition of an invariance condition, which may simply consist of the choice of a given numeraire (a unit commodity price and a unit activity level). The trouble is that the stability properties of the modified adjustment process may depend on the invariance condition that has been selected. In other words, normalization may involve serious distortions, if intended simply as a tool for simplifying adjustment processes¹³.

This means that invariance conditions should not be arbitrary, and can be introduced only if they reflect properties of the real world; hence, the importance of considering the characteristics of money as a numeraire good: as it turns out, while there are reasonable assumptions leading to boundedness of money prices, one cannot think of an obvious invariance condition, which money prices satisfy in real economies.

The above remark suggests also that the macroeconomic dimension of adjustment processes is not irrelevant to the issue of gravitation. Indeed, what has been said concerning the possible distortion of stability properties caused by arbitrary invariance conditions, holds true, *a fortiori*,

¹³ Cf. Fisher [19], Flaschel and Semmler [20].

when the imposition of arbitrary macroeconomic conditions is considered. The assumption of Say's law is a case in point: in so far as gravitation is concerned with stability in relative magnitudes, macroeconomic dynamics is often "simplified" through the assumption of Say's law. Although this simplification may have its merits, the stability of LPPs must be (and has been, in part) investigated also under alternative macroeconomic assumptions.

It is important to notice in this respect that the stability of LPPs does not require a world where aggregate demand failures are ruled out¹⁴. Gravitation has to do with stability in proportions, which does not necessarily imply macroeconomic stability¹⁵.

3. Classical adjustment processes

3.1.

Reduced to its bare bones, the process of adjustment described by Smith, Ricardo and Marx is as follows: changes in prices depend on excess demand (hence, on output), intersectoral changes in output depend on rate of profit differentials (hence, on prices). Here, the word "change" should be interpreted as "proportional change per unit of time". Since price changes depend on output and output changes depend on prices, this form of adjustment is usually called "cross-dual" in the literature, but the definition is to some extent misleading, because strict cross-duality holds true only if simplifications are introduced. In the general case, since present demand depends also on net investment, and this depends on the planned change in output, (proportional) price changes come

¹⁴ Screpanti [45] contrasts the different premises to the analysis of gravitation that were offered by Smith and Ricardo on one side, and by Marx on the other. The main ground for this dichotomy is that Marx, unlike Smith and Ricardo, rejected Say's law. So far, so good; but Screpanti seems to imply that a more complex analysis of gravitation, where aggregate demand failures are admitted should reach negative conclusions.

¹⁵ Cf. Duménil and Lévy [14],[15].

to depend on both prices and quantities. The same holds true for (proportional) changes in output, if rate of profit differentials are interpreted as deviations from the average rate of profit, which depends, in its turn, on the composition of output.

The above process is sometimes "simplified", by assuming that capitalists know the uniform, long-period rate of profit r^* , and that the rate of profit differentials are computed as deviations from r^* . The assumption makes proportional changes in output depend only on prices. Another crucial "simplification" is obtained if current net investment (and hence current excess demand) is not related to the planned change in output, but consists of a proportional increment of inputs, according to the steady-state rate of growth g^* (supposedly known). Proportional price changes come to depend only on current output.

When both "simplifications" are introduced, the adjustment process takes on a simple, strictly cross-dual form; for ease of reference, in the present paper this form is labelled "simplified" cross-dual¹⁶.

Notice, in passing, that, in the "non-simplified" case, the realization of capitalists' plans requires the implicit presence of stocks of inventories, only in so far as planned investment and consumption (after replacement of inputs) give rise to a positive excess demand for one or more goods; in the "simplified" case, inventories are needed also because net investment does not provide the inputs which are necessary to the production of planned output.

In addition to the "simplifications" just described, different specifications of the classical adjustment process arise as a consequence of the way in which the relation between plans and realizations is dealt with.

There are at least two aspects of this relation, which are important in this respect:

¹⁶ Cf. Flaschel and Semmler [20].

a) whether or not plans are always realized;

b) whether price making is accomplished by "the market", or by firms.

In a first class of models price adjustment is accomplished by firms and it is not instantaneous: the price ruling at the next date is set at the present (hence, on the base of present information). Plans are always realized, and this is allowed by sufficiently large stocks of inventories. With some remarkable exceptions¹⁷, the presence of stocks of inventories is only implicit: their dynamics is not formalized and does not affect investment decisions¹⁸.

In all the other models price formation is accomplished instantaneously by "the market"; these models differ in the way plans, and investment plans in particular, are formed.

In so far as plans are revised instantaneously, and the commodity market is assumed to be stable, present prices represent short-period equilibrium prices¹⁹: they make sure that the present excess demand for each commodity is zero.

Alternatively, plans are not revised instantaneously, but depend on the prices observed before "the market has been opened". In this case, realizations do not coincide with plans, except by a fluke; they are determined by a rationing procedure, which is, to some extent, arbitrary: some models assume that intended consumption is always realized, and realized net investment is determined by net saving²⁰; in other models, planned net investment is always realized, and workers' consumption absorbs the residual supply²¹. Prices are set by the market so that plans, which are not realized in physical terms, are realized in money terms.

It is worth stressing that a matching of supply and demand, which occurs through a revision of investment plans,

¹⁷ Cf. Franke [23], Dumenil and Levy [12], [13], [14].

¹⁸ Cf. Boggio [8] and [9], Flaschel and Semmler [20].

¹⁹ Cf. Arena, Froeschle and Torre [3] and [4]; Franke [23].

²⁰ Cf. Nikaido [37] and [38].

²¹ Cf. Kubin [31] and [32].

interferes with intersectoral capital transfers; the revision of consumption plans, forced by market prices, brings in a mechanism of substitution in consumption (see below, paragraph 3.2.4)²².

As it turns out, the different specifications of the classical adjustment processes, do not always find a compelling theoretical justification. Unfortunately, the results of the analysis have often proved to depend crucially on the choices that had been made; hence, the need to obtain a better understanding of how the different results are related to those choices, and to single out the more promising lines of research.

3.2.

At a first glance, the idea that intersectoral transfers of capital, triggered by profit differentials, should lead to a uniform rate of profit, seems to be intuitively sound. Still, stability analyses of the classical adjustment process have led to partly-negative results, in the sense that some restrictions are known to yield instability, and stability has been proved so far only under quite particular assumptions. This fact seems to require a few words that may help economic intuition.

3.2.1. The transfers of capital triggered by current profit differentials have both supply and demand effects, but these effects do not fall upon the same date. In as far as current profit differentials affect current investment, current demand is also affected, while current output is obviously not. Thus, before having any stabilizing influence by increasing the supply of those industries yielding higher than average (rate of) profits, transfers

²² It has been suggested that this view of rationing is more realistic than the alternative one (where investment plans are rationed), because the access to short term finance is easier for firms than for consumers (and workers in particular); cf. Kubin [32].

of capital have a demand effect, and there is no reason to expect that this effect is stabilizing. Indeed, they may cause a positive excess demand and, hence, increase the price of goods produced by industries yielding higher than average profits. If this is the case, when the increased output of such industries will be available, they, or at least some of them, will yield a still higher rate of profit, at the new ruling prices. At this stage, though the net supply of such commodities is higher than it was at the initial date (as a consequence of the assumed vitality of the economic system), excess demand need not be lower: the current demand for these commodities is sustained by the transfers of capital stimulated by the still higher profit differentials.

In models with only two goods, one circulating capital good and one wage good, and where workers' consumption is included in the input matrix (*i. e.*, the wage rate is fixed in physical terms and is paid *ex-ante*), the above situation does necessarily arise if capitalists invest all their profits, and the "organic composition of capital" is higher in the capital-good industry. For example, a positive profit differential in this industry increases its output at a proportional rate, which is higher than the maximum rate (r^*), which can be attained under unchanging sectoral proportions; the fact that proportions are changing, does not make the situation more viable, because the assumption on technical coefficients implies that the planned change in proportions increases current demand in the "wrong" direction: the outcome is that the current demand for the capital good is necessarily higher than the current output of the same good; hence, its price increases...

3.2.2. The above example illustrates quite clearly how the assumption that capitalists invest all their profits has a negative influence on stability. The same example may also suggest that restrictions on technical coefficients are in

any case necessary for instability. This is not true, however. As long as capitalists invest all their profits, workers' consumption is included in the input matrix, and production takes time (i. e., the length of the production period is not infinitesimal), classical adjustment processes have been shown to be unstable. The result highlights that stability is more problematic, under a realistic representation of the time dimension of production²³.

3.2.3. It is worth adding that the above instability results do not apply to "simplified-cross-dual" processes. "Simplified" cross-dual processes in continuous time (i.e. with infinitesimal production lag), can be shown to yield stability of the LPP, under otherwise general assumptions on technical conditions (including joint production) and for economies with any finite number of commodities. If capital transfers do not only depend upon profit differentials, but also upon the change thereof (derivative control), asymptotic stability is obtained²⁴. Notice, in passing, that, although there is no consumption out of profits, profits are not automatically invested in these models.

Beyond the need to consider the behaviour of discrete time formulations of the "simplified-cross-dual" models, there are reasons to believe that their stability properties are not sufficiently robust. This is because "simplified-cross-dual" models prove to be structurally unstable, when they are considered as particular (non generic) cases of more general forms of adjustment: perturbations to this highly particular structure, however small these may be, produce a qualitative change in its stability properties. We shall

²³ Cf. Boggio [10].

²⁴ Cf. Flaschel and Semmler [20].

come back on this point later on, when such more general forms of adjustment will be considered²⁵.

3.2.4. One may object that the instability results of paragraph 3.2.2. are not very disturbing, after all. It is a fact that profits are not automatically invested in real-world economies. Indeed, less drastic assumptions, concerning investment behaviour, open the way to positive results, even when instantaneous production and arbitrary restrictions on input proportions are ruled out.

Still, the models yielding such "positive results" are not as general as one would like them to be. As it turns out, asymptotic stability requires a mechanism of substitution in consumption, which rests on *ad-hoc* restrictions. So long as investment reactions to price changes are not too fast, the "right" demand effects, from the side of consumption, are sufficient to dampen the possibly perverse demand effects of net investment.

Obviously enough, there are two ways in which market prices may affect the composition of consumption: they may act directly, in which case we are faced with proper substitution effects, or they may act through income effects.

The former type of influence is assumed in models where capitalists consume more (less) of one commodity, whenever (*ceteris paribus*) the price of another (of the same) commodity is higher²⁶. In the presence of sufficiently slow capital transfers (and of workers' consumption included in the given input matrix), the assumption implies that all goods are gross-substitutes, a fact which underlines its *ad-hoc* nature²⁷.

As was observed before, another way to obtain direct substitution, through prices, occurs in models where

²⁵ See below, paragraph 4.2..

²⁶ See, for instance, Boggio [8].

²⁷ Cf. Boggio [10].

workers, which are payed (*post-factum*) a constant nominal wage, plan the composition of their consumption in nominal, rather than in physical terms²⁸. In this case, the consumption of one commodity is not directly affected by the price of other commodities; still the relative composition of the consumption vector responds to price changes exactly as in the previous case.

A different, and very simple, form of substitution occurs, via income effects, if the composition of workers' consumption differs from the composition of capitalists' consumption (while both are fixed in physical terms)²⁹. Unfortunately, not all differences in composition will serve to the purpose of stability, as is shown by the following result: for a given composition of workers' consumption, there exists a continuum of a priori plausible compositions of capitalists' consumption, such that the classical adjustment process is unstable³⁰.

3.3.

Our presentation of the dynamic properties of the classical adjustment process have been concerned, so far, only with local stability; indeed, this is the only perspective which is considered, and which is allowed for, in most models: the same simplifications, which are legitimate when the system is close to its LPP, would not be legitimate, when it is far. There is, however, a number of models which lend themselves to global considerations, for example because stocks of inventories are not required (models with market-clearing prices, models with rationing), or because they are dealt with explicitly.

One of these models, namely a model with rationing of workers' consumption, provides an interesting example of how, a failure of local stability of the LPP, does not lead

²⁸ Cf. Kubin [31] and [32].

²⁹ See, for instance, Dumenil and Levy [11].

³⁰ Cf. Boggio [10].

to explosive behaviour, because of boundedness of deviations³¹. Boundedness is obtained as follows: Say's law is dispensed with, but aggregate investment is sustained by exogenous growth prospects; workers' monetary expenditure on each commodity is proportional to the level of employment (hence, demand for each commodity goes to infinity, as price goes to zero faster than employment); capital-transfers' contribution to the growth of one sector becomes progressively weaker, as the relative size of the sector grows larger and larger.

Again, the *ad-hoc* element, in this boundedness argument, appears to be the mechanism of substitution in consumption.

4. Composite forms of adjustment.

4.1.

It is worth supplementing the overview on classical adjustment processes, which was given in section 3., with a few general remarks.

i) The idea that in a competitive environment firms are price-takers and "the market" makes prices, is clearly related to the neoclassical notion of perfect competition³²; the idea that firms make prices, is not only much closer to real world conditions, but it is also consistent with the classical view of competition³³. The crucial distinction, however, is not so much whether firms make or do not make prices; more important is to identify meaningful criteria of price adjustment.

ii) In so far as price formation is concerned with the money value of the output already in existence, rather than with the money value of future output (*i. e.* price formation takes place after production), and output is

³¹ Cf. Kubin [32].

³² Cf. Stigler [49], McNulty [35].

³³ Cf. Eatwell [16].

perishable, it may be legitimate to assume that market price depends only on supply and demand, and is not directly influenced by cost³⁴.

This type of price formation may well be accomplished by price-making firms, rather than by "the market": in the former case we would have a proper price adjustment, with transactions carried out at non-clearing market prices. Still, insofar as goods are not storable, the market price must eventually clear the market, or it must be zero.

iii) Things are quite different, if price decisions are concerned with the market price of the output to be produced, rather than of the output in existence. In this case, in so far as firms are allowed to make prices, it is highly plausible that price formation is not independent of cost considerations. This would be all the more true if goods are storable.

The presence of stocks makes it possible to distinguish between investment and output decisions; if firms are not price-takers, this naturally leads to conjecture that output decisions not only depend upon price-cost considerations, but are directly influenced also by demand.

4.2.

The above remark hints at a composite adjustment process, which retains both classical and Keynesian elements. There exist in the literature stable dynamic models which retain such Keynesian elements. They define dual systems where price changes depend on cost (hence on prices), given sectoral target rates of profit r_i ($i=1, \dots, n$), while changes in output depend on the demand generated, via

³⁴ The view of price formation, which has been just described, prevails in the writings of the classics, in so far as the organization of their ideas on production and circulation were clearly influenced by the observation of the productive cycle in agriculture. Thus, Smith suggested that the market price is determined as a result of the output brought to the market, and of effectual demand. Interestingly enough, he distinguished between the price reaction of durables and of non-durables to a given excess supply. Cf. Smith [46], Book I, ch. VII.

multiplier effects, by investment decisions³⁵ (following exogenous growth expectations, or other rules). These models have been shown to be stable in relative variables³⁶.

In the particular case, where the planned rates of growth and the target rates of profit are assumed to be uniform across industries and to be all equal to the long-period rate of profit r^* (workers' consumption is included in the input matrix, capitalists do not consume), relative prices converge to the (unique) prices of production p^* , relative outputs converge to the (unique) steady growth relative outputs q^{*37} . By analogy with our former definition of a "simplified cross-dual" adjustment³⁸, we define this particular case "simplified-dual" adjustment.

In the more general case, where the target rates of profit are not uniform across industries, prices converge to a generalized production-price vector³⁹. Within this type of models, the formation of target rates of profit is not explained, and rate of profit differentials do not feed back into investment decisions. This fact can be justified, if one interprets the Keynesian dual adjustment as a short-run phenomenon, which could be combined with a long-run, classical adjustment⁴⁰.

The existing seminal attempts to integrate Keynesian and classical adjustment processes emphasize different Keynesian reactions; thus, they do not arrive at the same model structure. Still, their results are very instructive,

³⁵ Investment decisions are either determined by exogenous (and uniform) normal-growth expectations, as in Filippini [18], or by maximum (uniform) growth compatible with available productive capacity, as in Aoki [1]. In this paper investment decisions are affected also by price considerations, but these do not follow classical threads of thought.

³⁶ They are explicitly derived from the early formulations of the dynamic Leontief system, from which they differ in two main respects: in the first place, the assumption of perfect foresight is dispensed with; in the second place, full utilization of productive capacity is not assumed. As is well known, the early formulations of the dynamic Leontief system yielded dual instability.

³⁷ Cf. Flaschel and Semmler [21], [22].

³⁸ See above, paragraph 3.1.

³⁹ Necessary conditions are specified in Boggio [10].

⁴⁰ Cf. Boggio [10].

in so far as they give convergent indications. A study by P. Flaschel and W. Semmler⁴¹ examines the stability properties of a composite, "simplified-cross-dual" and "simplified-dual" dynamics. An earlier study by L. Boggio⁴² considers a composite form of adjustment, which combines a mark-up process of price formation, with a classical adjustment, where target rates of profit are revised according to excess demand, and intersectoral transfers of capital respond to profit differentials. In models, by G. Dumenil and D. Levy⁴³, the classical, cross-dual, adjustment is supplemented by a Keynesian effect of excess demand on output, which takes place through a changing level of stocks per unit of output. In all of these studies, asymptotic stability requires that the adjustments of classical type proceed at sufficiently low speed. So long as excess demand is not allowed to have a fast influence on prices (either because its immediate influence falls mainly on output, or because prices depend mainly on cost), and capital transfers respond slowly to profit differentials, the possibly "perverse" demand effects of capital transfers do not feed back rapidly into the system dynamics. This fits quite well with the above economic interpretation, in terms of short-run and long-run, of the Keynesian and of the classical adjustment processes.

Remark. A "simplified" cross-dual adjustment process can be interpreted as a very particular and unlikely (non generic) representative of a much larger class of adjustment processes, namely the composite Keynesian and cross-dual adjustment processes, where the Keynesian component is sufficiently weak. Representatives of this class are generically unstable⁴⁴, so that the dynamic stability of the "simplified" cross-dual case (i. e., a composite case

⁴¹ Cf. Flaschel and Semmler [21],[22].

⁴² Cf. Boggio [9].

⁴³ Cf. Dumenil and Levy [13],[14].

⁴⁴ Cf. Flaschel and Semmler [21], [22].

where the adjustment speed of the Keynesian links is zero) can be interpreted as following from *ad hocness* of assumptions: an infinitely small perturbation of the "simplified" cross-dual adjustment would destroy its stability properties.

4.3.

The stability results obtained for the composite adjustment processes do not require *ad-hoc* restrictions on input proportions, on technology (fixed capital and joint production are allowed in some models), on the number of commodities, or on consumption; thus, there is an important indication that composite forms of adjustment can support the gravitation hypothesis. Still, there are at least two aspects, which seem to deserve a close consideration.

In the first place, the existing literature does not give a clear indication concerning the integration of the classical adjustment process, which is most realistic and/or theoretically appropriate: short-run mark-up processes are emphasized in Boggio's work; the stabilizing influence of a short-run relation between excess demand and output (in the presence of stocks) is highlighted by Dumenil and Levy⁴⁵. It would seem that these integrations are more complementary than conflicting, as will further stressed below.

In the second place, we observed before how the stabilizing influence of these integrations can be traced back to a common feature, i. e. to a weaker effect of demand on prices and profitability. Asymptotic stability requires that the effect in question is weak enough. One may wonder whether this is a general feature of capitalist economies under (classical) competition. Indeed, evidence of relatively fast price reactions to slack demand conditions is not unfrequent, even in modern capitalism.

⁴⁵ Cf. G. Dumenil and Levy [13],[14].

Some light may be shed on the above two related points, if we consider the problem of gravitation in a more global perspective. If market prices are sufficiently close to long-period prices, as is assumed in local stability analyses, they necessarily fulfil some minimum profit requirement; e. g., they cover input costs; if the market rate of interest is lower than the long-period rate of profit, these costs can be inclusive of interest. The same condition would not be fulfilled in one or more industries⁴⁶ if market prices are far from long-period prices. It is not at all obvious that, in the latter situation, firms of these industries would be prepared to increase their output, to meet a higher demand, and would not drastically increase the price of output. Indeed, it is doubtful whether firms producing a storable output would let the price fall below the short-run lower bound corresponding to a minimum-profit requirement. If the condition is not fulfilled, production should come to a stop. The money rate of interest (or a function thereof) can be quite plausibly conceived as a short-run lower bound for the rate of profit on replacement costs, which is implicit in the pricing decision.

The above remark has two immediate and quite obvious implications.

First, in the presence of quantity adjustment in response to excess demand conditions, price making cannot be totally independent of cost considerations. Hence, the dichotomy between mark-up pricing and price adjustment according to excess demand, is sometimes exaggerated.

Second, if cost considerations set a short-run lower bound to the movement of market prices (and if commodities are all basics), the dynamics of relative prices is necessarily limited to a bounded region in price space: hence,

⁴⁶ Suppose there are n goods (all basics), and the real wage is fixed in physical terms. Let μ_i be the ratio between the market price and the long-period price of commodity i ($i=1, \dots, n$) in terms of an arbitrary commodity numeraire. The industry with the lowest μ_i would certainly make losses, if some μ_i is sufficiently far from 1.

deviations of market prices from natural prices would be bounded, *a fortiori*. In so far interest costs contribute to determine the short-run lower bound of prices, the amplitude of those deviations comes to depend crucially upon the behaviour of the market rate of interest. This argument, and other arguments hinging upon asset re-evaluation through financial investment, suggest that financial phenomena are highly relevant to the issue of gravitation.

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