UNIVERSITÀ DEGLI STUDI DI SIENA

QUADERNI DEL DIPARTIMENTO
DI ECONOMIA POLITICA

Ennio Bilancini
Fabio Petri

The Dynamics of General Equilibrium: A Comment on Professor Gintis

n. 538 – Agosto 2008

Abstract - This is a comment on Gintis (2007, 'The Dynamics of General Equilibrium', *Economic Journal* 117 (523) , 1280–1309), who provides an agent-based model of a Walrasian economy where the tâtonnement is replaced by imitation. His simulations show that the economy converges to the Walrasian equilibrium. Gintis concludes that 1) his stability results provide some justification for the importance placed upon the Walrasian model, and 2) models allowing agents to imitate successful others lead to an economy with a reasonable level of stability and efficiency. Since these conclusions appear to be intended as general, we caution that Gintis's findings can only be accepted for Walrasian models without capital goods; in models with capital goods imitation-based adjustments alter the equilibrium's data (which makes the demonstration of stability impossible) and raise other important problems (absent from Gintis's simulations) still awaiting exploration.

Keywords: Walrasian equilibrium, imitation, stability, agent-based simulations, capital goods

JEL code: D51, D58, B12, B13

Ennio Bilancini, Dipartimento di Economia Politica, Università degli Studi di Siena
Fabio Petri, Dipartimento di Economia Politica, Università degli Studi di Siena

Ennio Bilancini and Fabio Petri University of Siena

THE DYNAMICS OF GENERAL EQUILIBRIUM: A COMMENT ON PROFESSOR GINTIS

§1

Professor Gintis must be congratulated for his study about the stability and efficiency role of imitative behavior in general equilibrium models. By means of agent-based simulations, Gintis (2007) shows that imitation can be a powerful mechanism fostering stability and efficiency in stochastic ergodic systems of traders, consumers and firms. In particular, Gintis provides evidence that, at least in some cases where (in spite of equilibrium uniqueness) the tâtonnement is unable to ensure convergence to equilibrium (Scarf (1960)), imitation produces convergence. The importance of this finding is reinforced by the fact that the adjustments based on imitation and error correction posited by Gintis provide a much more realistic description of adjustment processes than the tâtonnement fairy tale.

However, we find that the two general conclusions, drawn by Gintis on the basis of his study of the production model of sections 4 and ff., are too strong. Let us briefly review them. The reported simulations show that, under a wide range of initial parameter values, there is convergence to a nearly-full-employment steady state which closely approximates the quantities and relative prices of the Walrasian equilibrium of that economy. Gintis concludes that:

(i) [this result] ‘provides some justification for the importance placed upon the Walrasian model in contemporary economic theory’ (p. 1303),

(ii) ‘models allowing traders, consumers, workers and firms to imitate successful others lead to an economy with a reasonable level of stability and efficiency’ (p. 1304).

If valid in the general terms in which Gintis formulates them, these

conclusions would be of extreme importance. But we claim that the scope of these conclusions is limited to the class of Walrasian models where production is carried out without capital goods. This is so, we will argue, in spite of the fact that in the production economy model there is a factor that Gintis calls capital, because this 'capital' is in fact a homogeneous land; therefore it is not proved that the convergence-to-equilibrium results apply also to Walrasian models where production includes the utilization and production of heterogeneous capital goods. In fact, we further argue, both conclusions become questionable, albeit not to the same degree, the moment the implications of admitting production with capital goods are considered; and for reasons of great relevance. Briefly, our arguments are as follows.

We argue in Section 2 that the extension of conclusion (i) to Walrasian models with heterogeneous capital goods encounters a logical difficulty. The Walrasian equilibrium[1] of an economy with utilization and production of heterogeneous capital goods, be it intertemporal or temporary, includes given endowments of the several capital goods among the data (endowments, preferences and technical possibilities) that determine it. But imitation requires time-consuming disequilibrium adjustments; then the stocks of the several capital goods in the economy will change during disequilibrium and, because of this, the adjustment process cannot logically prove the asymptotic convergence to the Walrasian equilibrium corresponding to the initial data, depriving

[1] We will argue as if, given the data, the Walrasian equilibrium were unique. As professor Gintis freely admits, his assumptions on consumer preferences and on technology make it very likely that the model has a unique Walrasian equilibrium; this means that his result of convergence to a unique 'steady state' would need reassessment for models of economies without capital goods but with a substantial probability of multiple equilibria. But we do not further discuss this issue because we consider our objections based on the problems raised by capital goods to be more important.

conclusion (i) of its foundation. Actually, as we explain at the end of Section 2, the implications of this observation point in a direction opposite to conclusion (i). They also have relevance for the question why the auctioneer-based tâtonnement is still dominant in the discussion of the stability of general equilibrium.

As to (ii), differently from (i) we emphasize in Section 3 that there are no logical reasons preventing conclusion (ii) from being valid for economies with capital goods. Actually, we think that the exploration of the validity of (ii) for economies with capital goods would be an interesting investigation to carry out. However, in such an investigation the presence of capital goods utilized and produced, coupled with the need to admit time-consuming (or, as we prefer to say, *non-virtual*) adjustments as required by imitation, would oblige one to tackle problems (e.g. what determines investment decisions) that do not arise in Gintis's model, and for which the potential implications of the realistic imitation-based adjustments considered by Gintis will depend on theoretical choices on which there is an ongoing debate, so that the validity of (ii) becomes a totally open question. Gintis's apparent interpretation of (ii) as also valid for economies with capital goods is therefore unsupported. We conclude our comment on Gintis's article with a brief illustration of two of these problems and of some of their potential implications.

§2

Gintis writes that the goods in the model of his Section 4 are produced by labour and capital, but the model includes no production nor depreciation of capital goods, and thus also no investment decisions and no need to reach an equilibrium between savings and investment; thus it cannot be capital he is talking about[2], it must be some indestructible, non-produced factor such as a

[2] An Appendix to the present Comment critically discusses a possible defence of

type of land. In other words, Gintis's model is one of production with labour and land, not capital.

An extremely important aspect of models of production without capital goods among the factors is that the data that determine the Walrasian equilibrium can be assumed, with some plausibility, to be unaffected by the implementation of disequilibrium productions and exchanges. These data are tastes, technical knowledge and the factor endowments of consumers. As a first approximation, one can assume that tastes and technical knowledge are unaffected by disequilibrium productions and exchanges. Since factor endowments do not include produced goods, one can assume that the total endowment of each factor is unaffected by disequilibrium productions. If one further assumes that lands and other natural resources can be rented but not alienated[3], it is then legitimate to compare the Walrasian equilibrium with the outcome of any realistic adjustment process requiring the implementation of disequilibrium productions and exchanges. If the adjustment process results in the economy gravitating towards a state which is reasonably close to the Walrasian equilibrium, then one can argue that the assumed adjustment process, not the auctioneer fairy tale, provides some justification for considering the Walrasian equilibrium a good indication of the tendential result of market forces. This is what Gintis does and, we are arguing, legitimately so for production economies without capital.

---

the treatment of capital as analytically identical to homogeneous land.

[3] In the history of neoclassical theory the effects on equilibrium of redistributions of land ownership due solely to disequilibrium transactions appear to have been universally considered negligible, and with good reason, it would seem; redistributions of land property are mostly very slow and gradual, and when not, they are not due to disequilibrium but rather to political or other cataclysmic changes, to which the method of comparative statics should be applied.

However, the situation is radically different when we turn our attention to economies with capital goods. In fact, introducing capital goods as factors of production in a Walrasian framework forces the equilibrium's data to include endowments of the several capital goods[4]. This inclusion renders necessarily negative the answer to the question, can the Walrasian equilibrium corresponding to those data be seen as the asymptote of realistic adjustment processes allowing for the implementation of disequilibrium productions and exchanges? Any such adjustment process would inevitably alter the quantities of the several capital goods in the economy and, hence, that group of data[5], rendering therefore nonsensical the question of stability of equilibrium with respect to that type of dynamics. It makes sense to talk of convergence to, and stability of, an equilibrium only if the givens determining the equilibrium are not influenced by the dynamical law governing the system.

Now, Gintis's adjustment process is definitely one of those that would alter the data of the Walrasian equilibrium of an economy with capital goods. Imitation requires that disequilibrium actions be implemented and their consequences be observed (as indeed they are in Gintis's analysis), and this takes

---

[4] The given vector of endowments of capital goods is precisely what these models have in common with Walras' original model with capital goods (which, however, was neither an intertemporal nor a temporary equilibrium model, cf. Petri (2004: ch. 5)) and is the reason why here we accept to call them Walrasian in spite of their differences from Walras.

[5] One encounters, in fact, the problem highlighted by Franklin M. Fisher when writing: "In a real economy, however, trading, as well as production and consumption, goes on out of equilibrium. It follows that, in the course of convergence to equilibrium (assuming that occurs), endowments change. In turn this changes the set of equilibria. Put more succinctly, the set of equilibria is path dependent ... [This path dependence] makes the calculation of equilibria corresponding to the initial state of the system essentially irrelevant." (Fisher, 1983, p. 14).

time[6], during which time the endowments of capital goods can change significantly[7].

These observations have implications for an opinion expressed by Gintis in the opening lines of his article, where he argues (p. 1280) that the auctioneer assumption survives "because no one has succeeded in producing a plausible decentralized dynamic model" for Walrasian equilibrium models. It seems to us that an even more important cause has been some perception of the logical difficulty we have pointed out. The very origin of the 'auctioneer', the introduction by Walras – in the 4th edition of his *Eléments* – of the provisional 'tickets' in a tâtonnement originally conceived as taking time and involving actual disequilibrium productions, was due to that difficulty: Walras explicitly indicates that the advantage of the 'bons' is to avoid changes in the endowments of capital goods during the groping toward equilibrium (Walras 1954, p. 282, §251; 1988, p. 377). And, although sometimes only implicitly, the difficulty has

---

[6] Indeed, considerable time, since in Gintis's simulations goods are produced each period and it must take some time to produce them (in fn. 5, p. 1297, Gintis interprets his period as representing a month), and adjustments take hundreds of periods. Thus Gintis calls 'long-run market clearing prices' (p. 1282) the prices his adjustments converge to. But in economies with heterogeneous capital the determination of long-period, or long-run, relative product prices goes necessarily together with an endogenous determination of the composition of capital, which is the reason why traditional marginalist analyses (e.g. Wicksell) did not take as given the endowments of the several capital goods and had then to take as given the total endowment of 'capital' conceived as a single factor of variable 'form', an amount of exchange value - the conception of capital nowadays universally recognized as indefensible.

[7] Nor can the relevance of this problem be decreased by suggesting that the change in the capital endowments might be small, because even if small it might still cause drastic alterations of prices (Garegnani 1990, pp. 57-58), and furthermore it is easy to conceive cases (e.g. circulating capital goods specific to a production method which is abandoned during disequilibrium) where the change might be very rapid.

been admitted by numerous authors[8]. On this basis, we suggest, one can better understand why there has been so little attempt even *to try* to do without the auctioneer for economies with capital goods.[9] Indeed, the moment one drops the tâtonnement and admits that adjustments inevitably take time, it is unclear what 'stability' of an intertemporal or temporary equilibrium can mean.

We can now assess the implications of the above considerations for Gintis's conclusion (i). The 'importance placed upon the Walrasian model in contemporary economic theory' would not be there if the Walrasian equilibrium approach were not considered applicable also to economies with capital goods. The Walrasian models of pure exchange and of production without capital are

---

[8] F. M. Fisher (cf. footnote 5) admits changes in endowments due to disequilibrium productions. With reference to temporary equilibrium, Bliss writes: 'there might not be enough time within the space of a [Hicksian] "week" for prices to adjust to an equilibrium' (Bliss, 1975, p. 28), a cause for worry only if from one 'week' to the next the data of equilibrium are going to change significantly, which, as pointed out in the text, will not be the case for economies without capital goods. Arrow and Hahn find it difficult to abandon the tâtonnement because, they note, at disequilibrium prices not even planned *intentions* can be all carried out, which makes the results of non-virtual disequilibrium particulary difficult to determine, 'and it is a special feature of what we shall call a tâtonnement that it sidesteps this difficulty' (Arrow-Hahn 1971, p. 264): this admitted indeterminability of the results of non-virtual disequilibrium implies that the economy (including the capital endowments) would go off the equilibrium path, and in unpredictable directions.

[9] We are aware of a single neoclassical author attempting such a task, F. M. Fisher (whose researches on the topic, motivated by the observation quoted in fn. 5 above and culminating in Fisher (1983), end up essentially in defeat: cf. the negative assessment by Fisher himself in Fisher 2003, p. 91; also Petri 2004, pp. 48-49, 67-71). This is all the more striking since there has been, on the contrary, a number of adjustment models that do without the auctioneer for pure exchange economies (a very recent one is Axtell 2005); the absence of attempts to extend them to economies with capital goods would appear to confirm the impossibility of the task within a Walrasian framework.

only simpler introductions to a theory whose usefulness would be quite small if its generalization to include capital goods were not possible. Therefore results not generalizable to the Walrasian models of economies with capital goods cannot justify the importance nowadays attributed to the whole class of Walrasian models. Unfortunately, as pointed out above Gintis's convergence result suffers precisely from such non-generalizability. Indeed and somewhat paradoxically, Gintis's insistence on the need to drop the auctioneer and to admit non-virtual adjustments goes in a direction opposite to that suggested by his conclusion (i). By arguing in favour of adjustment processes that take time and require the implementation of disequilibrium production decisions, Gintis implicitly argues against the capacity of Walrasian models to indicate the state toward which market forces cause economies with capital goods to tend: realistically conceived disequilibria necessarily alter the equilibrium's data, and in directions that Walrasian equilibrium theory cannot indicate because it is silent on what happens in disequilibrium, then the theory is unable to indicate the tendencies of economies not continuously in equilibrium. It seems to us that this amounts to a serious questioning, rather than 'some justification', of 'the importance placed upon the Walrasian model in contemporary economic theory'.

§3

We have already said that we find Gintis's conclusion (ii) acceptable, as long as it is restricted to models without capital goods. Moreover, and differently from conclusion (i), we see no logical reason preventing (ii) from possibly holding also for economies with capital goods, and no doubt an investigation of such a question would be very important. But it seems clear to us that on this question very little can be inferred from Gintis's present simulations. In order to motivate this view, we proceed to point out some very

important open problems, absent from the framework of Gintis's simulations, that unavoidably prop up in a study of economies with capital goods where adjustments are non-virtual.

We see no reason to doubt that also in a model with capital goods firms' adjustments as formalized by Gintis will lead to the same adaptation of productions to demands for the several produced goods, at prices covering normal costs on average, that he obtains for his model. Indeed we see Gintis's formalization of firms' decisions as in line with textbook Marshallian analysis of long-period industry adjustments. Note that, importantly, this process will *endogenously* determine the quantities produced and the inventories of the several capital goods existing in the economy; these will result from an adaptation to the firms' demands for capital goods. However, the implied capacity of the composition of production to adapt to the composition of demand is not the same thing as 'an economy with a reasonable level of stability and efficiency'. Stability requires absence of strong fluctuations of aggregate demand, and efficiency requires a tendency toward the full employment of resources, in particular of labour. Here problems prop up in the economy with capital goods that are absent in the labour-land economy, and on which Gintis's exercise does not help us.

We may start from labour employment. In Gintis's model wage flexibility ensures a tendency toward the full employment of labour because firms increase the proportion of labour to 'capital' when the real wage decreases, and the total endowment of 'capital' is given (and fully employed by assumption). Relative to this, one striking difference made by the presence of heterogeneous capital goods in amounts determined endogenously by demand is that, when looking for the effects of changes in wages, one no longer has the right to take as given the endowments of the factors other than labour. The implications are of great importance, not only for Gintis-type simulations but, it would seem, for

economic theory in general. The system of general equilibrium equations becomes indeterminate; hence an equilibrium real wage can no longer be determined; and given the real wage, labour employment is still not determined[10], and with Gintis-type industries it will certainly depend on aggregate demand to some extent, since those industries tend to adjust production to demand. Then also the effect of wage flexibility on labour employment will depend on its effect on aggregate demand[11].

Thus, it would seem, the results of Gintis-type simulations applied to an economy with capital goods will relevantly depend on what determines aggregate demand. Now, it seems clear that in such an economy Gintis-type adjustments imply the (dynamic) Keynesian multiplier. This is because the constraint on the purchasing power of consumers deriving from their *actual* income (i.e. from whether they have found purchasers for the factor services they offer) implies the existence of some form of Keynesian consumption function. Then much will depend on what determines the autonomous components of aggregate demand − investment, first of all. Now, notoriously the

---

[10] The determination of labour employment on the basis of a parametrically given real wage in a fully disaggregated general equilibrium system is the basis of the traditional labour demand curve; it consists, essentially, of determining the equilibrium real wage associated with a parametrically given labour supply, and then interpreting the latter as the demand for labour and hence the labour employment that would result from that real wage. Such a determination becomes impossible if the endowments of some factors are not given. The implication is that one must abandon the notion of a definite labour demand curve.

[11] The assumption itself of wage flexibility may need reconsideration if it is unable to bring the economy to (near-)full employment in reasonable time and without too drastic a fall in real wages. The empirical evidence, for example Bewley (1999, 2005), certainly does not support the assumption of indefinite wage flexibility; nor does imitative behaviour necessarily entail it. But if wages are not flexible, what determines their level becomes an open problem.

theory of aggregate investment is a field characterized by considerable uncertainty and disagreement. Therefore there seems to be no generally agreed way to introduce investment decisions into Gintis-type simulations; and yet, much will depend on what is assumed in this respect. For example an accelerator theory of investment, coupled with imitative behaviour, might well cause ruinous multiplier-accelerator interactions.

The above considerations make clear that the consequences of abandoning the auctioneer and introducing time-consuming imitation-based adjustments in models of economies with capital goods can only be assessed after taking sides on some relevant open problems of current economic theory. For the moment, one can only say: we don't know. In conclusion, Gintis's claim about the capacity of imitation to induce stability and efficiency must be interpreted as supported by his analysis only for economies without capital goods.

This is what we intended to prove in this Section, but we consider it even more important to have shown, in the process, some of the striking implications of the admission of non-virtual adjustments in economies with capital goods. These implications reinforce the conclusion of Section 2: Gintis's commendable insistence on the need to abandon the auctioneer and to admit time-consuming adjustments has implications that, far from supporting the Walrasian approach, reveal a need to depart from it and, in particular, to admit that quantities of capital goods are endogenously determined, with all the consequences of such an admission.

****

APPENDIX. Capital like land?

One aspect that puzzled us in professor Gintis's contribution is his treatment of capital as not only homogeneous but also neither depreciating nor produced, and therefore formally identical to a kind of land. In the main article we have argued that this treatment of capital eliminates essential aspects of economies with capital goods, rendering Gintis's final conclusions disputable. In this Appendix we ask whether the traditional marginalist conception of capital as a single factor of variable 'form' might be used to support such an analytical choice.

Indeed some readers might attempt to defend Gintis's treatment of capital as simply taken over from other neoclassical models, in particular from the innumerable expositions in the pure theory of international trade where the analysis, clearly aimed at determining persistent (long-period) situations, describes countries producing two commodities A and B with the use of the two factors labour and capital, where capital is treated as similar to land in that it is apparently neither produced nor deteriorated by use. In these models capital is homogeneous, and this is well known to reflect the traditional marginalist/neoclassical conception of capital goods as embodiments, crystallizations, of a single factor 'capital' of variable 'form' (cf. Petri 2004 for a recent exposition of that conception and of its analytical roles; also Garegnani 1990). However, while it is not difficult to understand how that conception can have justified macro models (e.g. Solow's growth model) where capital is treated as homogeneous but depreciation and production of capital are admitted, it is perhaps less clear to other modern readers how that conception can have justified the treatment of capital as identical to land. It may therefore be worthwhile briefly to remember the essential terms of the issue. Although we will hardly be speaking of the 'Walrasian model', we *will* be discussing whether professor Gintis's results can support the thesis that the neoclassical supply-and-demand forces, when coupled with more realistic descriptions of disequilibrium behaviour, 'lead to an economy with a reasonable level of stability and efficiency'.

With the single exception of Walras, the marginalist/neoclassical approach was born on the basis of a conception of capital as in some sense a homogeneous factor of variable 'form' embodied in the several capital goods, a factor whose total endowment (a scalar) could be taken as given as legitimately as e.g. the endowment of (each type

of) labour. In such a conception, net savings do alter the endowment of capital, but at a speed (comparable with the speed of change of population) which is very slow relative to the potential speed with which its 'form' (i.e. composition) can change, and this makes it legitimate to treat the total capital endowment as given while at the same time treating its 'form' as endogenously determined by the tendency of gross investment to go where rates of return are higher. When capital is so treated, then in a rigorous disaggregated equilibrium model (e.g. Wicksell's) there will appear both the total endowment of capital, a datum, *and* the quantities of the several capital goods, endogenously determined by the equilibrium, which is a long-period equilibrium (not to be confused with a steady-growth path); but more frequently the endogenous determination of the composition of capital is left implicit, the different capital goods do not appear in the model at all, and in the production functions there appears only 'capital' the single factor; this is implicitly justified by the belief that, given the purposes of the analysis, the explicit determination of the composition of capital would not add to what can be concluded on the basis of its total endowment and of its marginal productivity in the several industries. Importantly, if that conception of capital is granted, the impermanence problem does not arise: the data of equilibrium are sufficiently persistent because the endowments of the several capital goods are *not* data of the equilibrium, they are determined endogenously, only the total endowment of capital appears among the data; then the adjustment toward equilibrium can be conceived as taking time and involving actual productions, there is no need to assume the auctioneer (which in fact was assumed by Walras but not by the authors adopting this conception of capital).

It is an essential element of this conception of capital that the substitution mechanisms between capital and labour (or land) are believed to work ultimately in the same way as between labour and land, in spite of the peculiarity of capital of being an amount of exchange value[12]; thus the demand for capital is believed to be a regularly decreasing function of its 'price', the rate of interest; and from this a negative elasticity of investment with respect to the rate of interest is derived, that makes it

---

[12] The equilibrium earnings of capital goods are proportional to their value, and therefore if these earnings are to be seen as reflecting the amount of a single factor capital 'embodied' in the different capital goods, this amount is necessarily proportional to (and hence measured by) their value.

plausible to assume the stability of the savings-investment market − hence the marginalist/neoclassical faith in Say's Law.

On this basis it is possible to explain the absence of the savings-investment market in some neoclassical models where capital is treated like a single factor similar to land. The implicit conception of capital is the one we have just described. The already noticed slowness of change of the total quantity of capital suggests that for certain purposes (not, of course, when the issue is growth) it can be legitimate to neglect that change; then when formulating a model where a savings-investment market does not appear at all, and capital and labour produce only consumption (or exported) goods, one is not denying that there is production of capital goods too, and that there is a savings-investment market, but one is assuming that the latter market is in equilibrium (Say's Law holds), and that in the time period covered by the analysis the change of the total capital stock is so small that one may well assume that the economy is stationary. The aggregate income appearing in the model is then to be interpreted as *net* income.

If this traditional neoclassical conception of capital were acceptable, professor Gintis's 'capital' could be interpreted as indeed capital and not land, and his analysis could be interpreted as not restricted to what, for brevity, we can call a-capitalistic production economies[13]. But after the criticisms advanced in the Cambridge debates on capital theory that conception is universally recognized to be indefensible.

It may be useful to remember two aspects of the critique. The first criticism is generally accepted: the endowment of capital as a single quantity of variable 'form' is indeterminable, because it must be an amount of value: the observed value of the capital endowment of an economy cannot be taken as independent of prices, it would change if relative prices were to change, so it cannot be considered given when relative prices are what the analysis must determine; and any other number would be arbitrary. The second criticism − with which there seems to be much less familiarity −

---

[13] Obviously then the model would have little right to be considered Walrasian, because Walras did not entertain that conception of capital. Furthermore, professor Gintis's analysis would be *assuming* the stability of the savings-investment market, rather than proving it on the basis of the postulated behaviours of agents. Still, it is possible that this traditional treatment of capital was the reason why professor Gintis felt authorized to introduce a factor 'capital' analytically identical to homogeneous land.

is that the phenomena of reswitching and reverse capital deepening show that substitution between capital and labour behaves totally differently from that between labour and land in the a-capitalistic economy, hence investment can no longer be presumed to be a regularly decreasing function of the interest rate, and as a consequence the adaptation of investment to savings cannot be plausibly assumed (Petri 2004, ch. 7). The implications of these criticisms are far-reaching; we remember only two. It is an implication of the first criticism that one can no longer draw a labour demand curve because one no longer knows what amount of capital to take as given when attempting the determination of the marginal product of labour; thus we find again the conclusion that wages cannot be determined by the intersection of a demand curve and a supply curve because the labour demand curve cannot be determined (Petri 2004: ch. 8). One implication of the second criticism is that Say's Law cannot be presumed to be valid[14]; one is then brought to attribute greater plausibility to Keynes's thesis, that it is savings that will adapt to investment via changes in the level of aggregate output.

Unless refuted (and so far they have not been refuted), these implications undermine any presumption that the results of a model where the production side and income distribution are modelled as in professor Gintis's analysis, thus excluding all savings-investment problems on the aggregate demand side and all measurement problems on the endowment-of-capital side, may reflect the functioning of market economies where capital and investment play a role.

---

[14] Professor Gintis on p. 1300 mentions reswitching only as a possible cause of multiple equilibria; the fact that, by implying reverse capital deepening, reswitching undermines the role of the rate of interest in ensuring Say's Law, and thus undermines the right to assume the absence of aggregate demand problems, is not mentioned. It is also not clear what results precisely, and what kinds of equilibria − Arrow-Debreu? long-period? steady-growth? −, he has in mind when mentioning that reswitching might imply multiple equilibria. And it deserves notice that the possibility of reswitching (and hence of multiple equilibria) is the sole consequence of admitting heterogeneous capital mentioned in the article; the impermanence problem is nowhere hinted at.

REFERENCES

Arrow, K. J., and F. H. Hahn (1971), *General Competitive Analysis*, Edinburgh: Oliver & Boyd.

Axtell, R. (2005). 'The Complexity of Exchange', *Economic Journal* 115 (504), F193–F210.

Bewley, T., (1999). *Why Wages Don't Fall During a Recession*, Cambridge and London: Harvard University Press.

Bewley, T., (2005), 'Fairness, reciprocity and wage rigidity', in H. Gintis, S. Bowles, R. T. Boyd and E. Fehr, eds., *Moral sentiments and material interests*, Cambridge, Mass.: MIT Press, pp. 303-338.

Bliss, C.J. (1975). *Capital theory and the distribution of income*, Amsterdam and Oxford: North-Holland.

Fisher, F. M., (1983). *Disequilibrium foundations of equilibrium economics*, Cambridge: Cambridge University Press.

Fisher, Franklin M., (2003). 'Disequilibrium and stability', in F. Petri, F. Hahn, eds., *General Equilibrium. Problems and Prospects*, London: Routledge, pp. 74-94.

Garegnani, P. (1990). 'Quantity of capital', in J. Eatwell, M. Milgate, P. Newman, (eds), *Capital Theory*, London: Macmillan, pp. 1-78 .

Gintis, H. (2007). 'The Dynamics of General Equilibrium', *Economic Journal* 117 (523) , 1280–1309.

Petri, F. (2004). *General Equilibrium, Capital and Macroeconomics: A Key to Recent Controversies in Equilibrium Theory,* Cheltenham: Edward Elgar.

Scarf, H. E. (1960). 'Some examples of global instability of competitive equilibrium', *International Economic Review*, vol. 1, pp. 157–72.

Walras, L. (1954). *Elements of Pure Economics*, London: George Allen and Unwin [1874].

Walras, L. (1988). *Eléments d'économie politique*, variorum edition; vol. VIII of Auguste et Léon Walras, *Oeuvres économiques complètes*, edited by Pierre Dockès et al., Paris: Economica.