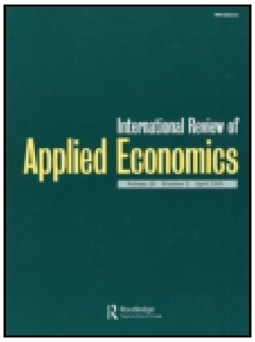

International Review of Applied Economics

ISSN: 0269-2171 (Print) 1465-3486 (Online) Journal homepage: http://www.tandfonline.com/loi/cira20

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To cite this article: MARC LAVOIE , GABRIEL RODRÍGUEZ & MARIO SECCARECCIA (2004) Similitudes and Discrepancies in Post-Keynesian and Marxist Theories of Investment: A Theoretical and Empirical Investigation , International Review of Applied Economics, 18:2, 127-149, DOI: 10.1080/0269217042000186697

To link to this article: https://doi.org/10.1080/0269217042000186697

Published online: 22 Jan 2007.

International Review of Applied Economics,
Vol. 18, No. 2, 127–149, April 2004

Similitudes and Discrepancies in Post-Keynesian and Marxist Theories of Investment: A Theoretical and Empirical Investigation[1]

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ABSTRACT *There has been a substantial amount of convergence between post-Keynesian and Marxist economics, the writings of Kalecki being common ground for both traditions. Still, some differences remain. While authors in both traditions seem to agree to a large extent on short-period issues, long-period matters relating to the role of saving, the rate of profit, inflation, crowding out, excess money supply, are still contentious. All this seems to depend on the exact form taken by the investment function, more specifically the role of capacity utilization. Four different equations are set up to be tested, two of which correspond to two variants of the Marxist view, while the other two equations correspond to a naive and a sophisticated Kaleckian view, the latter being based on hysteresis. The equations are tested on three sets of annual Canadian data. Various statistical tests are applied to all four equations in an effort to rank them, notably information and encompassing tests. The Kaleckian equation with hysteresis generally comes out empirically with the preferred statistical properties, when manufacturing data on actual rates of capital accumulation are considered separately or when both realized and intended rates of investment for the total industrial sector are used.*

KEY WORDS: Investment functions; post-Keynesian economics; Marxist economics; encompassing tests

Introduction

With the fall of the Berlin Wall and the strengthening of the neoclassical stronghold upon academic institutions, it is possible to observe some convergence among the various heterodox branches of economics. One particular source of convergence has been the rediscovery of the works of Michal Kalecki, who was trained as a Marxist economist, but whose influence has become quite large among the successors of the so-called Cambridge economists. Kalecki's importance has been underlined by the godmother of post-Keynesianism, Joan Robinson, and rightly so it seems now.

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ISSN 0269-2171 print; ISSN 1465-3486 online/04/020127-23 © 2004 Taylor & Francis Ltd.
DOI: 10.1080/0269217042000186697

The importance of Kalecki, beyond his economic and technical insights, lies in the fact that economists from both the Marxist branch and the post-Keynesian branch now make use of his insights and share common models that have been inspired by his work. This common model has made it possible for Marxists and post-Keynesians to engage in a dialogue (as in Deprez & Dalendina, 1994), something that was not always so easy. In particular, Gordon (1994) has pioneered the use of closely related econometric models to compare various families of Marxist and post-Keynesian macroeconomic views.

This having been said, one should not understate the tight links that have always existed between those probing the issue of profit realization, studied by Marxists, and the lack of effective demand, analysed by post-Keynesians. These tight links are obvious in the classic work of Baran & Sweezy (1966) or in books such as that of Bhaduri (1986), to give but two examples. Also, as shown by Lee (2000), some Marxist economists were associated with the institutional beginnings of a post-Keynesian group in North America.

There are two claims that we wish to make. First, Marxist and post-Keynesian economists basically agree on the short-run dynamics of macroeconomics. This agreement relies on a common use of the notion of effective demand, based on independent investment functions (independent of saving), the relevance of income distribution, and the importance of debt payments. Our second claim is that Marxist and post-Keynesian economists disagree on long-run issues. In other words, they disagree about the slow adjustment mechanisms that lead from a short-run equilibrium to fully adjusted positions that are compatible with long-run sustainable processes. In the long run, post-Keynesians would still make the claim that there is room for cooperation between entrepreneurs and workers, whereas Marxists would focus on the necessary conflictual relations. Another way to sum this up is to say that for post-Keynesians, long-run variables are still demand-led, while for Marxist authors they are supply-led, determined by the normal profit rate and the saving rate.

While authors in both traditions seem to agree to a large extent on short-period issues, long-period issues relating to the role of saving, the level of real wages or the rate of profit, inflation, crowding out, excess money supply, are still contentious. The resolution of many of these issues seems to depend on the exact shape of the investment function and the role of capacity utilization. Ultimately, post-Keynesians claim that the rate of accumulation is tied to the rate of capacity utilization, whereas Marxists believe that it is *the rate of change* in the rate of accumulation that is influenced by the rate of capacity utilization.

Before going any further, questions of definition should be settled. It should be obvious that there are many strands of Marxism, just as there are many strands of post-Keynesianism. The analysis that follows cannot do justice to all these strands. Specific authors will be used as exemplars. In addition, for lack of space, we cannot discuss all issues of relevance. For instance, the issues of pricing and competition and those relating to money creation and finance will be left aside.

In what follows we shall develop the nuances that characterize the various Marxist and post-Keynesian positions on the issue of investment behaviour, but set within the framework of the so-called Kaleckian investment function. This investment function itself will be highly restricted since it will exclude the various financial variables—real interest rates, interest rate spreads, debt ratios, interest coverage ratios—which have been shown empirically to be significant determinants of investment behaviour by heterodox authors. The reason for this is that we wish to focus on the crucial distinctive features of the post-Keynesian and Marxist investment models, and these are located in the role played by the rate of capacity utilization. Indeed, in the last section of the paper, each of the four proposed investment functions is given an econometric specification on the basis of Canadian data. These specifications are then compared and ranked on the basis of various statistical tests.

Short-run Analysis

It is tempting to make the claim that in the short run, all heterodox economists are Kaleckians. As is well known, Kalecki argued that firms operating elsewhere than in the primary sector face constant unit prime costs up to full capacity. Increases in aggregate demand are thus mainly reflected in increases in output and employment. This is accepted both by post-Keynesians and by Marxists, provided the economy is not too close to full employment or full capacity. The notion of effective demand, and its impact on the economy in the short run, is something upon which authors of all heterodox traditions are in general agreement.

Members of both schools of thought make an extensive use of Kalecki's famous equation, according to which the profits of firms are equal to their investment expenditures plus the consumption of capitalists out of their profits, under the assumption that wage income is entirely or almost entirely spent. From the implicit consumption function imbedded in this equation, it follows that in the short run a decrease in the propensity to save will have a favourable effect both on employment and on the profits of firms. In addition, an increase in real wages will have a favourable impact on aggregate demand and hence on the short-run determination of output and employment. In the short run, there is thus a positive relationship between real wages and the effective demand for labour (Seccareccia, 1991).

Kalecki himself extended his equation to the open economy with a government sector. In this case, in addition to the above-mentioned variables, profits net of taxes are increased by the government deficit and net exports. Government deficits thus have a positive impact on the cash flow of firms in the short run and hence ought to have a beneficial impact on the economy within the same time period.

In our opinion, there is nothing that distinguishes the Marxist approach from the post-Keynesian approach at that level. Post-Keynesians, or Kaleckians, usually assume, as a simplification, that aggregate supply adjusts to aggregate demand within the production period, as quantities produced adjust quasi-instantaneously, as they would in a service economy. However, this is an assumption of convenience, not one of necessity. Other post-Keynesians, such as Godley (1999) and Smithin (2001), do not make this assumption, supposing instead, as do Marxists such as Shaikh (1991) and Duménil and Lévy (1993), or other heterodox authors such as Flaschel *et al.* (2001), that aggregate demand and aggregate supply roughly balance over some relatively short period, but not within the production period. As a result, undesired inventories fluctuate and have a feedback effect on production decisions. This is without any doubt a more realistic assumption, but from a pedagogical point of view, it makes the model more complicated. The fact that inventories fluctuate with unexpected demand changes does not, in our view, constitute a distinguishing feature of the Marxist model compared to the post-Keynesian model. Both models, however, are distinct from the canonical neoclassical model, where aggregate supply and aggregate demand equate each other through instantaneous price adjustment.

Medium-run Analysis

While Marxists agree with post-Keynesians about the implications of short-run changes to real wages, saving propensities, government deficits and so on, they usually disagree about the long-run implications of these changes. Let us first deal with what we call, for lack of a better term, the medium-run implications of high employment and high rates of capacity utilization.[2] In the Marxist view, high levels of activity or falling rates of unemployment generate a more powerful labouring class. Workers do not fear being laid off anymore, just as Kalecki (1971, p. 140) argued: 'Under a regime of permanent full employment, the sack would cease to play its role as a disciplinary measure'. This has given birth to the 'efficiency wages' analysis—or 'labour effort extraction' problem—within neoclassical and Marxist literature, whereby firms must pay higher real wages to workers to extract the same level of effort when employment rates are higher or rising (Bowles & Boyer, 1988). Assuming that rates of capacity utilization and rates of employment are sufficiently positively correlated, it implies that unit costs are rising with increasing rates of capacity utilization.

This implication of the disciplinary effect of low activity and high unemployment has been imbedded in the shape of the profit-cost curve drawn by several Marxists, specially those linked with the 'social structure of accumulation' project (SSA). The curve is drawn in the profit rate and capacity utilization rate space. Post-Keynesians tend to draw such a curve as a simple horizontal line, under the assumption that neither unit costs nor the mark-up tend to change as more output is being produced and sold. When fixed costs are taken into consideration however, these fixed costs are spread over a larger volume as rates of capacity utilization are increased, so that rates of profit on capital become larger (Lavoie, 1998). In this more realistic case, the profit–cost curve is upward sloping. Marxists believe however that a downward-sloping segment can be appended, either because decreasing returns are eventually reached, or because the 'labour effort extraction' effects take over. In general, thus, the profit–cost curve will take a bell shape (Gordon, 1997, p. 118).

The 'labour effort extraction' analysis developed by the proponents of the social structure of accumulation, which, as pointed out by Green (1988), has some affinity with the neoclassical 'efficiency wages' hypothesis, is tightly linked to the profit-squeeze explanation of cycles provided by some Marxist authors, in particular Goodwin (1967) and Goldstein (1999). For these authors, expansion breeds the seeds of its own destruction because high rates of capacity utilization and high employment strengthen the negotiating power of the working class and leads to higher real wages, higher unit costs, and lower profit margins. This is also the view of the social structure of accumulation proponents, like Gordon (1994, p. 158), who argue that, at first, with increases in utilization and employment rates, labour productivity rises faster than real wages, while eventually the reverse occurs (Gordon, 1994, p. 158). Profit is squeezed from the cost side, and this leads to lower profit rates and lower profit shares, despite the high rates of capacity utilization. Other Marxist authors have proposed a different profit–squeeze theory, in particular the so-called nutcracker theory, linked to post-Keynesian concerns with effective demand (Sherman, 2002).

Post-Keynesians have reservations regarding the traditional way to assess business cycles. In the standard assessment, consistent with the profit squeeze story, it is noted that profit rates or profit shares start to fall *before* output diminishes.

However, from a dynamic point of view, profit rates or shares should start to fall as soon as *the rate of growth* of output falls, not when its absolute value falls. What one should look for are points of inflection, not turning points as in the standard method.

Long-run Analysis and the Specification of the Investment Function

The Kaleckian View

These concerns notwithstanding, even if higher rates of capacity utilization generate higher unit costs and lower profit rates calculated at standard rates of capacity utilization or lower profit shares, why should this have any impact on the rate of accumulation? One would expect the higher real wages to have a favourable impact on the realized rates of profit, by contrast with the normal rate of profit or the rate of profit assessed at the standard rate of capacity utilization. In other words, even though higher real wages imply a movement along the real wage/profit frontier, calculated at full capacity or at the normal or standard rate of capacity utilization, the realized frontier is moving outwards, and hence it is possible for both the real wage and the realized rate of profit to increase together, even beyond the short run.

Indeed, this is exactly what the Kaleckian growth models proposed by post-Keynesians show. Higher real wages and lower propensities to save (and larger government deficits) generate higher realized rates of profit and higher rates of accumulation. This is based on investment functions of the following type:

$$g = \gamma + \gamma_u u + \gamma_r r \tag{1}$$

or

$$g = \gamma + \gamma_u (u - u_n) \tag{2}$$

where g is defined as the rate of capital accumulation ($g = I/K$), r is the realized rate of profit, u is the realized rate of capacity utilization, u_n is the standard (or normal) rate of capacity utilization, while the γ's are parameters.

Taking Normal Profitability into Account

These investment functions have been criticized by both Marxist and Sraffian economists. The main argument against such investment functions is that they fail to incorporate the idea that new investment ought to depend on expected profitability, computed at normal prices and based on standard rates of capacity utilization, rather than on current profitability as measured by realized rates of profit.[3] This argument has been advanced mainly by Sraffians. Another argument, that of double counting, has been advanced mainly by Marxists, in particular Bhaduri and Marglin (1990). In their view, equation (1) is mis-specified since the rate of utilization enters twice the investment function, because the realized rate of profit depends itself on the rate of capacity utilization, being equal to:

$$r = mu / v \tag{3}$$

where m is the share of profits while v is the capital/capacity ratio.

As a result, equation (1) implicitly assumes that if u rises and m diminishes by an equal amount, keeping r constant, firms will *necessarily* invest more, an economically unwarranted condition according to Bhaduri and Marglin.

In the simplified case where there are constant returns and no fixed costs, when the rate of utilization is kept at its normal or standard level, we can see that there is a one-to-one relation between the share of profits m (or the profit margin) and the normal profit rate r_n.

As a remedy, equations (4) and (5) can be proposed as alternative investment functions:

$$g = \gamma + \gamma_u u + \gamma_n r_n \tag{4}$$

$$g = \gamma + \gamma_u u + \gamma_m m \tag{5}$$

When these equations are being used, higher real wages and lower propensities to save need not be associated any longer with higher rates of capital accumulation and higher realized profit rates. Various regimes can be associated with different parameter values, and the Kaleckian results only constitute one of the regimes. On this issue, Blecker (2002) concludes that Kaleckian results are most unlikely in open economies or when workers save.

By way of conclusion on this topic, it should be noted that Kalecki (1971, p. 158) himself was not very much convinced by the arguments of equations (4) or (5). Kalecki considered whether an increase in real wages would lead to a decline in the volume of investment. Kalecki's view was that, since investment decisions take time and are lagged with respect to achieved results, investment would not immediately change following real wage increases. Because wages are mostly spent, entrepreneurs would not observe any fall in total profits, despite the fall in profit margins. Capacity utilization rates would be higher however, and this would constitute a favourable incentive for investment. Thus, if a decision to cut investment was not taken right away, according to Kalecki, it would never be taken.[4]

Fully adjusted Positions in the Long Run

Divergences on the Relevance of Long-period Positions

There is however another critique of the Kaleckian model that has developed over the last decade, a critique relating to the long run. Post-Keynesians are usually rather reluctant to get into any discussion of the long run, first because Keynes pointed out that 'in the long run we are all dead', but also because long-run equilibria are often assumed, without any explanation as to how they are achieved. Post-Keynesians like to quote Kalecki (1971, p. 165) on this issue, when he says that 'the long-run trend is but a slowly changing component of a chain of short-period situations; it has no independent entity'. Any discussion of fully adjusted long-run positions must thus be accompanied by a story explaining the mechanisms that bring a series of short-run equilibria towards the long-run position.

This critique of the Kaleckian growth model, which constitutes the crux of the present article, is that the Kaleckian model lacks coherence in the sense that there is nothing in the model to bring its equilibrium rate of capacity utilization back to its normal level. This is considered an anomaly of the model because one would expect that the equilibrium rate of utilization would equate eventually its normal level, and as a result that the equilibrium rate of profit would turn out to equate its normal value, even though actual rates might only gravitate around these equilibrium values (Committeri, 1986; Auerbach & Skott, 1988, p. 53; White, 1996; Franke, 2000, p. 42).

This critique, in some sense, is not new. When Kalecki was first formalizing his ideas based on the existence of excess capacity, even in the long run, Keynes was objecting to his model precisely on the grounds that, in the long run, excess capacity could not exist. By contrast, Kalecki (1971, p. 183) was arguing himself that assumptions of 'a constant degree of long-run utilisation of equipment' were 'fallacious'. Similarly, Steindl (1952, p. 12) claims that although 'intuition leads us to identify planned […] excess capacity with actual long-run excess capacity […] on closer examination this idea proves wrong […]. The degree of utilisation actually obtaining in the long run, we must conclude, is no safe indication of the *planned* level of utilisation.'

Economists like Robinson (1956), on the other hand, were being torn between the classical belief that economies operate in the long run at normal capacity, while acknowledging that this would not be so in the short run. Robinson attempted to explain the transition from a short-period Keynesian or Kaleckian model, where utilization rates can fluctuate freely, towards the long-period world, where rates of capacity utilization are at their normal values; but, other than providing a useful typology of growth regimes, she failed.

Divergences on Definitions of Normal Capacity

This divergence of views about the possible convergence towards the *normal* degree of capacity utilization may have arisen as a result of divergent definitions of the *normal* rate of capacity utilization. In the Marxist and Sraffian view, the normal rate of capacity utilization is the *optimal* rate of capacity utilization, one which arises from profit maximization in the context of a microeconomic choice of technique devoid of uncertainty (Kurz, 1986; Franke, 2000). In the Keynesian and Kaleckian view, each individual segment of plant is assumed to operate at its optimal level as defined by engineers, under the standard requirements of cost minimization, given the existing legislation and customs. This, we think, is fully compatible with the Sraffian or Marxist view. However, Kaleckians believe that, *in addition*, businesses expect some plants or segments of plant to remain idle in normal conditions.

Why is this so? Excess capacity is akin to liquidity preference. Firms hold on to excess capacities to face an uncertain future (Steindl, 1952, p. 2). Firms fear losing customers if they are unable to respond quickly to changes in demand and in the composition of demand. The existence of excess capacity is thus linked to uncertain macroeconomic conditions. The rate of capacity utilization is increased by bringing into use plants that were previously idle. The normal rate of capacity utilization, in that context, is thus a convention, which may be influenced by historical experience or strategic considerations related to entry deterrence. Although firms may consider the normal rate of capacity utilization as a target, macroeconomic effective demand effects might hinder firms from achieving this target, unless the normal rate is itself a moving target influenced by its past values.

We believe that the capacity utilization rates as defined by Statistics Canada are consistent with this Kaleckian view. Statistics Canada defines the *maximum practical capacity* as maximum output under normal conditions, which is then compared to actual output, to obtain rates of capacity utilization. This capacity is defined in such a way that the rate of capacity utilization can easily exceed 100%. This will occur whenever the plant is utilized beyond normal conditions (for instance with a Saturday shift, when a five-day shift is the norm). Still, the measured rate of capacity utilization oscillates between 70% and 87% in all years. In other words, there is excess capacity over the long run, as Kaleckians claim. While each plant segment may be operated in accord with cost-minimization principles, firms retain excess capacity. So much can be deduced from the actual numbers given by the Canadian statistical agency and from its definition of practical capacity, as provided in the questionnaire sent out to 7000 manufacturing firms.

> [Maximum practical capacity] is defined as maximum production attainable under normal conditions. To calculate capacity production, follow the establishment's operating practices with respect to the use of productive facilities, overtime, work shifts, holidays, etc. For example, if your plant normally operates with one shift of eight hours a day five days a week, then capacity will be calculated subject to these conditions and not on the hypothetical case of three shifts a day, seven days a week. (Statistics Canada)

The crucial divergence between post-Keynesian and Marxist authors is that the latter in contrast to the former believe that, in the long run, the rate of utilization gravitates around its normal level, assumed to be a constant, while the realized rate of profit is equal to the normal rate of profit. It is this constraint over the value that the realized rate of capacity utilization can take that explains the crucial divergences in the long-term policies that would be advocated by post-Keynesians and Marxists. As Moudud summarizes correctly:

> Both traditions would agree that in the short run capacity utilization can take any value, as determined by demand …. The distinction between the two traditions arises over the medium to long run. In the classical tradition capacity utilization gravitates around normal ($u = u_n$) and the corresponding normal rate of profit ($r = r_n$) is given by technology and income distribution. (Moudud, 1998b, p. 19)

Classical Traverses Towards the Fully Adjusted Position

The Duménil and Lévy Proposal

There are at least two families of models that are clear examples of the Marxist long-run view, according to which higher real wages and lower propensities to save lead to a slowdown in accumulation in the long run, even though it may increase the pace of accumulation in the short run. These are the Duménil and Lévy (1993, 1999) model and the Franke (2000) model on the one hand, and the models proposed by Shaikh (1989, 1991) and developed by Moudud (1998a, b) on the other hand. Setting aside the two-sector Franke (2000) model, let us deal with the model of Duménil and Lévy (1999). The slow-moving mechanisms that they propose are the following:

$$\pi = \beta(u - u_n) \tag{6}$$

$$\mathrm{d}\gamma / \mathrm{d}t = - \in \pi \tag{7}$$

where γ is the autonomous component of investment functions.

What happens is the following: π is the rate of demand price inflation, which is assumed to occur as long as the actual rate of capacity utilization is above its normal value. It is assumed that the central bank will push up the real rate of interest as long as this demand inflation occurs. As a result, any demand shock, such as higher real wages or lower propensities to save, that propels the economy above its normal rate of capacity utilization generates a devastating response from the central bank. The higher real rates of interest are assumed to have a negative effect on the autonomous component of the investment function, the γ parameter of equation (2). This parameter shifts down as long as the actual rate of utilization is above its normal value, i.e. as long as real interest rates are pushed upwards.[5] Eventually, aggregate demand is so depressed that rates of utilization are brought to their normal levels. When this occurs, the rate of accumulation will have reached its long-run equilibrium value, and will be equal to the following:

$$g^{**} = s_p r_n. \tag{8}$$

In other words, the model of Duménil and Lévy demonstrates that in the long-run fully adjusted position, the rate of accumulation becomes *positively* related to the propensity to save (out of profits) and to the normal profit rate, i.e. the rate of accumulation is *inversely* related to the real wage. This is what they call the *classical* tradition, and what Shaikh and Moudud call the *classical-Harrodian* perspective or the *classical growth and cycle* model. These authors all claim that while the short run may entertain the main elements of demand-led Keynesian economics, long-run growth requires higher thrift and higher normal profit rates. Thus in the words of Duménil and Lévy (1999, p. 686), 'a sequence of Keynesian equilibria can converge toward classical equilibrium'. Franke (2000, p. 47) is also on the look for a model that would be 'Keynesian in the short run and classical in the long run. The problem to be investigated is whether the Keynesian short-run equilibria show a tendency to converge to the classical long-run equilibrium.' The successful traverse so established leads Shaikh (1989, p. 72) to conclude that such a result 'vitiates all claims that there is an inherent contradiction between theories of effective demand and classical and Marxian theories of growth'. In the view of these authors, the traverse towards the classical long-term equilibrium provides the long-sought synthesis between Keynesian and Marxist economics.

Crucial Discrepancies between Kaleckians and Marxists

Owing to the presumed Wicksellian reaction function of the monetary authorities, where real rates of interest are hiked up whenever inflation is positive, as well as to the inflation behaviour assumed by Duménil and Lévy, both the paradox of costs and the paradox of thrift are gone.[6] Equation (8) allows Moudud (1999, p. 33) to claim that 'following the classical tradition the rate of profit … is a key variable that *drives* investment spending. Thus in contrast to the Keynes–Kalecki tradition, the path of accumulation is fundamentally regulated by the rate of profit.'

Equation (8) can be compared to Harrod's well-known formula for his warranted rate of growth, where we have:

$$g_w = s / C_r \tag{9}$$

where s is the overall propensity to save, and C_r is the desired incremental capital/output ratio.

Harrod's equation, as reinterpreted by neoclassical economists, implies that faster growth is only possible if the overall propensity to save is increased. Indeed, as is recalled by Moudud (1998b, p. 20), this was exactly Domar's view of equation (9) and the warranted growth rate, when he argued in 1944 that: 'The fall in the rate of growth is accompanied, or rather caused, by a declining propensity to save.' Under standard assumptions, this implies that either the share of profits or the propensity to save (out of profits) be increased. Marxists authors make a similar interpretation; and indeed, Moudud (1998a, p. 36) rewrites Harrod's warranted growth rate in terms of Duménil and Lévy's long-run equilibrium growth rate g^{**}, given by equation (8).

The key feature that brings about these results is that the *rate of change* in the rate of accumulation is a function of the discrepancy between the actual and the normal rate of capacity utilization. Taking the total differential of the standard Kaleckian investment function, while taking into account the additions made by Duménil and Lévy, i.e. equations (6) and (7), we obtain:

$$\mathrm{d}g = -\beta \in (u - u_n) + \gamma_u(\mathrm{d}u) \tag{10}$$

The change in the rate of accumulation depends on the discrepancy between the actual and the normal rates of utilization. In the steady state of the Duménil and Lévy (1999) model, where $\mathrm{d}u = 0$, the rate of accumulation becomes constant only when $u = u_n$. This can be contrasted to the straightforward differentiation of the Kaleckian investment function, under the assumption that both γ_u and u_n are constants:

$$\mathrm{d}g^i = +\gamma_u(\mathrm{d}u)\cdot \tag{11}$$

The Shaikh Equation

Although they use an entirely different model, both Moudud and Shaikh arrive at equation (8), with higher rates of accumulation being generated ultimately by higher propensities to save and higher rates of profit. Both Shaikh (1991) and Moudud (1998a, 1999) start from an equation that describes the evolution of the share of fixed investment in output. Shaikh (1991, equation 15, p. 329) writes that 'when capacity utilization is above normal, firms will be stimulated to raise investment in fixed capital faster than output and hence to raise the fixed investment share'. A very similar story, but stated in more ambiguous terms and without any further justification, can be found in Moudud (1998a, equation 38, p. 34): 'Investment in fixed capital increases when the capacity utilization rate is above the normal rate.' In both Shaikh (1991) and Moudud (1998a), the rate of growth in fixed investment relative to output growth accelerates whenever the rate of utilization is above its normal value. They have:

$$s_f = +\alpha(u - u_n) \tag{12}$$

where s_f is the rate of growth in the share of fixed capital investment relative to output, and where in fact the normal rate of capacity utilization is assumed to be equal to unity ($u_n = 1$).[7]

It is clear that a steady growth rate is reached only when $u = u_n$, that is when the actual rate is equal to the normal rate. The reader may note however that Shaikh posits that an above normal rate of utilization leads to an *accelerating* growth rate of investment, whereas in Duménil and Lévy's equation (10), this above-normal rate of utilization led to a *decelerating* rate of accumulation (the sign of the first term on the left-hand side was negative). At first sight, one would have thought that Shaikh's mechanism would induce some unstable process: a high rate of utilization would induce faster fixed capital accumulation, and this would stimulate effective demand, inducing in turn a higher rate of capital utilization. Indeed, this would be a possible characterization of Harrod's dynamic instability principle. Yet this will not be the case, for according to Shaikh (1989, p. 79), 'an acceleration in the growth of capacity will end up decelerating the growth of actual production, so that the capacity level will tend to fall back toward normal …'. (cf. Shaikh, 1991, pp. 327–328).

Equation (12) can be rewritten in terms of dg, as in our other investment functions, provided we take note of the following definitions.

$$s_f = \mathrm{d}I / I - \mathrm{d}Y / Y = g_I - g_Y \tag{13a}$$

$$g = I/K$$

and hence:

$$\mathrm{d}g / g = g_I - g \tag{13b}$$

Removing the g_I term by putting together equations (12), (13a) and (13b), we obtain:

$$\mathrm{d}g = +\alpha(u - u_n)g + (g_Y - g)g \tag{14}$$

Equation (14) shows that when the rate of accumulation g gets sufficiently high compared to the rate of growth of output g_Y, the negative term may overcome the other positive terms, forcing the rate of accumulation to decelerate. According to Shaikh (1991, p. 327), this will necessarily occur eventually, since the rise in the share of fixed investment will lead to a fall in the share of material investment and hence eventually to a fall in the growth rate of actual output g_Y.

While equation (12) may be appealing, it remains to be shown why one would have entrepreneurs behave as described by equation (12). Putting together equations (12) and (13a), we get:

$$g_I = \mathrm{d}I / I = g_Y + \alpha(u - u_n)$$

which resembles, but is not the same as, the standard Kaleckian investment function, which we reproduce below for convenience:

$$g = \mathrm{d}K / K = \gamma + \gamma_u(u - u_n)$$

and where γ is usually interpreted as some secular rate of growth, which could be the secular component of the growth rate of output g_Y.

In the standard Kaleckian investment function, given by equation (2), it is argued that capacity, as represented by K, ought to grow faster when the rate of capacity utilization is above its normal value. The justification for such a behaviour is that capacity should grow in line with the secular growth rate of output. In

Shaikh's version, it is not clear why the growth rate of fixed *investment* $\mathrm{d}I/I$, in contrast to *capacity*, should behave in such a manner.

A Keynesian Traverse Towards the Fully Adjusted Equilibrium

The extended Kaleckian model to be presented may be considered as a counter-example to the traverses modelled by Marxist authors who show how a Keynesian–Kaleckian short-run world behaves in a classical way in the long run, once fully adjusted positions are reached and compared.

Lavoie (1996) and Dutt (1997) have shown that the Kaleckian model and its implications can be retained even when the model returns to a fully adjusted position. It is possible to devise various slow-moving mechanisms that will drive a standard post-Keynesian model towards a fully adjusted position, i.e. a long-run equilibrium where the rate of capacity utilization is equal to its normal value, while at the same time retaining the essential features of the Kaleckian growth model. One of these mechanisms, suggested by Lavoie (1996), involves only the investment function, and is made up of the following set of differential equations:

$$\mathrm{d}u_n / \mathrm{d}t = \sigma(u - u_n) \tag{15}$$

$$\mathrm{d}\gamma / \mathrm{d}t = \psi(g - \gamma) \tag{16}$$

where γ is the autonomous component of investment (the expected secular rate of accumulation or the expected secular growth rate of sales).

Here, for the reasons outlined in the section on fully adjusted positions in the long run, both the normal rate of capacity utilization, u_n, and the expected secular growth rate, γ, are assumed to react to past realized values. With such differential equations, the paradoxes of thrift and of costs now hold, both in the short run and in the long run. This slow-acting mechanism allows maintaining Kaleckian results in the long run, even though this long run is characterized by a rate of capacity utilization that is equal to its normal value. However, the normal rate of capacity utilization is not unique anymore. There is hysteresis.

Now, taking the total derivative of Kaleckian investment equation (2), while taking into account the above two equations, (15) and (16), we obtain a more sophisticated Kaleckian equation, which is given by:

$$\mathrm{d}g = \psi(g - \gamma) - \sigma\gamma_u(u - u_n) + \gamma_u(\mathrm{d}u) \tag{17}$$

Statistical Tests of the Four Investment Functions

Preliminaries

From the above analysis, we have therefore derived four investment functions, all in the form of differential equations, the statistical properties of which can now be compared with one another. To be able to do so, we must first present the discrete versions of each of these equations. The four relevant investment functions are equations (10), (11), (14), and (17). For convenience, we shall call equation (10) the French Marxist equation (FM), equation (11) the naive Kaleckian equation (NK), equation (14) the American Marxist equation (AM), and equation (17) the hysteresis Kaleckian equation (HK).

The equations to be estimated are shown below. In all cases, the dependent variable corresponds to the change in the rate of accumulation of capital (either actual or intended), denoted as Δg_t, where g_t is the rate of growth of the stock of capital at time t ($k_t - k_{t-1}$ with k_t being the logarithm of the stock K_t). The equations are estimated using Statistics Canada data for both the Canadian manufacturing sector and the total industrial sector. The series are annual data and they span the period 1960–2000, with the exception of the intended investment data that was only available for the period 1960–98.[8] These estimated equations are as follows:

$$\Delta g_t = \alpha_0 + \alpha_1 a_{t-1} + \alpha_2 \Delta u_{t-1} + \in_t \tag{10-FM}$$

$$\Delta g_t = \beta_0 + \beta_1 \Delta u_{t-1} + \beta_2 \Delta u_{t-2} + \in_t \tag{11-FM}$$

$$\Delta g_t = \mu_0 + \mu_1 a_{t-1} g_{t-1} + \mu_2 (\Delta y_{t-1} - g_{t-1}) g_{t-1} + \in_t \tag{14-AM}$$

$$\Delta g_t = \lambda_0 + \lambda_1 x_t + \lambda_2 z_{t-1} + \lambda_3 \Delta u_{t-1} + \in_t \tag{17-HK}$$

The independent variables are the change in the rate of capacity utilization, which is denoted as Δu_t, defined as $u_t - u_{t-1}$, where u_t represents the rate of utilization of productive capacity. We also use as explanatory variable the deviation between the current rate of capacity utilization (u_t) and its 'normal' level, which we denote as u_n, and their deviation being defined as z_t or a_t.

Note that the variable u_n is not observed. In the Marxist view, the normal rate of utilization is defined according to the principle of cost minimization, as the Sraffians would have it, as was discussed in an earlier section. The normal rate of utilization should not be influenced by its past values. Since Marxists assume that actual rates of utilization gravitate around their normal value, we may thus take the normal rate to be the average rate of capacity utilization over the period considered. We thus use a_t, the discrepancy between the actual capacity rate and the average rate of capacity utilization, in the two Marxist equations.

By contrast, in the sophisticated Kaleckian view, the rate of utilization, which is considered to be normal, is influenced by its past values. There are many ways to decompose a times series into its permanent and transitory components (see Hamilton, 1994). For our purpose, we shall use an established, simple and direct approach for the two Kaleckian equations that consist of applying the HP filter (Hodrick and Prescott, 1980) to u_t. This procedure allows us to identify an estimate of the permanent component in the series u_t, which we denote as the series u_n. In turn, we can construct the series z_t, which can be interpreted as an estimate of the transitory component of u_t, and hence the discrepancy between the actual and the normal rates of capacity utilization.

In much the same way, the variable x_t is calculated as the difference between g_t and its trend component, which is defined as γ. This component is also calculated by using a HP filter. In terms of our analysis, the distance x_t can be considered as the transitory component of g_t (x_t could also have been the distance between g_t and the trend component of the rate of growth of sales g_Y).

Finally, the variable Δy_t is the logarithmic rate of growth of real output Y($g_Y = y_t - y_{t-1}$). It should be noted that the coefficient μ_2 in equation (14-AM) ought to be equal to one, by reason of the identities that were used to derive its theoretical counterpart in equation (14). However, to be able to compare all four investment equations, we have left the coefficient μ_2 unconstrained.

Table 1. Estimates for manufacturing sector (t-statistics in parentheses)

$$\Delta g_t = \underset{(-0.46)}{-0.0018} + \underset{(1.43)}{0.0016} a_{t-1} + \underset{(3.48)}{0.0042} \Delta u_{t-1} + \epsilon_t \qquad \text{(FM-1)}$$

$R^2 = 0.435$

$F(2,33) = 12.33\ (0.000)$

$$\Delta g_t = \underset{(-0.58)}{-0.0022} + \underset{(4.78)}{0.0049} \Delta u_{t-1} + \underset{(2.23)}{0.0023} \Delta u_{t-2} + \epsilon_t \qquad \text{(NK-1)}$$

$R^2 = 0.479$

$F(2,32) = 14.76\ (0.000)$

$$\Delta g_t = \underset{(0.69)}{0.0041} + \underset{(1.04)}{0.02301} a_{t-1} g_{t-1} + \underset{(2.43)}{4.589} (\Delta y_{t-1} - g_{t-1}) g_{t-1} + \epsilon_t \qquad \text{(AM-1)}$$

$R^2 = 0.207$

$F(2,32) = 4.172\ (0.025)$

$$\Delta g_t = \underset{(-0.72)}{-0.0025} + \underset{(3.34)}{0.6402} x_t - \underset{(-1.44)}{0.0028} z_{t-1} + \underset{(4.75)}{0.0057} \Delta u_{t-1} + \epsilon_t \qquad \text{(HK-1)}$$

$R^2 = 0.597$

$F(3,31) = 15.32\ (0.000)$

Empirical Results

The results from analysing the above-mentioned estimated equations are presented in Tables 1–3. Table 1 deals with the actual changes in capital stocks, for the manufacturing sector; Table 2 does the same for the total industrial sector; finally Table 3 also deals with the total industrial sector, but by taking investment intentions as the estimate for changes in capital stocks. We added this variable among our tests because it is sometimes argued that investment intentions are a more appropriate variable (Courvisanos, 1996, ch. 5). Overall, the signs are usually as expected from theory, except in the case of the (FM) equation, where, despite our efforts, the discrepancy between the actual rate of capacity utilization and its

Table 2. Estimates for total industrial sector (t-statistics in parentheses)

$$\Delta g_t = \underset{(-0.65)}{-0.0010} + \underset{(0.72)}{0.0004} a_{t-1} + \underset{(1.82)}{0.0011} \Delta u_{t-1} + \epsilon_t \qquad \text{(FM-2)}$$

$R^2 = 0.172$

$F(2,33) = 3.34\ (0.048)$

$$\Delta g_t = \underset{(-0.71)}{-0.0010} + \underset{(2.53)}{0.0012} \Delta u_{t-1} + \underset{(1.77)}{0.0009} \Delta u_{t-2} + \epsilon_t \qquad \text{(NK-2)}$$

$R^2 = 0.234$

$F(2,32) = 4.90\ (0.014)$

$$\Delta g_t = \underset{(-0.63)}{-0.0009} + \underset{(0.37)}{0.0052} a_{t-1} g_{t-1} + \underset{(3.36)}{7.580} (\Delta y_{t-1} - g_{t-1}) g_{t-1} + \epsilon_t \qquad \text{(AM-2)}$$

$R^2 = 0.305$

$F(2,32) = 7.02\ (0.003)$

$$\Delta g_t = \underset{(-0.95)}{-0.0012} + \underset{(3.74)}{0.7024} x_t - \underset{(-2.00)}{0.0016} z_{t-1} + \underset{(3.30)}{0.0018} \Delta u_{t-1} + \epsilon_t \qquad \text{(HK-2)}$$

$R^2 = 0.431$

$F(3,31) = 7.82\ (0.001)$

Table 3. Estimates for total industrial sector, investment intentions (t-statistics in parentheses)

$$\Delta g_t = \underset{(6.93)}{0.0900} + \underset{(3.26)}{0.0155} a_{t-1} + \underset{(0.993)}{0.0048} \Delta u_{t-1} + \epsilon_t \qquad \text{(FM-3)}$$

$R^2 = 0.385$
$F(2,31) = 9.73\ (0.001)$

$$\Delta g_t = \underset{(6.12)}{0.0887} + \underset{(2.61)}{0.0124}\, \Delta u_{t-1} + \underset{(1.51)}{0.0074} \Delta u_{t-2} + \epsilon_t \qquad \text{(NK-3)}$$

$R^2 = 0.234$
$F(2,32) = 4.74\ (0.016)$

$$\Delta g_t = \underset{(5.68)}{0.0848} + \underset{(2.08)}{0.293} a_{t-1} g_{t-1} + \underset{(1.21)}{27.168} (\Delta y_{t-1} - g_{t-1}) g_{t-1} + \epsilon_t \qquad \text{(AM-3)}$$

$R^2 = 0.217$
$F(2,31) = 4.311\ (0.022)$

$$\Delta g_t = \underset{(7.50)}{0.0858} + \underset{(2.75)}{4.3640} x_t + \underset{(0.942)}{0.0064} z_{t-1} + \underset{(1.70)}{0.0082} \Delta u_{t-1} + \epsilon_t \qquad \text{(HK-3)}$$

$R^2 = 0.539$
$F(3,31) = 11.71\ (0.022)$

average rate carries a positive sign rather than the negative sign set by Duménil and Lévy. It should also be noted that the μ_2 parameter in the (AM) equation is not near unity, as theory tells us it should be.

As can be observed from the regression results displayed in the tables, broadly speaking the (AM) equation displays lower values of R^2 with the exception of data of the total industrial sector, where the (FM) equation shows the lowest R^2. In addition, observing the t ratios, the variables with the highest levels of significance are consistently Δu_{t-1}, Δu_{t-2} and x_t, for both the manufacturing sector and the all industry data sets, while in the data set relating to 'investment intentions' the variable a_{t-1} shows a strong statistical significance.

Since our goal is to identify the best equation in the sense that it is able to encompass its rivals and is sufficiently robust to the application of different well-established tests, we then proceeded with the following applications. Among the tests that were applied, we evaluated (i) the autocorrelation of residuals by analysing the Lagrange multiplier (*LM*) statistic at different lags (Breusch, 1978; Godfrey 1978); (ii) the normality of the residuals by using the *JB* statistic (Bera and Jarque, 1981); (iii) the possible presence of autoregressive conditional heteroscedasticity (*ARCH*) which is verified by using an *LM* statistic for different lags (Engle, 1982); (iv) the possibility of misspecification by applying the Reset statistic to each equation (Ramsey, 1969), (v) heteroscedasticity with and without cross products; and (vi) instability analysis of coefficients and variance based on the approach suggested by Hansen (1992).[9]

Table 4 presents the results obtained from the application of a set of diagnostic tests on each equation and for each one of the data sets used (the manufacturing sector, the total industrial sector and the annual investment intentions of Canadian firms also in the overall industrial sector). Observing the top panel (the manufacturing sector) of Table 4, we observe that equations (FM), (NK) and (HK) present problems with the normality of the residuals, and equations (NK) and (AM) have autocorrelated residuals. However, all equations are stable in coefficients and

Table 4. Diagnostic statistics

Statistic test	FM	NK	AM	HK
Manufacturing sector				
AR (1–2)	1.363 (0.271)	5.375 (0.010)	7.323 (0.003)	0.610 (0.550)
ARCH (1)	2.622 (0.115)	1.555 (0.222)	0.000 (0.998)	0.092 (0.763)
Normality	10.081 (0.006)	9.202 (0.010)	1.483 (0.476)	7.943 (0.018)
Heteroscedasticity	0.755 (0.563)	0.840 (0.511)	3.707 (0.016)	0.321 (0.919)
Heteroscedasticity X	0.892 (0.500)	0.665 (0.653)	4.679 (0.003)	0.261 (0.978)
Reset	1.827 (0.186)	0.101 (0.752)	0.614 (0.439)	0.987 (0.328)
Instability variance	No	No	No	No
Instability coefficients	No	No	No	No
Industrial sector				
AR (1–2)	1.028 (0.369)	4.678 (0.017)	0.683 (0.512)	1.123 (0.339)
ARCH (1)	0.915 (0.347)	0.671 (0.419)	2.876 (0.100)	0.414 (0.524)
Normality	6.790 (0.033)	4.368 (0.113)	1.363 (0.505)	13.081 (0.001)
Heteroscedasticity	0.327 (0.857)	0.188 (0.942)	1.643 (0.192)	0.420 (0.858)
Heteroscedasticity X	0.277 (0.921)	0.161 (0.975)	1.304 (0.293)	0.281 (0.973)
Reset	0.008 (0.929)	1.703 (0.201)	1.736 (0.197)	0.131 (0.719)
Instability variance	No	No	No	No
Instability coefficients	No	No	No	No
Industrial sector (investment intentions)				
AR (1–2)	3.656 (0.038)	3.810 (0.034)	3.875 (0.032)	3.517 (0.043)
ARCH (1)	0.226 (0.638)	0.029 (0.865)	0.149 (0.702)	0.104 (0.749)
Normality	0.184 (0.912)	0.726 (0.695)	0.246 (0.884)	0.496 (0.780)
Heteroscedasticity	3.488 (0.021)	5.554 (0.002)	2.505 (0.066)	2.625 (0.044)
Heteroscedasticity X	2.814 (0.037)	4.275 (0.006)	2.644 (0.047)	1.968 (0.099)
Reset	0.037 (0.848)	0.144 (0.706)	0.298 (0.588)	0.356 (0.555)
Instability variance	No	No	No	No
Instability coefficients	Yes (intercept)	Yes (intercept)	Yes (intercept)	Yes (intercept)

variance. The middle panel (the industrial sector) indicates the presence of autocorrelation in equation (NK). On the other hand, the problem of the non-normality of the residuals persists in equations (FM) and (HK). The bottom panel (the annual investment intention of the industrial sector) shows evidence of autocorrelation problems for all equations at the 5.0% significance level. The equations suffer from problems of heteroscedasticity. In terms of stability, the results from the Hansen (1992) statistic indicate that the intercept term is not stable in all equations.

One possible way of ranking a set of estimated equations in accordance with some preference order is to use established information criteria such as the *Akaike* (*AIC*), *Schwartz* (*SIC*) or *Hannan–Quinn* (*HQ*) techniques. These results are presented in Table 5 for the three versions of the data set analysed and for the *AIC*, *SIC* and *HQ* criteria. First, let us consider the results when using data for the manufacturing sector (the top panel). Equation (HK) was ranked highest since it presented the lowest *AIC*, *SIC* and *HQ* values. Equation (HK) was then followed, in rank order, by equations (NK), (FM) and (AM) respectively. Considering data for the complete industrial sector (the middle panel), the *AIC*, *SIC* and *HQ* criteria selected, once again, equation (HK), as the preferred estimated equation, followed, instead, by equations (AM), (NK) and (FM) respectively. Moreover, results

Table 5. *AIC*, *BIC* and *HQ*

Equation	*AIC*	*BIC*	*HQ*
Manufacturing sector			
FM	–7.355	–7.222	–7.309
NK	–7.438	–7.304	–7.392
AM	–7.016	–6.883	–6.970
HK	–7.636	–7.458	–7.575
Industrial sector			
FM	–9.260	–9.127	–9.214
NK	–9.338	–9.205	–9.292
AM	–9.435	–9.301	–9.388
HK	–9.577	–9.399	–9.516
Industrial sector (investment intentions)			
FM	–5.077	–4.942	–5.031
NK	–4.856	–4.722	–4.811
AM	–4.835	–4.700	–4.789
HK	–5.306	–5.127	–5.245

obtained using investment intentions in the industrial sector confirm the fact that equation (HK) is the preferred estimation. However, in this case, it is followed, instead, by equations (FM), (NK) and (AM).

Therefore, taken overall, our statistical results rank equation (HK) as the preferred specification for the three versions of the data set. Equations (FM), (NK) and (AM) appear in the third or fourth positions depending on the data series employed. Note, however, that in some cases the penalty factor imposed by *AIC*, *SIC* or *HQ* to the number of estimated parameters can hide possible problems of stability or misspecification.

In light of the above concerns, another technique of ranking our estimated equations was adopted that entails the so-called encompassing tests. The principle of encompassing is very general and can be legitimately used to evaluate whether a model specification encompasses its rival empirically (see Mizon, 1984; Mizon and Richard, 1986; Hendry and Richard, 1989). A model 'A' is said to encompass a model 'B' if model 'A' is able to explain the results obtained using model 'B'. To continue to select the most adequate equation, we use four encompassing tests. The first statistic was proposed by Cox (1961) and it is distributed asymptotically as $N(0,1)$ under the null hypothesis of encompassing. The second test, proposed by Ericsson (1983), is based on the instrumental variable method and has the same limiting distribution as Cox (1961). The third test was developed by Sargan (1959) and follows a χ^2 distribution. Finally, the fourth test is the non-nested *F*-statistic proposed by Davidson and MacKinnon (1981).[10]

These empirical findings are presented in Tables 6–8. First, let us consider the results for the Canadian manufacturing sector (Table 6). The evidence, according to the statistics of Sargan (1959) and the *F*-test, indicates that equation (FM) is able to encompass equations (NK) and (AM) but not equation (HK). Using the other two test statistics, equation (FM) is not able to encompass equations (NK) and (HK). In the case of equation (NK), the four statistics indicate that it is able to encompass equations (FM) and (AM) but not equation (HK). With regards to equation (AM), the evidence from all four statistics is that this equation is not able to

Table 6. Encompassing tests for manufacture sector

Equation	Statistic	FM	NK	AM	HK
FM encompasses	Cox		–4.432 (0.000)	–0.206 (0.836)	–29.100 (0.000)
	Ericsson		4.056 (0.000)	0.195 (0.845)	23.190 (0.000)
	Sargan		2.499 (0.114)	2.504 (0.315)	9.983 (0.006)
	F-test		2.626 (0.115)	1.164 (0.326)	6.802 (0.004)
NK encompasses	Cox	0.302 (0.762)		–0.835 (0.404)	–7.183 (0.000)
	Ericsson	0.291 (0.771)		0.769 (0.442)	5.787 (0.000)
	Sargan	0.113 (0.736)		3.075 (0.215)	12.887 (0.002)
	F-test	0.109 (0.742)		1.594 (0.219)	10.114 (0.000)
AM encompasses	Cox	–7.150 (0.000)	–9.899 (0.000)		–13.140 (0.000)
	Ericsson	5.402 (0.000)	7.125 (0.000)		8.496(0.000)
	Sargan	10.857 (0.004)	13.033 (0.001)		17.276 (0.000)
	F-test	7.702 (0.002)	13.307 (0.004)		11.342 (0.000)
HK encompasses	Cox	0.050 (0.960)	–25.110 (0.000)	–0.405 (0.689)	
	Ericsson	–0.047 (0.962)	22.560 (0.000)	0.370 (0.711)	
	Sargan	0.002 (0.962)	6.104 (0.013)	2.916 (0.233)	
	F-test	0.002 (0.963)	7.355 (0.011)	1.503 (0.239)	

encompass any other equation. Finally, according to the four test statistics, equation (HK) is able to encompass clearly all other equations, with the exception of the equation (NK).

Table 7 presents the results for the total industrial sector. Our empirical findings suggest that equation (FM) is not able to encompass any equation. However, notice that the statistic of Sargan and the F-test indicate a borderline acceptance of the

Table 7. Encompassing tests for industrial sector

Equation	Statistic	FM	NK	AM	HK
FM encompasses	Cox		–3.159 (0.001)	–3.807 (0.000)	–10.930 (0.000)
	Ericsson		2.842 (0.004)	3.259 (0.001)	8.819 (0.000)
	Sargan		2.576 (0.108)	5.469 (0.065)	9.244 (0.009)
	F-test		2.714 (0.109)	3.088 (0.060)	6.094 (0.006)
NK encompasses	Cox	–0.255 (0.798)		–2.792 (0.005)	–5.637 (0.000)
	Ericsson	0.242 (0.808)		2.406 (0.016)	4.567 (0.000)
	Sargan	0.051 (0.820)		5.456 (0.065)	10.633 (0.049)
	F-test	0.049 (0.825)		3.084 (0.060)	7.465 (0.002)
AM encompasses	Cox	0.283 (0.777)	–0.623 (0.533)		–3.348 (0.000)
	Ericsson	–0.274 (0.784)	0.579 (0.562)		3.182 (0.001)
	Sargan	0.423 (0.814)	2.769 (0.250)		15.483 (0.001)
	F-test	0.196 (0.823)	1.421 (0.257)		9.061 (0.000)
HK encompasses	Cox	0.316 (0.756)	–4.308 (0.000)	–4.296 (0.000)	
	Ericsson	–0.294 (0.769)	3.810 (0.000)	3.608 (0.000)	
	Sargan	0.093 (0.761)	4.272 (0.038)	11.463 (0.003)	
	F-test	0.089 (0.766)	4.796 (0.036)	8.507 (0.001)	

Table 8. Encompassing tests for industrial sector (with investment intentions)

Equation	Statistic	FM	NK	AM	HK
FM encompasses	Cox		0.171 (0.864)	1.481 (0.138)	–5.536 (0.000)
	Ericsson		–0.164 (0.869)	–1.516 (0.129)	4.520 (0.000)
	Sargan		0.029 (0.864)	3.367 (0.185)	7.934 (0.018)
	F-testt		0.028 (0.868)	1.767 (0.188)	4.988 (0.014)
NK encompasses	Cox	–6.358 (0.000)		–1.108 (0.267)	–12.350 (0.000)
	Ericsson	5.317 (0.000)		1.014 (0.311)	9.054 (0.000)
	Sargan	6.161 (0.013)		1.104 (0.576)	12.425 (0.002)
	F-test	7.441 (0.011)		0.535 (0.591)	9.699 (0.000)
AM encompasses	Cox	–4.432 (0.000)	–1.761 (0.078)		–8.041 (0.000)
	Ericsson	3.674 (0.000)	1.578 (0.115)		5.760 (0.000)
	Sargan	9.305 (0.009)	1.734 (0.420)		14.630 (0.002)
	F-test	6.219 (0.006)	0.858 (0.434)		8.341 (0.000)
HK encompasses	Cox	0.489 (0.624)	0.320 (0.748)	1.175 (0.239)	
	Ericsson	–0.466 (0.641)	–0.304 (0.761)	–1.175 (0.240)	
	Sargan	0.226 (0.634)	0.104 (0.747)	3.086 (0.214)	
	F-test	0.220 (0.642)	0.100 (0.753)	1.605 (0.218)	

encompassing hypothesis regarding the equation (NK). While equation (NK) is able to encompass equation (FM), equation (AM) is able to encompass equations (FM) and (NK). Finally, equation (HK) is able clearly to encompass only equation (FM). Unlike Table 6, in Table 7 equation (HK) is not able to encompass equation (AM). Interestingly, as before, equation (HK) is not able to encompass equation (NK). Table 8, relating to investment intentions, confirms broadly most of the empirical findings obtained thus far. For instance, equation (AM) is able to encompass only equation (NK). In this case, (HK) is able to encompass all other equations.

To summarize: from all of the above analysis, we are able to infer that equation (HK) is preferred regardless of the data set. This overall empirical result is quite robust to the application of criteria such as the *AIC*, SIC and *HQ*, as well as a wide variety of encompassing tests.

Concluding Remarks

The distinguishing feature of the classical model, as presented by Marxist authors, is the equation that compels the rate of accumulation to change whenever the actual rate of capacity utilization deviates from its normal value. In the Duménil and Lévy model, the assumption that high rates of capacity utilization induce faster price inflation, combined with the reaction function of an inflation-fighting central bank, does the trick. In the Shaikh and Moudud models, the key assumption is the introduction of a negative non-linear term in the investment function. These mechanisms constrain the economy to converge to or gravitate around a uniquely defined normal rate of utilization of productive capacity. However, what if the normal rate of capacity utilization were itself endogenous and influenced by the actual rates that are determined by the short-run gyrations in effective demand, as in the hysteresis versions of the natural rate of unemployment? In this case, the long-run results of the classical model would not necessarily arise.

It should be noted that there are obvious policy implications regarding fully adjusted positions. As pointed out by Moudud (1998b), both post-Keynesians and Marxists agree that, in the short run, government deficits ought to have favourable effects on growth. However, for Marxists, these effects are likely to become negative in the medium and long run because government deficits reduce the aggregate propensity to save and, hence, decrease the possible warranted rate of growth (unless government expenditures generate additional investment expenditures). Consequently, there arises some form of long-run crowding out. In the Kaleckian framework, government deficits could also curtail output growth, but the cause of this negative impact has nothing to do with its saving-reducing effect. In Lavoie (2000), government deficits could have a negative impact on long-term growth that is induced by shrinking profit rates. This occurs when the government is targeting a given debt-to-income ratio when real interest rates are high. There are thus obvious policy implications regarding the precise underlying investment function being considered to be the most appropriate.

In the last section, we have provided an econometric and statistical appraisal of the four investment equations that have been proposed by various heterodox authors whose approach share common distinguishing features. We used Canadian times series data for capacity utilization rates, capital stock, and intended investment spanning the period 1960–2000, for both the manufacturing and the total industrial sectors. As a general rule, our regression results show that the (HK) equation performs better than the three other specifications stipulated above, using standard indicators such as R^2, F-statistics, and t-ratios. It also performed better when various comparative diagnostic tests, information criteria, and encompassing tests were applied, whatever the precise test being applied. These statistical tests allow us to conclude that the sophisticated Kaleckian investment equation (HK) is the preferred investment function.

Acknowledgements

Part of this research was made possible through a grant of the Center for Employment and Price Stability (University of Missouri in Kansas City). We are grateful for the various comments, especially those of Jamee Moudud, Marc-André Pigeon, Tom Rymes and Anwar Shaikh, as well as those of the two anonymous referees of the *Review*. We retain the sole responsibility for all remaining errors or omissions.

Notes

1. The theoretical portion of this paper was presented at the Progressive Economics Forum session of the annual meetings of the Canadian Economics Association (May–June 2001, McGill University, Montreal) and at the first meeting of the International Confederation of Associations for Pluralism in Economics (June 2003, University of Missouri in Kansas City), while the empirical part was presented at the annual meetings of the Eastern Economic Association (February 2003, in New York City).
2. The commonalities and differences arising from this section are discussed in more detail in Lavoie (1987).
3. There is another debate going on in the case of two-sector or multi-sector models, with authors such as Dutt, Glick and Park being involved, but that issue is beyond the scope of the present paper.
4. The lag could also go the other way, however. If the current consumption of workers is based on expected income, rather than actual income, an unforeseen increase in real wages will not lead to an increase in consumption, and as a result, profits are likely to fall rather than to increase when

real wages are increased, for a given amount of investment. With this kind of lag, the profitability effect is more likely.

5. A somewhat similar mechanism, but with a more complicated twist, is to be found in Franke (2000). High rates of utilization induce rising costs and high rates of interest, both features leading to a reduction in net profitability and hence in rates of accumulation.
6. The implications of this reaction function for the behaviour of real interest rates following an increase in the propensity to save are discussed in Lavoie (2003, pp. 61–64).
7. Shaikh (1989), however, is rather unclear on this. He calls k the rate of accumulation in fixed capital (1989: 78), leading the unsuspecting reader to believe that his equation 27 (p. 78) is of the type: $dg/g = +\alpha(u - u_n)$. But then in a previous page and also in the next one (pp. 73, 79), k is defined as the ratio of investment to potential profits, and hence as some measure of the share of fixed investment in output, thus indicating that he intends to use equation (12) of the present paper.
8. The variable u_t was obtained from Statistics Canada under the CANSIM I label numbers D883647 and D883544; while the variable K_t was drawn from the CANSIM I series D993721 and D993325. On the other hand, real output data both for the manufacturing sector and for all industries were derived from the CANSIM II series V328599 and V328622 respectively, while the annual series on intended investment for the industrial sector as a whole had to be collected directly from the Statistics Canada publication *Private and Public Investment in Canada: Intentions*, Cat. No. 61–205. It is important to note that unlike the actual rates of accumulation, which were calculated directly from the capital stock series, the 'intended' rates of accumulation were compiled as a ratio of the annual planned capital expenditures for the current year to the actual capital stock data of the previous year.
9. Most estimations were performed using PcGive 10.0 of Hendry and Doornik (2001), which is an Ox-Metrics package.
10. Davidson and MacKinnon (1984) also proposed a *J*-test. Results from the application of the *J*-test give the same conclusions.

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