Profitability Gap Theories of Investment

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Colin Richardson*

School of Economics
University of Tasmania

ABSTRACT

The key structural-form equation in my thesis relates farmers' annual investment in seedcorn (I sacks pa) to a *gap* between the expected (re% pa) and the normal (n% pa) profit rates on capital stock: $I = (1 + \phi\ [re - n])\ Io$, where "$\phi$" is their reaction-coefficient and "o" indicates a one-year time-lag. By way of justification, this paper demonstrates that similar "expected profitability gaps" are implicit in every influential theory of investment behaviour. These comprise theories descended from Brainard/Tobin ("q-ratio"), Jorgenson/Eisner/Strotz ("user-cost"), Harrod/Samuelson/Hicks ("multiplier-accelerator"), Keynes/Kalecki ("marginal-efficiency"), and Smith/Ricardo/Marx ("uniform-profitability"). Thus the [re – n] explanator constitutes a kind of "genome" that is present in all investment functions.

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PREFACE

Title of Thesis: *The Traverses of a Post-Keynesian Corn Model of a Monetary Economy*
Supervisor: *Dr Jerry Courvisanos*

The "traverse" is defined as the dynamic disequilibrium adjustment-path that connects an initial with a final growth-path, should one exist. My thesis develops a nested sequence of five post-Keynesian corn models of a closed monetary economy and analyses the traverses sparked off by perturbing the parameters of the fifth (flexprice) model. Also, a package of economic policies is designed to minimise disruption along an "instrumental traverse" path.

Common to all five models is an "expected profitability gap" investment function: $I = (1 + \phi\ [re - n])\ Io$ sacks of seedcorn per annum (pa). From this year's harvest, I sacks are retained by capitalist farmers to plant as next year opens; re% pa is the rate of profit they *expect* to earn as next year closes; n% pa is the *known* opportunity cost of capital; ϕ is their reaction-coefficient; and Io sacks is this year's opening capital stock (= last year's investment retention) of seedcorn *qua* "circulating capital".

This particular investment equation is what drives the dynamics of the model and its traverses, making it imperative that a robust justification for its use be provided. This paper attempts to make the case.

The chapter structure of the thesis is as follows:

1. The Traverse, Post-Keynesian Economics and Research Objectives
2. Analytical Survey of the Traverse Literature
   Appendix: Traverse Models after 1973
3. Research Methodology
   Appendix: The Investment Function Genome
4. A Fixprice Corn-Credit Economy
5. Flexing the Corn Price, Money Wage and Interest Rate
6. A Flexprice Corn-Credit Economy
7. An Instrumental Traverse
8. Principal Findings, Limitations of the Analysis and Future Directions

This paper is based on the Appendix to Chapter 3.

Introduction

This paper aims to demonstrate that all classical *uniform-profitability*; Keynesian *marginal-efficiency*; neo-Keynesian *multiplier-accelerator*; and neoclassical *q-theory* and *user-cost* investment functions are merely individual "ontogenic" expressions of a general "phylogenic" investment equation. By analogy with an organism's genes, we may characterise the *expected profitability gap* investment explanator as the common "genome" of all specimens within the investment equation species.

The *phylogenic investment function* is specified as I = f (a, Ko), where I is annual real net investment in (and Ko the opening real capital stock of) a firm, industry, sector, or economy; while a% per annum (pa) is the expected profitability gap *genome*. This key concept is defined as a = (re – n)% pa, where re% pa is the rate of profit entrepreneurs expect to earn on their investment and n% pa is their opportunity cost of capital. Alternative terms for n% pa include "normal rate of profit", "hurdle rate of return", "target rate of profit", and "required profitability".

The opportunity cost of capital is defined as n = (i + φ)% pa, where i% pa is the market rate of interest on money loans and φ% pa is the risk premium attaching to real investment in some particular firm, industry, sector, or economy. *Expected* profitability (re% pa) may differ from *realised* profitability (r% pa) for all expectation functions – except in the special case of "rational expectations" (re = r) where every investor, like the magus Merlin, possesses perfect foresight.

The expected profitability gap genome can be traced back through John Maynard Keynes (1936), Michal Kalecki (1933), Irving Fisher (1930), Keynes (1930), Arthur Spiethoff (1925), and Knut Wicksell (1898, 1906), with Henry Thornton (1802) being the ultimate progenitor of this universal "primitive" of investment and capital theory.

Net Investment as a Gap Concept

Each year's opening capital *stock* is either completely or partially absorbed in the current year's production process. This loss of capital value is a *flow* called "depreciation". Thus, a stock of *circulating* capital is equivalent to a *fixed* capital stock that suffers a δ = 100% pa depreciation rate.

In the absence of price inflation, an opening stock of fixed capital worth Ko dollars will grow indefinitely over historical time ($\Delta t = 1$ year) so long as *net* investment

$$I = K - Ko = \Delta K = \Delta K/\Delta t \qquad \text{dollars pa}$$

is positive, i.e. if *gross* investment each year (Ig dollars pa) exceeds the loss of opening capital value (δ Ko dollars pa) due to depreciation

$$I = Ig - \delta\, Ko > 0 \qquad \text{dollars pa.}$$

In a cyclical trough, net investment also may be negative ($Ig < \delta\, Ko$) and, in the long-period equilibrium of a classic stationary state, it would be zero ($Ig = \delta\, Ko$).

Now in circulating capital models having $\delta = 100\%$ pa, economic growth occurs when net investment is positive, just as in fixed capital models. The only difference is that no visible evidence of the previous year's opening capital stock remains; Ko has been entirely absorbed in (i.e. depreciated by) the process of production during the current year. The *exemplar* is a stock of seedcorn used to produce a flow of corn output, from which the opening stock is renewed post-harvest, one year later.

Already it can be seen that "gaps" are important in capital and investment theory, e.g. the positive, zero or negative "differences" between K and Ko are identical with those between Ig and δ Ko. These gaps/differences may also be expressed as "ratios", i.e. $(K / Ko) = 1$ is mathematically equivalent to $(K - Ko) = 0$. Thus the investment function genome may be present in gap theories, difference theories and/or ratio theories.

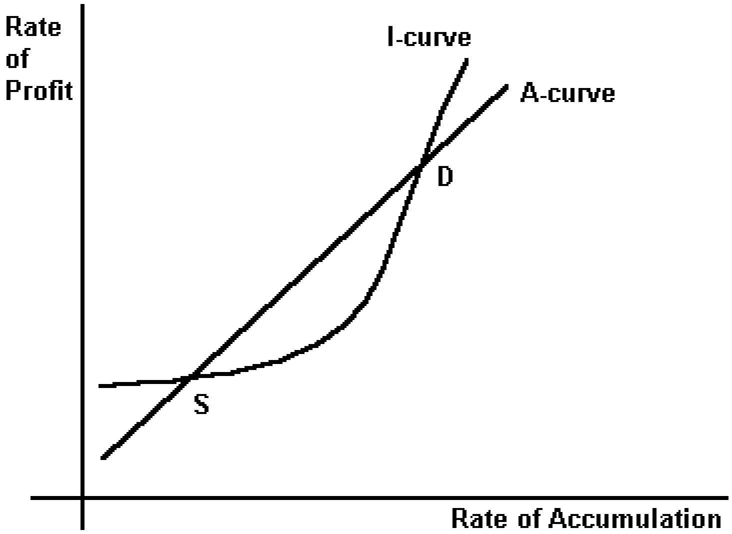
If net investment (I dollars pa) is itself a gap, it may come as no surprise that economists of all schools have theorised that it is *determined by* some kind of gap, difference or ratio. It is the purpose of this paper to show that many different species of investment functions are driven by entrepreneurial reaction to gaps of one kind or another. Furthermore, it is demonstrated that all such gaps ultimately reduce to a *single* difference, viz. the expected profitability gap genome (a% pa).

In my thesis, each farmer-investor is assumed to *react* to any positive (negative) gap in expected profitability by increasing (decreasing) this year's retention of seedcorn relative to the volume held back from last year's harvest. The corn economy's overall reaction-coefficient ($\phi > 0$) is the mean of all farmers' *subjective* responses. It cannot be construed as a degree of "gap closure" or as a "speed-of-adjustment" towards an objectively-determined optimal capital stock. If the profitability gap is zero, the positive reaction-coefficient can have no effect and farmers will be content to maintain aggregate real investment at last year's level (I = Io sacks pa).

Gap Theories of Investment

In the Harrod/Samuelson/Hicks multiplier-accelerator theories, the relevant gaps lie between the current and lagged values of output or consumption. The Jorgensonian user-cost theories feature differences between the actual and optimal capital stocks or production capacities. The Tobinesque "q" theories are based on a ratio between the Marshallian demand and supply prices of capital equipment.

Only in the Smith/Ricardo/Marx uniform-profitability and the Keynes/Kalecki marginal-efficiency theories is our expected profitability gap mechanism present in almost pristine form. And only in Joan Robinson (1962, p 48) are the mutual positive feedbacks of (a) expected profitability onto investment, (b) investment onto realised profitability and (c) realised profitability back onto expected profitability included.



Robinson states that “The A curve represents the expected rate of profit on investment as a function of the rate of accumulation that generates it. The I curve represents the rate of accumulation as a function of the rate of profit that induces it.” Desired rates of capital accumulation are shown at points S (unstable) and D (stable). Stability is assured at point D because the I-curve cuts the A-curve from below.

Significantly, Robinson refers to “desired” rather than “equilibrium” rates of capital accumulation. This is because the very fact that net investment which exceeds (or, indeed, falls short of) depreciation is occurring, indicates that the opening capital stock was *not* in equilibrium – given the expected future course of revenue, expense and associated profitability. And being out of equilibrium must mean that some kind of “gap” has developed, one which prevents capitalist investors from continuing to feel comfortable about the size and/or structure of their opening capital stock.

The Gap Zoo

Nuclear physicists were embarrassed by their “particle zoo” until, beginning in 1964, Murray Gell-Mann and others started to demonstrate that these 200-plus different sub-atomic particles detected in their accelerator rings were built out of only six quarks, six leptons and three bosons. Economists today should feel similarly uncomfortable about the “gap zoo” inhabiting their own accelerator models, as detailed below. This paper argues that *all* these various flow and stock gaps are merely imperfect proxies for something deeper and more fundamental: the difference between expected profitability (re% pa) and the opportunity cost of capital (n% pa).

Keynes (1936, pp 315-7), for instance, insisted that gaps between the subjective marginal efficiency of investment (MEI)[1] and the objective long-term rate of interest were responsible for fluctuations in the investment aggregate. These, he claimed, get amplified (by the multiplier) into instability, the trade cycle and the infrequent crises that afflict capitalist economies.

With respect to capital and growth, Edmond Malinvaud (1986, p 382) has stated that

> I agree with economic historians in thinking that an essential element … is the course of business profitability … this latter is precisely a deviation from the flexprice equilibrium.
>
> Business profitability may be characterised by the anticipated marginal pure profit rate (excess over the real interest rate …)[2]. Over decades and excepting cases of major shocks, this can be properly measured by the mean realized pure profit rate … The existence of a non-zero pure profit rate is inconsistent with existing flexprice growth theories … the observed differences, with at some times and places negative, at others high pure profit rates … truly reveal what is best interpreted as disequilibria of the price system.

With respect to the business cycle, Alan Freeman (1999) has developed a non-linear, continuous-time, two-equation investment model which is driven by a gap between realised and normal profitability. He proved that even such a simple abstract system will generate stable, persistent business cycles: "Neither neoclassical nor Marxist thinkers have, to my knowledge, constructed formal models in which the rate of profit itself exercises the predominant influence on investment behaviour, notwithstanding … [its theoretical importance and] … notwithstanding the significant empirical evidence uncovered, by authors of both schools, of profit rate variations during the course of the cycle" (p 4).

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[1] Keynes (1936, pp 135-46) called it the marginal efficiency of capital (MEC), but the context makes clear that he really meant the marginal efficiency of investment (MEI). This was pointed out by Abba Lerner (1944, 1953) and reinforced by Luigi Pasinetti (1974, pp 60-4).

[2] Malinvaud's "deviation" is the same concept as our expected profitability "gap": a = (re – n)% pa.

The Time-Profile of an Investment Project

The following time-profile shows how complex are the value flows associated with even the simplest of investment projects.

Year	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Sales Revenue				p.x	p.x	p.x	p.x	p.x	p.x	p.x	p.x	p.x	p.x	
less														
Wages				w.l	w.l	w.l	w.l	w.l	w.l	w.l	w.l	w.l	w.l	
Materials				mt	mt	mt	mt	mt	mt	mt	mt	mt	mt	
Maintenance				mn	mn	mn	mn	mn	mn	mn	mn	mn	mn	
Repairs							rp			rp		rp		
Taxes				tx	tx	tx	tx	tx	tx	tx	tx	tx	tx	
equals														
Receipts	0	0	0	Rs	Rs	Rs	Rs	Rs	Rs	Rs	Rs	Rs	Rs	Sv
must cover														
Rent Outlays				Or	Or	Or	Or	Or	Or	Or	Or	Or	Or	
Lease Value			Pr											
or														
Build Outlays	Ob	Ob	Ob											
Supply Price			Ps											
or														
Buy Outlays			Op											
Demand Price			Pd											

This investment time-profile shows a business firm (one producing to order, not for inventory) acquiring a machine with an output capacity of χ = x units pa. It will be needed in three year's time, has a service life of 10 years and its net scrap or surrender value will be Sv dollars, once decommissioned. *Prima facie*, the entrepreneur's only problem is to decide between renting, building or buying the machine.

Except for rent outlays (Or), there is no presumption that any annual dollar amounts need be the same as any other appearing in the same row. Fortunately, our entrepreneur knows how to reduce all this complexity and carry out the necessary comparisons. From the common time-stream of receipts (0/Rs/Sv) are subtracted the stream of outlays Ob (constructing) or the single outlay Op (purchasing). This yields two different time-streams, representing the "net proceeds" from each of these options. Then it is a simple matter of discounting each year's net proceeds before summing them to find the net present value (NPV) of each option as at the start of year –2 … and choosing the one with the highest NPV.

The leasing option cannot be treated the same way because its particular time-stream of equal annual rental payments (Or) *already includes* depreciation, interest and an allowance for risk – to compensate the lessor (rather than the lessee) for bearing these costs. Correct treatment of this option is addressed below.

Most business firms have a good idea of their opportunity cost of capital, a rate of discount or normal profit rate (n% pa) which they routinely use for such investment analyses. This is the "hurdle" rate of return which *any* proposed investment project must clear before it can be considered further, so often n% pa is called the "target rate of profit" or "required profitability". This hurdle rate is built up by adjusting for industry-specific risk (φ% pa) the opportunity cost of locking up generic liquidity (money and its closest substitutes) in highly-specific projects, rather than lending it out at the ruling nominal interest rate in the loans market (i% pa). Thus, n = (i + φ)% pa would be the discount rate used by our entrepreneur to compare different time-streams of net proceeds.

The two options (build *versus* buy) also could be compared by using n% pa to accumulate forward, rather than to discount back. By finding the future value (FV) of the stream of build outlays (Ob) as at the end of year 0, our entrepreneur would obtain a capital value (**Ps** dollars) directly comparable with the buying price of the machine (**Pd** = Op dollars). Then the rent option could be brought into the analysis by using n% pa to discount its stream of outlays (Or) back to the start of year 1 (= end of year 0), thus capitalising the flow of rental payments into its equivalent "lease value" (**Pr** dollars). The entrepreneur then will choose the lowest-cost option from among these three (now directly comparable) alternatives.

With three comparable capital values (**Ps**, **Pd** and **Pr**), it is a simple matter to calculate the "internal rates of return" (IRRs) associated with these options. An IRR is that particular discount rate which ensures equality between the present value of the common receipts stream (0/Rs/Sv) and the capital(ised) value of that particular investment option, both being evaluated at the end of year 0, when the machine is due to be commissioned. Provided all the annual Rs/Sv receipts are positive, there will be a *single* IRR for each option. The entrepreneur then chooses whichever option has the greatest IRR – and the resultant rankings will be the same as under the alternative decision rules of choosing that option having the highest NPV or the lowest capital(ised) cost. We may call the greatest of these IRRs the "expected profit rate" (re% pa). But only during year 11 will the firm finally know whether this *expectation* of profitability was, in fact, *realised* (i.e. whether or not r = re% pa).

Aggregate Investment Functions

The method of analysis used to rank all options in a single project also is applicable to all investment projects in a single firm, industry, sector, or economy. Now, an IRR or expected profit rate (re% pa) is precisely the same concept used by Keynes (1936, pp 135-46) in his *General Theory*, viz. the marginal efficiency of investment (MEI). In Chapter 11, Keynes argued that, if equilibrium prevails, aggregate investment must have been pushed to the point where the *economy-wide* MEI had fallen into equality with the ruling rate of interest on long-term government bonds. Here he was abstracting from risk (i.e. assuming that $\varphi = 0\%$ pa), but it is basically the same opportunity cost of capital concept, viz. $n = (i + \varphi)\%$ pa. So, in the long-period equilibrium of a stationary state, it must be true that re = r = n% pa. Furthermore, for the stationary state to be *maintained*, re = r = ro = n = no% pa must remain true for all entrepreneurs, year after year – where "o" indicates a one-year time-lag as before.

The above time-profile of one particular firm's three-option investment project shows clearly why all IRRs are *expected* profit rates. Consider what is known and what has to be *forecast*. Probably service life, annual output capacity (χ units), annual inputs of operating labour (l manhours), the rent outlays (Or dollars pa) quotation from the lessor, and the first year's build outlays (Ob dollars) under the construction option are fairly firm figures. Beyond a year or two, however, our entrepreneur's confidence in all other forecasted values – production (x units), capacity utilisation ($u = x / \chi$), prices (p dollars/unit), the money wage (w dollars/manhour), and annual materials, maintenance and repair costs – will fall off rapidly as the time-profile lengthens. And who can foresee what taxation (tx) changes may occur during the next 14 years?

When Keynes (1936, p 157) spoke of "… the forces of time and our ignorance of the future", it was obvious he believed the universe to be non-ergodic. He did not subscribe to the *ergodic axiom* of neoclassical economics, whereby economic agents "… draw samples from the past or present, assume that such samples are equivalent to drawing samples from the future, and then place them into an optimising algorithm", as Jerry Courvisanos (1996, p 164) puts it. That is why economic models of investment always should disclose which particular "expectations function" is being employed to generate the expected profit rate (re% pa). Aside from ergodic-universe rational expectations (re = r% pa), several non-ergodic specifications have been used to model real-world investor behaviour, including "static" and "adaptive" expectations.

Non-ergodicity aside, the rejection of rational expectations by post-Keynesians and others relies on five aspects of the real world: information, computability, complexity, aggregation, and observation. Even in an ergodic universe, it is *impossible* to forecast the future realised profitability of a present investment project. In neoclassical general equilibrium, "everything depends on everything else" (including the project's profitability), so the information requirements are prohibitive and the computability problem insurmountable. Furthermore, as even the simple Lorenz differential equation exhibits chaotic properties, it is not surprising that complex GE systems are afflicted by such problems as instability, multiple and shifting equilibria, indeterminacy, path-dependency, and hysteresis. Next, the celebrated individualism of capitalist entrepreneurs gives rise to a severe aggregation problem. With each investor operating in ignorance of all the others' undertakings, the whole may sum to more (less) than the parts due to synergies (incompatibilities). Finally, even casual empirical observation confirms that small investors usually rely on rules-of-thumb like payback periods, while the most sophisticated often forecast investment time-profiles using na?ve extrapolation methods.

Assisted by the three-option investment project time-profile analysed above, we will continue to develop the concepts needed to discuss aggregate investment functions having gaps, differences or ratios as independent variables. Thus far, we have introduced the profit rate, both expected (re% pa) and realised (r% pa); the opportunity cost of capital (n% pa); the price of a new capital good (Pd, its Marshallian demand price); the replacement cost of a new capital good (Ps, its Marshallian supply price); and the lease value of a new capital good (Pr). Implicitly, as part of the IRR calculation, the economic depreciation rate (δ% pa) also was introduced; on a physical capital asset worth K dollars with a 10-year service life, this rate would be δ = 10% pa.

The capacity utilisation rate (u = x / χ) already has been mentioned and our time-profile has sales revenue (p.x dollars pa) as its first row. We also could derive annual measures of value-added output (Y), profit (R = Rs – depreciation – risk-adjusted interest) and cash flow (Rc = R + δ K). Macroeconomic versions of all these variables, together with aggregate consumption (C), have all been used as explanatory variables in the various theories of investment behaviour. We now turn to the classic difference, gap and ratio theories that have been proposed since long before Keynes (1936) showed that investment determines both output and saving, rather than saving and investment jointly determining the real interest rate.

Classical "uniform-profitability" Investment Functions

With the exception of Karl Marx (see below) and Thomas Malthus, all classical economists – who include Adam Smith (1776) and David Ricardo (1817) – accepted that supply creates its own demand, in accordance with Say's Law of Markets. Therefore, given the classical "iron law" that real wages tend to the subsistence level – the corollary being zero saving by workers – it is saving by capitalists out of their flow of profits (R dollars pa) that determines investment.

Prima facie, there is no room here for real net investment to be determined by our expected profitability gap (a% pa) genome. At best, one component of it (viz. the interest rate, i% pa) could be said to influence the amount saved out of capitalists' profit incomes. But the really interesting question is: What is it that determines this macroeconomic flow of *profits* (hence also saving and investment) in the classical model?

At the microeconomic level, all classical economists were aware that industries differed with respect to the risk premium (φ% pa) that capitalists had to anticipate covering, before investing part of their profit-determined saving (opportunity cost = i% pa) in some particular industry. At this level, therefore, the allocation of real saving across all lines of production must have been governed by the rule re = n% pa, where both sides of the inequality differed across industries. However, the right-hand side of the inequality only differs because the risk premium (φ% pa) is *specific* to each industry. (The left-hand side differs because prospects of profitability are industry-specific as well.) What is *general* across all investment opportunities is the basal opportunity cost (viz. i% pa, quoted by the rentiers) of converting foregone consumption (i.e. saving) into particular stocks of working capital and outfits of capital equipment.

Combine these facts with the insistence, by all classical economists except Marx, upon a natural tendency for the economy to gravitate towards its “dismal” stationary state. We are left with a long-period equilibrium situation where the economy’s *average* re% pa has come into equality with its *average* n% pa (underpinned by its *common* interest rate of i% pa). The equalities $re = r = ro = n = no$% pa are replicated, in the stationary state, year after year *ad infinitum*. At this set of “uniform” rates of return to physical capital and to (risk-adjusted) money loans – and with equilibrium saving out of equilibrium profits being equal to equilibrium investment – we can see that $I = S = g (R) = f (re – n)$% pa, as per our investment function genome.

In other words, it is *microeconomic* competition between capitalists to invest their flow of saving out of profits (in those industries which they *anticipate* will yield the highest rates of return) that results in a particular *macroeconomic* outcome. The economy will be pushed onto its production possibilities frontier (PPF), with real income being continuously maximised in a classic stationary state. So, in this equilibrium of zero wage and price inflation, $Y = Z$ dollars pa, where Z is the maximum flow of output that the economy can produce with all firms operating at their full capacity utilisation levels ($x = \chi$ units pa). By definition, $Y = W + R$ dollars pa and the wage bill is also an identity: $W = w L$ dollars pa. With the uniform money wage (w dollars/worker pa) being fixed at the subsistence minimum, only the stock of employment (L workers) and the flow of profits (R dollars pa) are free to adjust.

So, with fixed w, it must have been L and/or R that were the motive forces pushing Y all the way out to Z on the economy’s PPF. Whereas Marx assumed an industrial “reserve army of labour” (viz. the urban unemployed), all other classical economists relied on unlimited supplies of low-productivity rural labour. Effectively, both scenarios result in an unlimited supply of labour at the going real wage. As the level of employment (L) is therefore a purely passive variable, the *sole* active force is the microeconomic competitive struggle between capitalists to maximise differences between re% pa and n% pa, industry by industry. This process maximises the macroeconomic flow of R dollars pa that they receive as profits, so the economy ends up on its PPF, and stays there for as long as the stationary state endures.

As the last of the classical economists, Marx accepted that fierce competition between capitalists tended to make profit rates uniform throughout the economy. What he could *not* take on board was the classical economists' creed that capitalists frugally saved, then passively invested, real resources that always were limited by whatever profit incomes the market dictated. Those whom Marx criticised do not seem to have been aware that their own classical microeconomic investment process, which *equalised* profitability across all industries, also *maximised* the macroeconomic flows of profits, hence saving, hence investment. So, during any given year when the process was active, aggregate net investment (I dollars pa) really *was* determined by the expected profitability gap genome (a% pa) in the classical model. This disequilibrium process continued until the "dismal" long-period equilibrium stationary state of $Ig = \delta Ko$ and $a = 0\%$ pa was attained.

Marx, however, was a dynamic disequilibrium theorist. To him, the economy is *always* in traverse. "Accumulate, accumulate; that is Moses and the Prophets!" Marx (1867, p 742) exclaimed, thus ruling out the classical inevitability of the stationary state and substituting in its place a relentlessly growing and fluctuating economy, subject to intermittent crises. Positive net investment was the *norm* and Say's Law inoperative. If capitalist entrepreneurs lacked sufficient current profits to support their investment schemes, there were always plenty of capitalist rentiers on hand to extend money loans on the promise of future profits … provided the former group of capitalists had sufficient collateral, of course.

Lack of collateral was the only thing preventing frugal workers from becoming capitalists, since Marx permitted wages to fluctuate above subsistence, thus allowing workers to save from time to time. When accumulation was strong (weak), wages rose (fell) and the reserve army of labour shrank (expanded). Whenever an investment boom carried the economy onto its PPF, this did *not* usher in a stationary state. For Marx, the PPF was forever moving outwards, due to net investment embodying the fruits of technical progress.

According to Ernest Mandel (1990), Marx showed that the "… inner logic of capitalism is … not only to 'work for profit', but also to 'work for capital accumulation' … Capitalists are compelled to act in that way as a result of competition. It is competition which basically fuels this terrifying snowball logic: initial value of capital - accretion of value (surplus-value) - accretion of capital - more accretion of surplus-value - more accretion of capital, etc. 'Without competition, the fire of growth would burn out', (Marx, 1894, p 368)." Obviously, it is the classical uniform-profitability investment function (based on the competitive struggle and including the profitability gap genome) that Marx is using to explain capital accumulation.

Keynesian "marginal-efficiency" Investment Functions

Three years before the *General Theory*, Kalecki (1933, in Polish) had published a model "… identifying aggregate investment orders as a function of both anticipated gross profitability and interest rates", according to Courvisanos (1996, p 15), who also quotes Josef Steindl (1981, p 125) as having identified three versions of the investment function in Kalecki's writings on the business cycle.

In Kalecki's (1933) Version I model, the investment function

$$I = f\,(re - i) \tag{1}$$

closely resembles our profitability gap genome. As Malinvaud (1986, p 382) later recommended (see quotation above), Kalecki went on to substitute average realised profitability for the unobservable expected (re% pa) profit rate. Furthermore, he dropped the interest rate variable on the empirical grounds that it closely follows fluctuations in profitability – and with smaller amplitude. The right-hand side of equation (1) is identical with the gap between the MEI and the interest rate that drives investment in Keynes (1936) and, moreover, pre-dates it by three years … about the same time as Kalecki's derivation of the principle of effective demand pre-dates that by Keynes in the *General Theory*.

In Kalecki's (1943) Version II model, the investment function

$$I = f(\Delta R, \Delta K) \tag{2}$$

has investment responding positively to the "profits gap" ($\Delta R = R - Ro$) and negatively to the "capital stock gap" ($\Delta K = K - Ko$). Not shown is a third determinant, the positive response to cash flow (Rc). Kalecki included this to reflect the "principle of increasing risk", viz. more internal financing means less recourse to risky external borrowing.

Dividing the first gap by the second yields the "marginal profit rate" $r' = (?R/?K)\%$ pa, which is equivalent to the difference between $r = (R/K)\%$ pa and $ro = (Ro/Ko)\%$ pa. Thus equation (2) could be recast as

$$I = f(r - ro) \tag{3}$$

This would be identical with our expected profitability genome whenever $r = re\%$ pa and $ro = n\%$ pa. The former would be true if $r\%$ pa represented an average of previously realised profit rates, the expectations function recommended by Malinvaud and used by Kalecki for the operational version of equation (1). The latter would be true if Kalecki began his analysis from a state of long-period equilibrium, in which the normal profit rate was being earned on a fully-adjusted capital stock. Kalecki (1954) suggests that this interpretation is correct: "… [if] we consider the rate of investment decisions in a short-period we can assume that at the beginning of this period the firms have pushed their investment plans up to the point where they cease to be profitable either because of the limited market for the firm's products or because of 'increasing risk' and the limitations of the capital market …" (pp 96-7)

In Kalecki's (1968) Version III model, investment depends on marginal profitability alone, so that

$$I = f(r') \tag{4}$$

is equivalent to his Version II model *sans* the cash flow (Rc) determinant. Kalecki realised that, due to technical progress, later vintages of capital stock tend to exceed earlier ones in productivity performance (hence also in profit potential), thus accounting for $r\%$ pa $> ro\%$ pa. Here we cannot even begin to do justice to the richness of Kalecki’s investment, cycles, distribution, and growth analyses, which include gestation lags, firm microeconomic foundations in the oligopoly context and much more.

Courvisanos (1996, p 20) states that “Josef Steindl is the most important Kaleckian writer on excess capacity and accumulation” and goes on to discuss how Steindl reinterprets the Version II model, replacing equation (3) with the *equivalent* function

$$I = f\,(u - u^*) \qquad (5)$$

where u is the actual, and u^* the planned (target/required/desired) degree of capacity utilisation.

At the microeconomic level, this [r <-> u] equivalence can be appreciated by comparing Steindl’s equation (5) with Kalecki’s equation (3) under the $ro = n\%$ pa assumption of a long-period equilibrium starting point for the analysis, $n\%$ pa being the planned (target/required/desired) profit rate. Since the *profitability* associated with a given stock of fixed capital rises (falls) with every increase (decrease) in a firm’s actual degree of capacity utilisation ($u = x / \chi$), we can see the direct analogue of our profitability gap mechanism in Steindl’s vision of entrepreneurs investing more (less) as $u > u^*$ ($u < u^*$) or leaving investment unchanged ($u = u^*$).

At the macroeconomic level, Steindl’s [r <-> u] equivalence can be further appreciated by defining $u = Y / Z$ as the *aggregate* degree of capacity utilisation. If the “capacity-capital ratio” is $v = Z / K$ and the “profits share” is $rs = R / Y$, the profit rate identity $(R/K) = (R/Y)\,(Y/Z)\,(Z/K)$ can be rewritten as $r\%$ pa $= (rs\ u\ v)\%$ pa. Now the long-period constancy of macroeconomic income shares (such as rs) is accepted as a “stylised fact” and often we can assume that the capacity-capital ratio (v) also is constant. Thus the profit rate ($r\%$ pa) must vary directly with, and proportionally to, the degree of capacity utilisation ($u\%$), as maintained by Steindl.

Neo-Keynesian “multiplier-accelerator” Investment Functions

Kalecki’s macroeconomic income distribution analysis is important for detecting the presence of profitability gaps, differences and ratios in the multiplier-accelerator investment theories that follow. His analysis shows how the economic activity aggregates favoured by neo-Keynesian investment theorists (mainly consumption and income, but profits and productive capacity also have been used) all depend upon total investment outlays.

Kalecki expands the *expenditure* components of a closed economy’s gross domestic product into $Y = Cw + Cr + I$, where the first two right-hand side terms are consumption out of wage and profit incomes. Then he uses the classical assumption concerning propensities to save out of wages (W) and profits (R), i.e. $sw = 0 < sr < 1$, to forge a link with the corresponding *income* components of GDP, viz. $Y = W + R$. So, if $W = Cw$ then $R = Cr + I$ must follow. Finally, Kalecki proposes $(Cr + I) \rightarrow R$ as the *direction* of causation. This is plausible since capitalists, having collateral (hence preferred access to finance), can decide their own investment and consumption outlays, but not their own profits. It is “the market” (apparently) that decrees what profits they may subsequently earn.

However, what no isolated investor ever perceives is this: the aggregate of all capitalists’ investment outlays (I dollars pa) principally determines what *level* of profits (R dollars pa) the market will generate for them all to partake of, in the form of the average *rate* of profit (r% pa) they realise on the economy’s aggregate capital stock (K dollars).

Thus, Kalecki (1971, p 13) could state that “… capitalists, as a whole, determine their own profits by the extent of their investment and personal consumption”, an insight he attained in the 1930s. It has since become known as *Kalecki’s dictum*: “Workers spend what they get, but capitalists get what they spend”. Sidney Weintraub (1979, p 101) describes Kalecki’s dictum as “… a penetrating light beam that speeds us close to the real situation”. Independently, Keynes (1930, p 125) had derived his equivalent “widow’s cruse” explanation of how profits are generated:

> If entrepreneurs choose to spend a portion of their profit on consumption …, the effect is to increase the profit on the sale of liquid consumption goods by an amount exactly equal to the amount of profits which have been thus expended. … Thus, however much of their profits entrepreneurs spend on consumption, the increment of wealth belonging to entrepreneurs remains the same as before. Thus profits, as a source of capital increment for entrepreneurs,

> are a widow's cruse which remains undepleted however much of them may be devoted to riotous living.

Subsequently, post-Keynesians such as Nicholas Kaldor, Robinson and Pasinetti have analysed the implications of Kalecki's dictum for aggregate demand, income shares and economic growth paths.

In the neo-Keynesian theory of Samuelson (1939), the relevant gap is a difference between the current and lagged values of consumption

$$I = f\,(C - Co), \qquad (6)$$

whose right-hand side is a proxy for the profitability genome, as demonstrated below. This also is true of the "standard" output accelerator theory that Roy Harrod (1936) had pioneered, J R Hicks (1950) had extended and econometricians such as Lawrence Klein (1950) had utilised, viz.

$$I = f\,(Y - Yo) \qquad (7)$$

Recall that Keynes (1936) showed how I – *via* the multiplier – determines **Y**, and hence also **C** $= Y - I = Cw + Cr$. Furthermore, Kalecki's dictum showed how $(Cr + I)$ determines R, albeit by assuming that $Cw = W$. Yet, *regardless* of the saving behaviour of workers, it remains true that $W = Y - R$ in any short-period analysis. Combining the insights of Keynes (I -> Y) and Kalecki (I -> R), leaves the wage bill ($W = w\,L$) as a pure residual. The money wage (w) might be contractual, but employment (L) is not, so it would seem that *investment* (determining profits, GDP, consumption, and employment) rules the roost.

Now, in the current (previous) short period, the capital stock K (Ko) is given, so the current profit rate $r = (R/K)\%$ pa must be implicit in both C and Y, while the lagged profit rate $ro = (Ro/Ko)\%$ pa must be implicit in both Co and Yo. Thus, both neo-Keynesian accelerator formulations – consumption gap equation (6) and income gap equation (7) above – may be viewed as *proxies* for the functions containing the profitability gap, viz. $I = f\,(r - ro)\%$ pa and, equivalently, $I = f\,(r')\%$ pa. These are the same as equations (3) and (4), respectively, of Kalecki's Version II model discussed above.

Neoclassical “q-ratio” Investment Functions

The q-ratio theory, which began with William Brainard & James Tobin (1968) and Tobin (1969), states that net investment by a business firm depends directly on the ratio of the stock-market valuation (Kd) to the replacement cost (Ks) of that firm, viewed as a collection of capital assets:

$$I = f(q) \tag{8}$$

where $q = Kd / Ks$. If $q > 1$ ($q < 1$) there will be positive (negative) net investment. If $q = 1$ there is no incentive to change the firm’s capital stock, so only replacement investments will be made.

When $q = 1$, this indicates that the firm considers it already possesses an *optimal* capital stock (K^*), so that $K^* = Kd = Ks$ must represent the outcome of successful efforts by managers to maximise the equity value of the firm to its shareholders. Associated with each possible value of capital stock is some maximum capacity to produce output (χ), as in the investment time-profile discussed above. Optimal capital stocks (K^*) or production flow capacities (χ^*) are key concepts in the neoclassical user-cost investment functions discussed below.

In our investment time-profile, we used the opportunity cost of capital (n% pa) to discount the expected net proceeds and find Pd (the machine’s Marshallian demand price), then to accumulate the build outlays and find Ps, its Marshallian supply price. For a firm whose only asset is such a machine, $Kd = Pd$ and $Ks = Ps$, so we can see that the q-ratio investment theory involves a comparison between the results of forward-looking and backward-looking present value methods.

Recall that the option which has the highest net present value (NPV) also is the one with the greatest excess of the internal rate of return (IRR) or expected profit rate (re% pa) over the normal profit rate or hurdle rate of return (n% pa). So, if all managers are striving to maximise the NPVs of the firms they control, the q-ratio theory also reduces to the expected profitability gap theory. Note that the use of stock-market valuations in the numerator of the q-ratio implies that the opinions of those who *own* the firm (its shareholders) are assumed to be identical with the opinions of those who *control* the firm (its managers). During the 19th century, most business firms were managed by their owners, in fact.

Now estimates of both re and Kd are *prospective*, being based on the expectation functions which guide investment behaviour. Keynes (1936, pp 156-8) contrasted “enterprise” with “speculation”, noting that the former paid close attention to the underlying fundamentals (e.g. our investment time-profile) while the latter was based on devoting “… our intelligences to anticipating what average opinion expects the average opinion to be” (i.e. stock-market sentiment). He saw that a 20th century phenomenon (the separation of ownership from control) encourages speculation and reduces enterprise, with rentier share-trading being comparable to the farmer who, having tapped his barometer, withdrew all his capital from agriculture during a few days of expected bad weather. Finally, Keynes (p 159) warned that “Speculators may do no harm as bubbles on a steady stream of enterprise. But the position is serious when enterprise becomes the bubble on a whirlpool of speculation. When the capital development of a country becomes a by-product of the activities of a casino, the job is likely to be ill-done”.

This term “bubble” has by now entered the theoretical lexicon of neoclassical economists. For instance, Robert Chirinko and Huntley Schaller (2001) published a paper titled “Business Fixed Investment and ‘Bubbles’: The Japanese Case”. After many pages of advanced econometric analysis and testing, they concluded: “The data suggest that there was a bubble that had an economically important and statistically significant effect on fixed investment in Japan.” Along the way, they noted that

> A variety of theoretical work has called the simple present value model of stock prices into question. Empirical studies have provided evidence that stock prices may vary too much relative to dividends, that investors may overreact, that there may be fads in stock market prices, and that there may be a tendency to be overly optimistic about the future performance of stocks that have done well in the recent past …
>
> Among policy-makers, there is a long-standing concern that extreme movements in asset markets may adversely affect the real economy … More recently, the high price of U.S. equities led to Federal Reserve Board Chairman Greenspan’s concern about “irrational exuberance” and the mid-1998 worldwide decline in equity markets raised fears about subsequent effects on real economic activity. (p 663).

So, with empirical estimates of the Marshallian demand price numerator of the q-ratio most often being sourced from stock-market company valuations (rather than from internal company valuations based on the underlying fundamentals and made by better-informed directors and managers), it is not surprising that this investment function has not performed well under econometric testing. Andrew Abel (1983) says the *marginal* q-ratio is a more relevant measure than the *average* q-ratio discussed above. Marginal q is defined as the ratio of the market value of an *additional* piece of capital equipment to its replacement cost. It is difficult to obtain data on (or even proxies for) this theoretically superior concept, although Hayashi (1982) cites cases where marginal q is *proportional* to average q, such as when the operating profit function and the augmented adjustment-cost function are of the same degree of homogeneity.

Neoclassical "user-cost" Investment Functions

Tobin's q-theory is the bridge linking the neo-Keynesian multiplier-accelerator and neoclassical user-cost investment functions with the Keynes/Kalecki marginal-efficiency approach. In the neoclassical investment theories inspired by Dale Jorgenson (1963), the relevant gaps are those between last period's and this period's *optimal* capital stocks

$$I = f\,(K^* - Ko^*) \tag{9}$$

or between the corresponding optimal output flow capacities

$$I = f\,(\chi^* - \chi o^*) \tag{10}$$

along a steady-state growth path. Trygve Haavelmo (1961) earlier had pointed out that "… the demand for investment cannot simply be derived from the demand for capital. Demand for a finite addition to the capital stock can lead to any rate of investment, from almost zero to infinity, depending on the additional hypothesis we introduce regarding the speed of reaction of capital-users". Thus, Jorgenson had to invoke various *ad hoc* "delivery lags" and "adjustment costs" (modelled by distributed lags) to explain why gap closure does not occur instantaneously.

In Volume I of his *Collected Works*, Jorgenson (1998, Preface) reminisced that he had "… defined the *user cost* of capital as the rental price of capital services, representing this price as the product of the price of investment goods and the cost of capital … I reserved the term 'cost of capital' for the sum of the rate of return, the rate of depreciation and the rate of capital loss, adjusted for the taxation of capital income".

Jorgenson's "user cost of capital" (c) is none other than the uniform annual lease payment in the time-stream of rent outlays (Or) of our investment time-profile example. As we saw, this time-stream can be discounted back at n% pa to find its associated lease value (Pr). A fuller statement of Jorgenson's investment function, based on the gap between two adjacent optimal capital stock values ($\Delta K^* = K^* - Ko^*$) – and shorn of its *ad hoc* distributed lags structure – would be

$$I = f\ (\Delta x, \Delta p, \Delta c) \tag{11}$$

where x is output and p is the price of that output, as per our investment time-profile. So, with sales revenue = p.x dollars pa (incorporating the firm's expected profit rate, re% pa) and user-cost = c dollars pa (incorporating the firm's opportunity cost of capital, n% pa) determining the optimal capital stock, this neoclassical investment theory already *resembles* our phylogenic investment function with its genomic expected profitability gap. Furthermore, the presence of these quantity and price terms shows that Jorgenson's investment function includes a "sales accelerator", comparable with the consumption (ΔC) and output (ΔY) accelerators of neo-Keynesian theory.

But resemblance is not enough. Jorgenson's *ad hoc* adjustment-costs soon were separated by Eisner & Strotz (1963), Lucas (1967) and Gould (1968) into "intrinsic" factors (i.e. costs of installation) and "extrinsic" factors (i.e. rising Marshallian supply price), then formalised as a convex function of the firm's capital stock, to reflect *marginal* adjustment costs. Thus was the neoclassical investment model "perfected"; it yields an entire optimal adjustment path for the scale of the firm. Several commentators, including Hayashi (1982) and Abel (1990), have shown that the Eisner-Strotz-Lucas-Gould neoclassical model with marginal adjustment-costs is formally equivalent to Tobin's (marginal) q-ratio theory of investment under certain assumptions, e.g. that the firm's cash flows are a linear homogeneous function of its capital and labour inputs and its investment outlays.

Other Neoclassical Investment Theories

The perfected neoclassical [user-cost = q-ratio] investment function has proved to be very flexible, easily absorbing such critiques as the influential “financial-constraint” and “option-value” approaches. Jensen & Meckling (1976), Stiglitz & Weiss (1981), Myers & Majluf (1984) and Chirinko (1987) initiated the *financial-constraint* investment theory by showing how easily the well-known “MM theorem” – proposed by Franco Modigliani & Merton Miller (1958, 1963) – can break down in real-world financial markets. One implication of the MM theorem (which both Jorgenson and Tobin accepted) is that the opportunity cost of capital for a firm is independent of both its financial structure (i.e. debt-equity ratio) and the mix of retained earnings, bond issues and share floats it chooses to finance net investment.

The financial-constraint theories may be seen as confirming Kalecki’s principle of increasing risk in that they imply a certain “pecking order” among sources of finance. At the top of this “financing heirarchy” sits retained earnings (least risky and cheapest), then come share floats (which dilute equity) and, finally, bond issues (most risky and dearest). The key assumption of the MM theorem is that firms can never increase their own capital value through purely financial operations because, if this *were* possible, rentiers could profit through arbitrage by replicating such operations in their own portfolios. But to do this, the rentiers need to possess precisely the same data as the managers of corporations.

Unfortunately, just as in Akerlof’s (1970) used-car markets, access to key information in the financial markets is “asymmetric”. To compensate for their lack of information (or mistrust of what information *is* available) on the real investment opportunities confronting firms, rentiers tend to raise the price of external finance above the opportunity cost to managers of using cash flows generated within their own firms. Basically, rentiers cannot know the full range of risk-classes (possible “adverse selection”), what action the firm’s managers will take (possible “moral hazard with hidden action”) or what outcomes are revealed by the firm’s monitoring of its own investment projects (possible “moral hazard with hidden information”), so they add an Akerlofian “lemons premium” to the normal market-clearing borrowing rate.

In hindsight, it was Kenneth Arrow (1968) who initiated the *option-value* investment theory by introducing the concept of “irreversibility”, whereby capital goods either cannot subsequently be resold to other firms or can be resold only at a significant loss. Thus investments which are more or less *firm-specific* may be classified as completely or partially *irreversible*. It was nearly twenty years before McDonald & Siegel (1986) highlighted the existence of a close analogy between the decision to make an irreversible real investment and the decision to exercise a financial option. Avinash Dixit & Robert Pindyck (1994) provide a systematic exposition of this neoclassical investment theory.

They point out that a *call option* gives its rentier owner the right to buy a financial asset at some predetermined price; once exercised, the option is “killed” and becomes worthless. By analogy, a firm’s managers “own” the option to take advantage of an (irreversible) investment opportunity *at any time* after analysis of its time-profile has shown that re = n% pa or, equivalently, that q = 1. To build or purchase the necessary capital equipment *immediately* the opportunity is identified would “kill” the real “option-value” of *waiting*, i.e. the benefits of postponing the investment until more information concerning future market conditions becomes available.

According to the “bad news principle” of Bernanke (1983), good news is irrelevant to the real option-value of an investment opportunity. In a world of uncertainty, there are positive probabilities of future upward or downward revisions to the expected profitability associated with any eligible investment project. But the option-value of avoiding losses by waiting must increase if there is *bad* news. Good news has no effect on the option-value because all it does is confirm the wisdom of investing *now* – which kills the option anyway. Dixit (1992, p 123) uses the bad news principle to explain why American companies are less aggressive investors than Japanese firms. The former face downside risk – hence their option-value of waiting to invest is always positive – whereas the latter are protected from losses by government supports. With an option-value near zero, any Japanese firm which has identified an investment opportunity *never waits.*

The existence of a real option-value of waiting drives a wedge between the two sides of the “rule” that a firm maximises its value to shareholders by investing in projects until re = n% pa or, equivalently, until q = 1. As Dixit & Pindyck (1994, Ch 5) state, “… the simple NPV rule is not just wrong; it is often *very* wrong." For reasonable parameter values, McDonald & Siegel (1986) have shown that it is optimal to defer investing until the present value of a project's benefits are *twice as large* as its capital cost! This represents an upper threshold for investment to occur immediately (e.g. via entry of new firms) but the theory also posits a lower threshold (perhaps well below q = 1) for disinvestment to commence. Dixit & Pindyck (1994, Ch 8, Sect 3) present an example: in the competitive world copper industry, prices above long-run average cost do not attract new entrants and prices below average variable cost do not induce exit by existing firms.

Both the financial-constraint and option-value theories are valuable in explaining why managers constantly worry about the financial structure of their firms, favour internal finance and continually seek projects for which re >> n% pa or, equivalently, q >> 1. These new approaches, therefore, are simply embellishments of (rather than replacements for) the perfected Jorgenson/Tobin neoclassical investment theory. As such, the insights they afford also are relevant to all other investment theories that are expressions of the expected profitability genome.

Empirical Findings

Kevin Hassett & Glenn Hubbard (1996, p 13) point out in their review of the evidence that "*Accelerator effects are strong and obvious*; user cost effects appear weaker and more subtle." Summers (1981) found that changes in cash flow help to account for fluctuations in aggregate investment. In addition, James Heintz (2000, p 5) has summarised the state of empirical knowledge thus

> Empirical estimates of investment functions often show *more robust effects from non-price variables, for example capacity utilization*, than from relative prices, such as interest rates … Tobin's Q provides a compelling theoretical framework for explaining investment …, yet empirical studies of the impact of marginal changes in the ratio of equity values to replacement costs have been uneven – many perform quite poorly. While estimates of marginal Q are often correlated with investment, a large portion of investment behaviour remains unexplained (Abel and Blanchard 1986). Other studies underscore the role distributive outcomes play as determinants of the rate of investment, and *many provide empirical evidence supporting a positive relationship between the profit rate and level of investment* (Gordon, Weisskopf & Bowles 1998, Glyn 1997, Marglin and Bhaduri 1990, Kalecki 1965).

Emphases have been added. Significantly, those ontogenic theories *most closely related* to the phylogenic investment function I = f (a, Ko) have performed the best under econometric testing. The italicised phrases indicate that Keynesian and neo-Keynesian investment theories are still alive and well at the turn of the millennium, more than 60 years after they were first proposed. In fact, the expected profitability gap genome a = [re – n] found above to be present in all four classes of influential investment theories is far older than that.

Origins of the Genome

The Chicago economist, Irving Fisher, was one of the first to explicitly state that net investment is driven by a profitability gap. As always, Keynes (1936, pp 140-1) was generous in his praise for a predecessor who had influenced his own work:

> Although he does not call it the ‘marginal efficiency of capital’, Professor Irving Fisher has given in his *Theory of Interest* (1930) a definition of what he calls ‘the rate of return over cost’ which is identical with my definition. ‘The rate of return over cost’, he writes, ‘is that rate which, employed in computing the present worth of all the costs and the present worth of all the returns, will make these two equal.’ Professor Fisher explains that the extent of investment in any direction will depend on a comparison between the rate of return over cost and the rate of interest. To induce new investment ‘the rate of return over cost must exceed the rate of interest’.

The neoclassical Fisher never committed the common modern-day error of conflating the rate of interest (i% pa) and the rate of profit (r% pa); the equilibrium condition that r = i% pa does *not* entail that r = i% pa. Keynes, who knew he lived in a non-ergodic world, correctly interpreted Fisher’s rate of return over cost as the *expected* rate of profit (re% pa).

Thus the expected profitability gap genome (as the explanator of net investment) can be traced back directly through Keynes (1936) to Fisher (1930). We already have seen how Kalecki (1933) utilised the same concept, which earlier had been deployed by Spiethoff (1925) in his business cycle theory.

As an explanator of the price level, however, the genome is far older. Keynes (1930) credited Wicksell’s (1898, 1906) gap between the “natural” and “money” rates of interest (which drove the Swede’s “cumulative processes” of deflation and inflation) – as the inspiration for Keynes’s own "investment-saving gap" theory of profitability and the price level in his *Treatise on Money*. Wicksell himself identified Thornton (1802) as the ultimate progenitor of this universal "primitive" of investment and capital theory.

Conclusion

All creatures in the gap zoo of investment theory *do* share the same expected profitability gap genome. This justifies using the phylogenic investment function to model real investment behaviour by farmers in the monetised corn economy that is simulated in my thesis. As the investment equation is what principally drives the complex dynamics of this flexprice corn model, including the all-important traverses, I examined a range of investment functions proposed by economists of several schools. Hopefully, the findings of this paper will help bring some taxonomic order to the veritable zoo of specimens that have been collected over many years.

The *empirical* results studied by numerous surveyors of the econometric literature establish that those investment functions most closely based on the expected profitability gap genome perform better than their competitors. There are compelling *theoretical* reasons for this outcome. The phylogenic investment function is more general; in fact, its genome appears to be one of the few universals of economic science, equally at home as an explanator of investment, inflation/deflation and related cumulative processes.

Depending on how one specifies the expectations function(s) of entrepreneurs, the expected profitability gap is equally applicable to the ergodic neoclassical universe of general equilibrium in logical time and the non-ergodic post-classical universe of equilibrium stationary states and disequilibrium traverse phenomena in historical time. Thus, the investment function genome holds out the prospect of helping unite, rather than further divide, opposing schools of economic thought.

References

Abel, Andrew B. "Consumption and Investment." In *Handbook of Monetary Economics*, edited by Benjamin Friedman and Frank Hahn, Chapter 14. Amsterdam: North-Holland, 1990.

———. "Optimal Investment under Uncertainty." *American Economic Review* 73 (1983): 228-33.

Abel, Andrew B, and Oliver J Blanchard. "The Present Value of Profits and Cyclical Movements in Investment." *Econometrica* 54, no. 2 (1986): 249-74.

Akerlof, G A. "The Market for Lemons: Qualitative Uncertainty and the Market Mechanism." *Quarterly Journal of Economics* 84 (1970): 488-500.

Arrow, Kenneth J. "Optimal Capital Policy with Irreversible Investment." In *Value, Capital and Growth: Essays in Honour of Sir John Hicks*, edited by J N Wolfe. Edinburgh: Edinburgh University Press, 1968.

Bernanke, B. "Irreversibility, Uncertainty and Cyclical Investment." *Quarterly Journal of Economics* 98 (1983): 85-106.

Brainard, William, and James Tobin. "Pitfalls in Financial Model Building." *American Economic Review (Papers and Proceedings)* 58 (1968): 99-122.

Chirinko, Robert S. "Tobin's Q and Financial Policy." *Journal of Monetary Economics* 19 (1987): 69-87.

Chirinko, Robert S, and Huntley Schaller. "Business Fixed Investment and 'Bubbles': The Japanese Case." *American Economic Review* 91, no. 3 (2001): 663-80.

Courvisanos, Jerry. *Investment Cycles in Capitalist Economies*. Cheltenham: Edward Elgar, 1996.

Dixit, Avinash K. "Investment and Hysteresis." *Journal of Economic Perspectives* 6, no. 1 (1992): 107-32.

Dixit, Avinash K, and Robert S Pindyck. *Investment under Uncertainty*. Princeton: Princeton University Press, 1994.

Eisner, R, and R H Strotz. "Determinants of Business Investment." In *Impacts of Monetary Policy*, edited by R Eisner and R H Strotz. Engelwood Cliffs, New Jersey: Prentice-Hall, 1963.

Fisher, Irving. *The Theory of Interest*. New York: Macmillan, 1930.

Freeman, Alan. *An Endogenous Profit Rate Cycle* [World Wide Web]. 1999 [cited]. Available from http://www.gre.ac.uk/~fa03/research/5c-endog.PDF.

Glyn, Andrew. "Does Aggregate Profitability Really Matter?" *Cambridge Journal of Economics* 21 (1997): 591-619.

Gordon, David, Thomas Weisskopf, and Samuel Bowles. "Power, Profit and Investment: An Institutionalist Explanation of the Stagnation of Us Net Investment after the Mid-1960s." In *Economics and Social Justice*, edited by Samuel Bowles and Thomas Weisskopf. London: Routledge, 1998.

Gould, J. "Adjustment Costs in the Theory of Investment of the Firm." *The Review of Economic Studies* 35 (1968): 47-55.

Haavelmo, Trygve. *A Study in the Theory of Investment.* Chicago: University of Chicago Press, 1961.

Harrod, Roy F. *The Trade Cycle: An Essay*. Oxford: Clarendon Press, 1936.

Hassett, Kevin, and R Glenn Hubbard. "Tax Policy and Investment.". Cambridge, Massachussetts: NBER Working Paper 5683, 1996.

Hayashi, F. "Tobin's Marginal and Average Q: A Neoclassical Interpretation." *Econometrica* 50 (1982): 213-24.

Heintz, James. *Distribution, Investment and Employment in South Africa* [World Wide Web]. Trade and Industrial Policy Secretariat Annual Forum, 2000 [cited]. Available from http://www.tips.org.za/events/f2000/heintz.pdf.

Hicks, J R. *A Contribution to the Theory of the Trade Cycle*. Oxford: Clarendon Press, 1950.

Jensen, Michael C, and William H Meckling. "Theory of the Firm: Managerial Behaior, Agency Costs and Ownership Structure." *Journal of Financial Economics* 3 (1976): 305-60.

Jorgenson, Dale W. "Capital Theory and Investment Behaviour." *American Economic Review Papers and Proceedings* 53 (1963): 247-59.

———. *Collected Works, Volume I*. Cambridge, Massachussetts: The MIT Press, 1998.

Kalecki, Michal. *Proba Teorii Koniunktury*. Warsaw: Institute for the Study of Business Cycles and Prices, 1933.

———. *Selected Essays on the Dynamics of the Capitalist Economy, 1933-1970*. Cambridge: Cambridge University Press, 1971.

———. *Studies in Economic Dynamics*. London: George Allen & Unwin, 1943.

———. *Theory of Economic Dynamics*. London: Allen & Unwin, 1954.

———. *Theory of Economic Dynamics (New Edition)*. London: Unwin University Books, 1965.

———. "Trend and Business Cycle Reconsidered." *Economic Journal* 78, no. 2 (1968): 263-76.

Keynes, John Maynard. *The General Theory of Employment, Interest, and Money*. London: Macmillan, 1936.

———. *A Treatise on Money*. London: Macmillan, 1930.

Klein, Lawrence R. *Economic Fluctuations in the United States: 1921-1944*. New York: Wiley, 1950.

Lerner, Abba P. "Interest Theory: Supply and Demand for Loans or Supply and Demand for Cash?" *Review of Economic Studies* (1944).

———. "On the Marginal Product of Capital and the Marginal Efficiency of Investment." *Journal of Political Economy* (1953).

Lucas, R E. "Adjustment Costs and the Theory of Supply." *Journal of Political Economy* 75 (1967): 321-34.

Malinvaud, Edmond. "Reflecting on the Theory of Capital and Growth." *Oxford Economic Papers* 38 (1986): 367-85.

Mandel, Ernest. *Karl Marx* [World Wide Web]. 1990 [cited]. Available from http://www.sozialistische-klassiker.org/Mandel/Mandele2.html.

Marglin, Stephen, and Amit Bhaduri. "Profit Squeeze and Keynesian Theory." In *The Golden Age of Capitalism: Reinterpreting the Postwar Experience*, edited by Stephen Marglin and Juliet Schor, 153-86. Oxford: Oxford University Press, 1990.

Marx, Karl. *Capital: A Critique of Political Economy, Volume I*. 1956 ed. Moscow: Progress Publishers, 1867.

———. *Capital: A Critique of Political Economy, Volume Iii*. 1956 ed. Moscow: Progress Publishers, 1894.

McDonald, R, and D Siegel. "The Value of Waiting to Invest." *Quarterly Journal of Economics* 101, no. 707-28 (1986).

Modigliani, Franco, and Merton Miller. "Corporate Income Taxes and the Cost of Capital: A Correction." *American Economic Review* 53 (1963): 433-43.

———. "The Cost of Capital, Corporation Finance and the Theory of Investment." *American Economic Review* 48, no. 3 (1958): 261-97.

Myers, S C, and N S Majluf. "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not." *Journal of Financial Economics* 13 (1984): 187-221.

Pasinetti, Luigi L. *Growth and Income Distribution: Essays in Economic Theory*. Cambridge: Cambridge University Press, 1974.

Ricardo, David. *The Principles of Political Economy and Taxation*. London: John Murray 1973, 1817.

Robinson, Joan. *Essays in the Theory of Economic Growth*. London: Macmillan, 1962.

Samuelson, Paul A. "Interaction between the Multiplier Analysis and the Principle of Acceleration." *Review of Economics and Statistics* 31 (1939): 75-8.

Smith, Adam. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Edited by R H Campbell and A S Skinner. Oxford: Oxford University Press 1976, 1776.

Spiethoff, Arthur. "Krisen (Business Cycles)." *International Economic Papers* 1953, no. 3 (1925): 75-171.

Steindl, Josef. "Some Comments on the Three Versions of Kalecki's Theory of the Trade Cycle." In *Studies in Economic Theory and Practice: Essays in Honor of Edward Lipinski*, edited by N Assorodobraj-Kula, C Bobrowski, H Hagemejer, W Kula and J Los. Amsterdam: North-Holland, 1981.

Stiglitz, J E, and A Weiss. "Credit Rationing in Markets with Imperfect Information." *American Economic Review* 71 (1981): 393-410.

Summers, L H. "Taxation and Corporate Investment: A Q-Approach." *Brookings Papers on Economic Activity* (1981): 67-127.

Thornton, Henry. *An Enquiry into the Nature and Effects of the Paper Credit of Great Britain*. Reprinted 1965 ed. New York: Augustus M Kelley, 1802.

Tobin, James. "A General Equilibrium Approach to Monetary Theory." *Journal of Money, Credit and Banking* 1, no. February (1969): 15-29.

Weintraub, Sidney. "Generalizing Kalecki and Simplifying Macroeconomics." *Journal of Post Keynesian Economics* 1, no. 3 (1979): pp 101-6.

Wicksell, Knut. *Geldzins Und Guterpreise (Interest and Prices: A Study of the Causes Regulating the Value of Money)*. Translated by Richard F Kahn. London: Macmillan 1936, 1898.

———. *Lectures on Political Economy, Volume II: Money*. Translated by E Classen. Edited by Lionel Robbins. London: Routledge 1934, 1906.