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Kalecki-Minsky-monetary circuit complexity

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Abstract: We work through a connection between commodity production and money. The former is drawn from the theories of investment of Michal Kalecki and Hyman Minsky. The latter is motivated by the theory of the monetary circuit translated in the framework of Wynne Godley and Francis Cripps (1983). We set up and solve a mixed differential-difference equation in the manner of Giancarlo Gandolfo (1971). Complexity is defined as the potential emergence of surprise in the combination of two parameters in the solutions of the equation, one for money and one for the real economy.

Keywords: bank money; investment lags; bifurcations

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INTRODUCTION

The integration of money with structures of production and exchange in economic theory continues to engage the best minds, orthodox and nonorthodox. In all schools embraced by the former, the individual is at the heart of the enterprises. Within the demands of general equilibrium theory, in particular, the social device of money emerging from individual choice is perforce abstract and stylised. However, on occasion, real-world elements are incorporated into the framework to ease translation into reality. For instance, in the aftermath of the financial debacle in the US in 2008, banks were introduced into the model. The representative bank is a maximand intervening between the maximands of the representative household and the representative firm. Bank and financial intermediary are interchangeable. In contrast, all nonmainstream schools are joined in studying the capitalist economy. Fluctuations and cycles impose varying constraints and opportunities on the choices available to individuals.

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The theoretical edifices of both general equilibrium and classical political economy or any pure theory for that matter are built on virgin territory. With neoclassical economics, the metaphor of a medieval fair was used, visited by agents for the purpose of bidding for goods and labour by offering own endowments of labour and goods. There was no room for the institution of money except in the pick of an arbitrary commodity as the denominator for every other commodity to serve as a measuring rod. Prices are relative prices. The role of money in classical economics is a matter of debate and an unsettled subject. One interpretation is that "money is a veil" and pride of place has to be accorded to the laws of production and distribution. "Neutrality" and "dichotomy" theorems, those between the real and the monetary spheres, follow. In the case of Ricardo, this view has been contested (Deleplace, 2022). The conclusion reached is that Ricardo subscribed neither to a commodity theory of money nor a quantity theory of money. Money is consistent with his theory of value and distribution. Indeed, since Ricardo allegedly held to the medium-of-exchange and unit-of-account functions of money, a shortage of money would trigger a depression via effects on production. If the store-of-value function of money is brought in by Keynes' liquidity preference, the demand for money is introduced. The depression might be characterised by equilibrium between the demand for and the supply of money. In his *Treatise on Money*, Keynes developed the connection between the different functions of money. Along with the *General Theory*, the monetary theory of production is the label given to the collection of Keynes' contributions. It is the agenda for alternative approaches to monetary circuit theory.

The monetary circuit originates with the entrepreneur or capitalist possessed of an idea or project who appears on an empty stage or a *tabula rasa* (a favoured expression) to employ willing and able workers waiting in the wings. All are innocent of priors like credibility and reputation. Therefore, both require the institution of a bank and bank money to initiate an overdraft facility/wage. Money is created in the simultaneous writing up of a debt (the wage bill) equal to an asset (the loan). Note the difference between the bank in the circuit approach and the bank in general equilibrium. Money is *emitted* here; it is *mediated* there. Output is to flow in the circuit approach. Prices are absolute or money prices. With the neoclassical bank, income, and savings therefrom, already exists, and is deposited in the bank to (potentially) generate investment. In sum, debt is primal in the monetary production framework.

In the following section we survey the state of play in the various

schools of the monetary circuit. We extend the discussion to the connection between money and production and investment in the data. We find the distinction between "initial finance" and "final finance" helpful in sharpening the specification of a formal model in the third section. The monetary circuit is combined with the macroeconomics of Godley and Cripps. Specifically, the relationship is found to reside in "initial finance" from which a so-called stock-flow norm, the money-income norm, is culled.

Our real circuit is an amalgam of the work of Kalecki and Minsky. Both theories are embedded in the rhythms of the cycle. With Kalecki, "the determination of investment decisions by, broadly speaking, the level and the rate of change of economic activity was the central pièce de resistance of economics" (Kalecki, 1968, p 263). As regards Minsky, we consider an early demonstration of complexity in his nonstandard logical loops in an otherwise standard macroeconomic model (Minsky, 1986), looking at the equilibrium in the markets for money and capital goods.[1] The equilibrating price level of capital goods is introduced in our third section. When investment I is determined, consumption, C, and GDP, Y, are solved out in the model. However, productivity of capital is expected future earnings (gross profits after taxes) of an assemblage of capital goods. The value of the capital stock must necessarily equal the discounted value of a stream of returns. Keynes' Marginal Efficiency of Capital (MEC) schedule can be introduced but it is unstable and shifts downwards whenever a wave of pessimism overcomes investors. Swings in investors' confidence can lead to destabilising cycles even when the interest rate is relatively stable in the face of aggregate demand shocks. Building upon Keynes, Minsky argued that the explanation for the level of aggregate demand must be sought in the financing of investment plans. Evaluations there affect the valuation of capital assets relative to the price of current output and this price ratio determines investment activity. Keynes' *General Theory*, Minsky reasoned, was concerned with how these two sets of prices (capital and financial assets on the one hand and current output and wages on the other) were determined in different markets by different explanatory variables which gave rise to fluctuations in economic activity. In the monetary circuit, wages W and money M are endogenous and, indeed, identical. Another connection with the monetary circuit is the functional connection between bank money and the (price of) capital goods (see equation 4 in footnote 1). We combine Minsky and Kalecki by drawing upon a parameter from Kalecki's model, the time taken for orders to be placed and capital goods to roll out, in the third section.

The complexity agenda in economics is open and does not exclude orthodox economics. Heterodoxy distinguishes itself with a frontal embrace of social aggregates and, thus, confronts the problematic of "social ontology" which is the excavation of the meaning and materiality of economic processes. The research programme is being refined (Paniagua, 2023). The task is to investigate money and banking and their emergent properties as an organising principle of society. The related "realist" orientation of the subject directs attention to institutional adjustment rules and iterations and away from the optimisation protocols of households and firms and banks. Keynes drew modern attention to the commitment of the fallacy of composition, as in the case of the paradox of thrift, moving from individual choices to the clash of wholes from which individual parts derive. The existence and stability of general equilibrium are well-worked and long-settled subjects. Yet, novelty might emerge from the interaction of the monetary aggregates which are the reflections of consumption and saving and investment problems solved out. Furthermore, in a forgotten dimension of 'old' dynamics, a distinction was made in theory between economic processes that required the finite passage of time to be effected and processes in which the time intervals could be set to zero. Mixed difference-differential equations are still not a tool in the kit of dynamic economists and we access the encyclopedic erudition of Gandolfo. In a breathtaking survey of the breadth of political economy, bringing precision and rigour to models that were short on both counts, Professor Gandolfo demonstrates the importance of mixed difference-differential equations. We employ his techniques to set up and solve a combined Kalecki-Minsky-monetary circuit differential-difference equation with its putative complexity in the third section. A final section is a summary and reflection.

MONEY, PRODUCTION AND INVESTMENT

Scholarship in the monetary circuit originated in France and Italy and subsequently moved to the USA and Canada (Berr and Moinvoisin, 2023). The core of all approaches is the principle of reflux. The thesis is that money is emitted by banks *ab novo* as they finance enterprise, to return to them via commodity production and the realisation of profits.

There are matters of emphases. Thus, "Initial Finance" is different from "Final Finance". It is only after the production circuit is complete and incomes have been earned that savings can result that can be absorbed in securities. Bernard Schmitt, a French pioneer was centered on the first, Augusto Graziani, the Italian progenitor, on the second. To be precise, final

finance for Graziani is not the financing of fresh investment but the issue of securities by firms to households to mop up their income in excess of that spent on goods and services, saving, in other words. The logical step is required for the initial total outlay of money to reflux to the firms, enabling them, thereby, to fulfil their obligations to their banks and close the circuit. With Alain Parguez, another French icon, borrowing was for the purpose of financing fresh capital expenditure. Consequently, the state of long-term expectations was central to the investment decision. After the capital expenditures came on stream, the next step in the monetary production process was the production and sale of goods and services. When profits accrued to firms, the credit disbursed to them was returned to banks (with interest) and the circuit was closed. Our model in the next section includes both Initial and Final Finance.

The connection between the theory of the monetary circuit and the framework of Godley & Cripps is intimate. Berr and Moinvoisin locate a divide which we cross. The monetary circuit is designed around flows, the radical contribution of Schmitt belonging to a different dimension altogether. All economic entities in his model are quanta. Time is quantum time. Godley & Cripps integrate stocks and flows via stock-flow norms. Consistent with the monetary circuit, money enters on the ground floor of their macroeconomic structure. Along with the development of the debt dynamics of a monetary economy, details of the production process with varying leads and lags are provided and captured. The notion of money is pure and the connection with commercial bank behaviour or Central Bank policy stances is not compelling.

The circuitistes were equally concerned about the transformation of inputs into outputs. For Schmitt, the emission of money was the "first moment", the return of money to the issuer the "third moment". Between, was the "second moment" which consisted of work in factories and farms, transportation of goods to and from warehouses and retail outlets, and so on. Parguez was influenced by Kalecki in refinement of the propensity to invest (Bellofiore et al., 2022). Both Kalecki and Minsky were sensitive to the difference between abstractions like normal prices and the level of output as a whole and what might be called the "everyday" processes of capitalist production (Galbraith, 2023). The distinction is apposite currently in the conjuncture of an unclear direction of the inflation rate but a clear and present danger of recession. The implications of a surprise shock to supply or to demand is an illustration. Take the case of the cost shock to automobiles in America. The impact on prices was muted. The activity of

addressing backlogs and queues, instead, was given a fillip. Demand shifted to used cars in fixed supply which sold at a price which the market could bear. In general, recent price effects were mostly confined to asset prices. Cycles in effective demand are explained by a fall in the quality of resources, an increase in the cost of materials, technical change making existing capital obsolete. Physical and human capital decay and must be refitted and rejuvenated.

The monetary and the fiscal authorities are on perpetual standby to weather the worst of the storms raised by shocks. How did Minsky and Kalecki perceive the two macroeconomic arms of the State? The prevalent view would combine them in the summary that the Central Bank is the 'banking arm' of the Government, and Central Bank money must back the bank money emitted by banks, acting as agents of both. We find subtle shadings between the two organs of the State, however. The capitalist class has mixed feelings about Government intervention, Kalecki explained repeatedly. He traced the alignment of Government with Capital and then with Labour depending on which side of the business cycle the economy found itself. Minsky was cynical in his unequivocal appraisal that the Central Bank of his time was in thrall to financial interests. In vindication, in the steady downward trend of the interest rate of the Greenspan put, the view from Main Street was that the Fed was captive to Wall Street. Here, a Minsky proposition is devastating as it is ominous. Minsky's "two-price" system referred to, the prices of financial assets on the one hand and the prices of goods and services on the other, is underlined (Ryan-Collins, 2023). A commitment on the part of the authorities to stability of one set of prices means instability in the 'dual' set of prices. Interest rates have begun to rise the world over following the Taylor-rule commitment to price inflation. As rates rise, investment in long-lived capital goods appears less and less attractive. However, incontrovertible evidence has disabused orthodox and unorthodox alike of the dependence of investment on the interest rate. Interest rates hovered around the zero lower bound the world over to little avail. Central Banks that experimented with negative interest rates abandoned the exercise, Japan being the last case, in the face of failure in igniting investment and employment. A realist conjecture is that expectations matter for investment decisions. It is expected demand and prospective profits that induce investment in long-lived capital goods. When the animal spirits have dimmed for reasons like wars, short-term financial returns exceed the rate of profit. The real estate market is the universal barometer of prospects. The residential real estate market has begun to nosedive as

prospective homeowners are discouraged by the high debt-servicing costs on mortgages and prospective landlords are dissuaded by the lower yield on rents relative to debt costs. According to the IMF, home prices are falling in two-thirds of OECD countries. On the other side of the balance sheet, falling house prices are unwelcome news to banks as homes are collateral for mortgages. Of greater interest to us is the commercial property market where leverage ratios are higher than in the residential sector. Therein lies the tale of the demise of Silicon Valley Bank and other middle-sized banks in the US. Their asset portfolios were chockablock with government bonds and mortgage-backed securities the purchase of which was induced, poignantly, by the web of regulations complicating flows of finance to private entities that had been spun by the government after 2008. Banks collapse in the blink of an eye while the fall in the prices of goods and services is gradual. Menu costs and implicit contract-like factors add stickiness to commodity price changes. Furthermore, the prices of commodities are affected more by supply chain disruptions than by interest rate hikes.

One option is to take a fresh look at credit guidance policies that were successful in the 1950s-1960s period of high growth and productivity. The corollary is guidance away from monies advanced for the production of luxury goods. So-called Asset-Based Reserve Requirements have long been a weapon in the heterodox economics policy armoury.

Theorists in the tradition of the monetary circuit refrain from weighting the 'bank' with the appellation 'central' or 'private' although the connection between the two might not be unproblematic. In recent years, evidence counter to the so-called bank lending channel by means of which Central Bank policies influence real activity via the supply of credit by banks, has been building (Roderweis et al., 2023). In the quoted study, the case is made for the European Central Bank (ECB) and its massive quantitative easing (QE) exercise after 2008. Banks purchased medium- and long-term government and corporate bonds in exchange for reserves. A so-called portfolio rebalancing effect was expected to spur real activity. The withdrawal of long-term paper from the market would increase their demand with money supply increasing at the same time, so the case was made. With excess demand in the market for bonds leading to a rise in their prices and a decline in long-term yields, investors would modify their portfolios accordingly, it was reasoned. A preliminary sobering observation to be made as a counter is that a rise in the prices increases the nominal wealth of the rentier class. The lower marginal propensity to consume of this class in

comparison with the working class has been documented. Reinvestment in new financial instruments continues upwards with a deleterious impact on production and productivity. The evidence corroborates the realignment of holdings in the direction of financial assets rather than corporate funding. Studies of the UK have demonstrated that portfolio choices by financial intermediaries were oriented towards non-bank financial sectors like life insurance companies and pension funds. In addition, the real estate market bubbles over under these circumstances. Bank lending in the housing market goes through the roof. Banks finance the rolling over and flipping of existing housing stock. The prices of housing stock goes up while the supply stays constant. The upshot of QE in 2012 and 2015 is that banks held on to idle reserves over and above the statutory liquidity requirements and interbank market exchanges. These results pertain to the low interest rate regime until the middle of 2022.

As a result, without naming it as such, studies across a wide spectrum support the theory of the monetary circuit as a unifying framework for understanding and policy direction. Central Bank reserves are neither necessary nor sufficient to backstop bank lending for inventory adjustments and production. The demand for reserves is crisis-driven, as a hedge and risk-mitigation measure. The reserves generated by the ECB met the payment requirements of bank customers. Short-term requirements always press as are precautionary holdings of cash to meet unexpected withdrawals. The legitimate needs of trade are satisfied by banks conjuring credit-wages out of "thin air", creating money by keying in two identical numbers, a loan and a deposit. Thus, the Bundesbank reports that most of the money in the Eurosystem emerges endogenously within the banking system and not exogenously through Central Bank actions. The Bank of England concurs, calculating that 97% of circulating money is bank money.

Following Marx and others, Roderweis et al. (2023) distinguish between lending for productive activity and lending for unproductive activity. In the case of the former, country studies ranging from the US to Japan confirm the correlation between credit to the non-financial sector and nominal GDP. Non-productive lending is defined as outlays notably to the mortgage market as well as to financial assets, driven essentially by the expectation of capital appreciation. Here the correlations favour lending booms with boom-bust cycles with the real estate market as the leading indicator. The authors confine their definition of productive credit to lending to non-financial corporations and exclude consumer loans in the manner of the monetary circuit. Store shelves are vacated by the demand for consumption goods.

Lending for capital goods, on the other hand, is a rotating fund moving between suppliers and employees coming to rest in the product. When sold, the loan is returned to the entrepreneur with profits and the basis of fresh borrowing and lending is laid.

A FORMAL KALECKI-MINSKY-MONETARY CIRCUIT CONNECTION

Minsky followed Keynes that the *General Theory* simultaneously held out an investment theory of business cycles and a financial theory of investment for capitalist economies (Minsky, 1992, 1994). Very early, he noted and cautioned against the declining role of the essential function of banks which was to support the capital development of an economy. When the knot tying the commercial banks and the Central Bank begins to loosen, the links between financial markets and the Central Bank grow strong. From monitoring the availability and cost of sound credit, the Central Bank transforms into a manager of expectations, especially the prognoses of fund managers of the stability of markets. Minsky opined that when markets follow Central Bank watchers, they usually get the signals wrong. The outcomes are "incoherent and chaotic" dynamics.

Our strategy of using sign-preserving functions to combine Kalecki and Minsky is borrowed entirely from Gandolfo. The notations below are culled from Gandolfo (1971) and Godley and Cripps (1983).

The difference between planned savings, $S(t)$, and planned investment, $I(t)$, is the accumulation or drawing down of inventories, *Inv*. With dots on variables denoting time derivatives as usual,

$$\dot{Inv} = S(t) - I(t) \qquad [1]$$

We recall that the standard definition of Investment is private investment plus public investment. Thus, *I(t)* can mask a paralysis of private investment and directed or induced public investment. In an approach that is also associated with Abba Lerner, Parguez insisted that governments were not subject to a budget constraint when it came to public investment. Parguez and Keynes shared the appraisal that the dynamics of an economy driven by private investment and private money can be unstable and the State must intervene to ensure stability through underwriting investment backed by fiat money. In recent times, financial stability has been added to the burden central bankers must bear. The job cannot mean more than dotting the i's and crossing the t's on the volumes on regulatory reform epitomised in the Dodd-Frank Act in the US. For macroeconomic policy is bound by the Theil-Tinbergen theorem. There cannot be more targets than there are

instruments. The interest rate, unfortunately, has proved to be a wayward arrow for hitting the bull's eye of a 2% inflation target. Besides, any policy action directed at financial stability self-contradicts laissez faire. For instance, bubbles cannot be pricked as they are forming. The presumption is that the authorities cannot possess a social welfare function different from private utility functions.

Behind the left-hand side of equation 1 is "Initial Finance", overdrafts that might be drawn upon by existing business. One or other scenario prevails depending on the curve of the cycle. Current production may be underway with labourers at work sites, repairing and maintaining capital goods, clerks and accountants updating files and keeping accounts. Inventory depletion would be movements of goods from the factory floor to retail outlets. Stocks are being run down so the expression would be negative. The inducement to invest on the right-hand side would exceed the propensity to save. In a downturn, on the other hand, the movement of inventories would be from stores to warehouses. Workers would be 'on-the-job unemployed', or laid off. The left-hand side of equation 1 would be positive. Savings plans now exceed investment plans. As already indicated with Minsky's model, we can underpin the investment function on the right-hand side of equation [1] by Keynes' MEC schedule with the life-span of long-lived, durable machines. The present value of period-by-period returns is calculated. "Final Finance" with credit rollovers supporting long-gestation projects must be availed of. The connection between Initial and Finance is elaborated below.

Godley and Cripps (1983, Chapter 4) define inventories to include work-in-progress and stocks of raw materials, finished and semi-finished goods measured broadly by the time between acquiring credit for the purpose of keeping the wheels of production and distribution turning, and receiving revenue from sales. With this collateral, entrepreneurs approach banks to extend lines of credit. The working class is remunerated. 'Relationship banking' is underway. Loans make deposits (money). The Schumpeter dictum is introduced below. Denoting the stock of money by *FA* and loans by *LI*, we have

$$Inv = FA = LI. \qquad [2]$$

Here *FA* and *LI* stand for the end-period stock of money and the value of outstanding loans. The steady-state money income norm alpha is $FA = \alpha Y$ (Godley and Cripps, 1983, p. 84). We work with a pared-down closed economy identity without government expenditure. In most textbooks the change in the stock of inventories, ΔInv, positive or negative, in discrete

time, is not added to $Y = C + I$. In continuous time, we have $Y = C + I + I\dot{n}v$, and can write down savings in equation [1] as $Inv/\alpha - C$.

Minsky's market for capital goods to be described meets the 'constant capital' funding of banks. First, we look at the two sides of the balance sheets of banks equilibrated by the interest rate. There will be a 'supply price of loans', i^S, and the inverse of the loan supply function, LI, is represented by $i^S = LI(i^S)$, and a 'demand price for deposits', i^D, with the inverse demand function for liabilities (money) written as $i^D = FA(i^D)$. Thereafter, we have an equilibrating interest rate. We assume the standard dynamic stability condition as

$$\dot{i} = f[FA(i) - LI(i)]. \qquad [3]$$

The interest rate is both a monetary rate as well as a real rate. It is the 'price of money' and, at the same time, a screening and monitoring device. Here f is a sign-preserving function. With that stipulation, we can separate the functions and write the equation, as advised by Gandolfo (1971), as

$$\dot{i} = f(FA(i)) - f\big(LI(i)\big). \qquad [4]$$

We depict the stationary solution thus

$$f(FA^*(i)) = f(LI^*(i)). \qquad [5]$$

Kalecki (1935) finessed the investment process to the following three stages (Gandolfo, 1971, p. 477). At any point of time there are orders, $I(t)$, for capital to replace worn and torn machines as well as net additions to the stock which coincides with the usual macroeconomic definition of investment. Assume that there is an average period of time, theta, after the orders are placed for the finished intermediate goods to roll out. The delivery of capital goods in the present, L, would then be

$$L(t) = I(t - \theta). \qquad [6]$$

At time t, let $W(t)$ be the total amount of unfulfilled orders. In that case,

$$W(t) = \int_{t-\theta}^{t} I(t)dt. \qquad [7]$$

Including our discussion of inventories, we have

$$Inv(t) = W(t) = \int_{t-\theta}^{t} I(t)dt. \qquad [8]$$

We proceed to combine "Final Finance" (equation [7]) and "Initial Finance" (equation [8]). Minsky, relatedly, distinguished between the technological elements making for the supply decisions for capital goods and the forward-looking explanatory variables driving the demand for capital goods (investment). In each sphere, there would be a supply price of capital goods depending on a supply function of the rollout of capital goods, $p^S = L(p^S)$, and a demand price for capital goods depending on a demand function for investment goods, $p^D = I(p^D)$. Fulfilling a promise made in the specification

of the Minsky model made in the first section, the equilibrium price of capital is defined by the equality of the demand and supply schedules. As earlier, we have a dynamic stability condition

$$\dot{p} = g(I(p) - L(p)). \qquad [9]$$

We assume that g is a sign-preserving function. Once more, with that proviso we can separate the functions and write the equation as

$$\dot{p} = g(I(p)) - g\big(L(p)\big). \qquad [10]$$

As with equation 4, the stationary solution is described as

$$g(I^*(p)) = g(L^*(p)). \qquad [11]$$

The flow of savings is the flow of deposits, $S = FA$. We are invoking the Graziani-Parguez circuit with deposits emerging after production and consumption. We assume that corresponding to the functions f and g introduced, we can write equation [1] thus (an interpretation of h to be offered below),

$$h\big(\dot{Inv}(t)\big) = f(S(t)) - g\big(I(t)\big). \qquad [12]$$

Substituting from equations [6] to [8] and with some consistency in the notation, we get the following nonautonomous differential equation.

$$h\big(\dot{Inv}(t)\big) = f\left(\frac{Inv(t)}{\alpha} - C(t)\right) - g(Inv(t-\theta)) \qquad [13]$$

The two functions on the right-hand side can be interpreted in the following light. The function f is an effective demand function. The *General Theory* is combined with the monetary circuit via the money parameter. The function g is a technical or technological supply function. Neither conform to the Aggregate Demand and Aggregate Supply functions of mainstream economics.

We call the solution $h\big(\dot{Inv}\big) \equiv 0$, an equilibrium point for the equation. The equilibrium values of Inv and C and the parameters are $Inv^*, C^*, \alpha^*, \theta^*$. Matters of stability arise off the equilibrium point. Take a value of $\theta \neq \theta^*$. The inequality might signal the end of "big-tech exceptionalism" (*The Economist*, 2022). America's new-age quintuplet of Meta, Alphabet, Amazon, Microsoft and Apple (MAAMA) are beginning to experience old-age technological problems. Geography still matters in a seamless world. Factories locked down in China have severely impacted Apple's projected revenues. $\theta \to 1$ has not spared Amazon which miscalculated shopper demand and got its stock management wrong. The tech titans still need physical bits and pieces rather than digital bytes alone. Politics has a role to play in a divided world. Broken supply chains and trade embargoes have the same effect.

Stationary solutions for each of the component functions on the right-hand side of equation [13] were described in equations [5] and [11]. The equilibrium point defined by the equality of the component functions, $f = g$, can be regarded as aggregate demand equaling aggregate supply with no presumption of market clearing. The equilibrium point is a source if $f - g > 0$. All nearby solutions tend away from it. A source is an unstable equilibrium. With an appropriately 'high' value of θ, we might conjecture a source with discrete time taken to place orders and produce goods if not in stock. Savings, on the other hand, can be exercised in real time as with depositing unconsumed wages in a bank. Indeed, the two functions f and g and their positive difference describe golden epochs of capitalism in the last century. Manufacturing was dominant with leads and lags in anticipating demands, placing orders, time travel from the factory floor to retail outlets and so forth. However, growth was buoyant and growing incomes translated into increasing consumption and savings. The equilibrium point is a sink if $f - g < 0$. All nearby solutions tend toward it. With just-in-time production as the dominant mode of production run by robots and drones that operate via international supply chains, θ tends to zero and the function g would be sensitive to and even anticipate inventory movements. Coupled with 'low' savings brought about by a 'low' level of income, a sink might be assumed in this case. A sink is a stable equilibrium. This case captures contemporary capitalism succinctly. Economies anywhere are plunged into a low-level equilibrium trap. The equilibrium is hysteresis. Returning to $f = g$, we have a bifurcation in case the equilibrium solution changes slightly.

Complexity arises in the case of variations in the two parameters alpha and theta. We have $0 \leq \alpha \leq 1$. The case of $\alpha = 0$ is meaningless both mathematically and with our economics. In the first case, division by zero is undefined. In the second, we would have no money in a monetary production economy. The other extreme, $\alpha = 1$, is not without interest. For Schmitt, Money equals Output. In his language, the output represented by money is an "empty wrapper" till production eventuates, goods are sold, profits are booked, and banks are repaid. Workers spend their incomes on wage goods which accrue as revenue and profits to firms producing Basics, all in a flash of quantum time. With Parguez, it was intermediate goods producers that entered into debt contracts with banks.

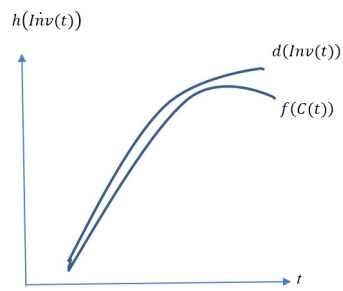
We proceed to examine the scenario $\alpha \to 1$ and $\theta \to 0$, more closely. Allowing the values of the two parameters to take their limiting values and using the sign-preserving property of the function f, equation 13 reduces to the following representation.

$$h(\dot{Inv}(t)) = f(Inv(t)) - f(C(t))) - g(Inv) \stackrel{\text{def}}{=} d(Inv(t)) - f(C(t)) \quad [14]$$

Here d is defined as $f - g$, the function f here shorn of the consumption function, f and g clubbed for their identical argument. Clearly, the simple intuition of $f - g$ with this truncated definition of d cannot be reclaimed. f is a 'money function', g is an inventory function. We cannot easily posit a sign for the value of d as we did earlier with $f - g$. We have a transformation of equation 13 into a nonhomogenous equation with $f(C(t))$ as a forcing term. The right-hand side of 14 must be investigated in toto.

Assume our function h is a Liapunov function, a differentiable function $h: \mathcal{O} \to \mathbb{R}$ defined on an open set $\mathcal{O}$ in $\mathbb{R} \times \mathbb{R}$ that contains an equilibrium point Inv^* of the system $\dot{Inv}(t) = d(Inv(t)) - f(C(t))$. If, furthermore, (a) $h(Inv^*) = 0$ and $h(Inv) > 0$ if $Inv \neq Inv^*$, (b) $\dot{h} \leq 0$ in $\mathcal{O} - \mathbb{R}$, then Inv^* is stable. In addition, if h also satisfies (c) $\dot{h} < 0$ in $\mathcal{O} - \mathbb{R}$, then Inv^* is asymptotically stable (Hirsch, Smale, and Devaney, 2004, pp. 194-195). We confine our discussion to stability and, therefore, (b) and (c) since (a) concerns the solution of h. With primes denoting derivatives, condition (b) is $d'(Inv(t))Inv'(t) \leq f'(C(t))C'(t)$. With condition (c), the inequality is strict. The economic intuition extends our base scenario of an unemployment equilibrium to include staggering and increasing inequality in any country of the world and the break in consumption between Basics and Non Basics that flows therefrom. Declining output and investment go with falling wages and layoffs. The equilibrium connotes appropriately 'low' consumption of essentials by the working class by the left-hand side of the inequality. If the condition on consumption is to be met by virtue of the right-hand side of the inequality, the consumption of Luxury Goods must not only be 'high' but the propensity to consume of the capitalist class must be high. The latter aspect of the condition seems to run counter to the assumption of the differing propensities to consume of the working class and the capitalist class in growth models. In response, we note that the condition makes no claim on the absolute propensities to consume. In any case, the differing consumption propensities are assumed of the incomes of the classes. We claim that the propensity to consume out of wealth is unboundedly large and is another reflection of the irrationality of the capitalist system. Under condition (c), the stagnation is secular. For the sake of completeness, we consider a source, $d(Inv(t)) > f(C(t))$ and rely on the concavity of the consumption function to show that the source also diverges eventually. Note that by our assumption, $d(Inv^*(t_o)) = f(C^*(t_o))$ is a member of $\mathcal{O}$ at the equilibrium point at t_0. The diagram is below.

Figure 1: A source in Kalecki-Minsky dynamics



We have provided a proxy of the claim that policy variables like State money are potentially "thwarting system" variables in their steady states or in equilibrium in the absence of which the capitalist economy might be condemned to instability (Ferri & Minsky, 1991). Recently, the idea of a supercycle has extended Minsky's concept of a thwarting system (Dafermos et al., 2022). We have recorded the "expansion" phase of the last cycle characterised by low interest rates and a low inflation rate. Low policy rates were a thwarting mechanism causing and effecting a long, if mild, upswing of activity. However, as the upswing gathers momentum, financial competition, in particular, gets ferocious and policy buffers are breached. Private indebtedness begins to rise, and the first signs of inflation are spotted as the cycle enters its "maturity" phase. Once inflation gets entrenched as does a commitment to high interest rates, the system is thrown into a state of "crisis". Fresh thwarting mechanisms must be installed.

CONCLUSION

A bank or Central Bank money-income norm is a necessary element in the stability of the economy as a whole. It underwrites production and investment in equilibrium. At the same time, material leads and lags in the production process must be incorporated into any meaningful dynamics of the capitalist economy.

Unfortunately, Central Banks remain committed to inflation targeting. If at all, production and investment might be crowded in by the fiscal authorities but here again the sword of Damocles in the form of Ricardian equivalence hangs over governments. In the present milieu anywhere in the world, modes and relations of production are unpropitious with domestic and global supply chains broken due to intra- and inter-country strife. Kalecki-Minsky investments are effected according to a MEC schedule after plans are laid. Orders for working capital are placed, and workers employed.

Activity gets underway under the eagle eyes of bank managers. When investments are financialized, in contrast, professions of faith are made with regard to Climate Change investments by the world's largest conglomerates. The costs are gargantuan and the uncertainties Keynesian. The world's largest finance capitalists have stepped into the breach. The difference between private finance and bank underwriting (in our sense) is that environmental-friendly projects nestle with derivatives, swaps, options, in financial portfolios. Jugglery with items is bread-and-butter business, and social-welfare-maximising schemes will be abandoned at the first signs of distress. Consequently, the governments in advanced economies have been offering "derisking" formulae for the investments. The fundamental theorem of finance is violated thereby, that risk and returns are related monotonically. Low risk and high returns is perverse. Keynes' "socialisation of investment", on the other hand, is vitally different with the State taking into itself, by means of public investment, the risks that stymie private investment. While degradation of the environment takes place in continuous time, the investments required to stem the rot on a war-footing are not even blueprints. At the same time, as the demands for current production continue unabated, coal- and fossil-fuel-guzzling investments have not missed a step. Profits must be earned and shareholders appeased.

The contribution of the monetary circuit is the theorem that banks, and only banks, create money. Money is congruent with employment and climate-change-ameliorating investments. Minsky articulated "Big Bank" and "Big Government" working in tandem in the context of 'stabilising unstable economies'. Only they can steer the difficult transition from brown to green technology. The tasks is uphill as gales of destructive privatisation sweep the world. We can further Kalecki's development of Marx's Departmental schema. The Capital Goods Department can be divided into drones, cloud computing, AI, earmarked for the production of Basics, and drones, cloud computing, AI, devoted to the production of Non Basics. The division can be effected in a regime of social control of the means of production. Under conditions of laissez faire, au contraire, the outcome will depend on the optimism of capitalists, and a reversal of the welcome militancy of different segments of the working class all over the world after decades of subjugation. Non Basics are goods that are not inputs into the production process. We have isolated luxury goods, $f(C(t))$, in our model. A wealth tax or inheritance tax and a capital gains tax have long been components of the policy toolkit of heterodox economists. In addition, not a few senior statesmen in orthodox macroeconomics have advised Central Bankers to be less inflation-obsessed

and revisit their historical role as a "bankers' bank". We support the new lease of life to nationalisation of banks with novel obiter dicta about entrepreneur selection and minimization of costs that can be ferreted out in the Minsky Archives at the Jerome Levy Institute, New York. In sum, we have provided a glimpse of the inside workings of simple commodity production. The emission, circulation, and extinguishing of money is an indissoluble part of the process. The possibility of complexity in the sense of bifurcations and chaos arises with disproportionality between the production of Basics and Non Basics. Inequality in economies increases while the commodity space shrinks and the space of financial instruments expands. We intend to use catastrophe theory in a model that sounds the death knell of finance capitalism.

Notes

1 His equations are 1. Y = C + I; 2. C = C(Y); 3. I = I(PIS, W); 4. PK = L(M, K); 5. PID = PK; 6. PIS = PID; 7. MD = MS. The subscripts D and S stand for demand and supply. Wages, W, and the capital stock, K, are given as is the stock of money, M. The 'price' of money PM = 1. The recursive structure of the model is as follows. The relation 4. yields a value of the market price of the existing capital stock, PK, for every quantity of M. From 3., given W, investment, I, adjusts so that PIS = PK, where PIS is the supply price of investment. Thereafter, equations 5. and 6. determine equilibrium in the market for capital goods, and 7. equilibrium in the market for money.

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