



Political Aspects of Innovation in an Ecologically Unsustainable World

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Abstract

A theoretical approach is developed to examine the problem of why it is difficult to shift away from the current ecologically unsustainable technological systems. The aim is to identify within capitalism the “political aspects” that enhance, but also undermine, the positive transformational power of innovation policies. As such, this paper follows the approach of Michał Kalecki that identified within capitalism the “political aspects” that enhanced and undermined the positive transformational power of Keynesian full employment policies. That analysis provided the basis for heterodox economists to analyse post-World War II economic policies from a political economy perspective. Using critical realism ontology, this paper provides a heterodox analysis of an economic policy framework that identifies what government and business support as “innovation policies”. From this emerges a critique to assist in developing public innovation policies to produce an effective innovation system with ecological sustainability. Three papers that follow this one in this session are case study applications of this approach.

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1. Introduction

This paper details the Political Aspects of Innovation (PAI) thesis in Courvisanos (2009) and uses this approach to examine the problem of why it is difficult to shift away from the current ecologically unsustainable technological system. The aim is to identify within capitalism the “political aspects” that enhance, but also undermine the positive transformational power of innovation policies. As such, this paper follows the approach of Kalecki (1943) that identified within capitalism the “political aspects” that enhanced and undermined the positive transformational power of Keynesian full employment policies. That analysis provided the basis for heterodox economists to analyse post-World War II economic policies from a political economy perspective. Similarly, this paper provides a heterodox theoretical analysis of an economic policy framework that identifies what business implements as innovation strategies and governments support as innovation policies, in the context of providing concrete benefits to a community. The Australian political economy milieu (as at the late 2000s) has been exemplary of how the PAI approach can be used to appreciate the undermining of the transformational power of innovation towards an ecologically sustainable economy. As a result, examples from Australia will illustrate the propositions in this paper. Deeper empirical applications of the PAI approach are provided by the remaining papers in this session of the Marseille Innovation Forum.

In this analysis, the issue is not the technical creativity and knowledge that leads to invention. As Tidd et al. (2005, p. 92) notes, invention denotes the “first combination of ideas around a concept”. Thus, there is the technical conception to solve a problem (e.g. the light bulb was invented by Humphry Davy in 1802 but the light did not last long), however there also needs to be a technology system that supports the evolution of the invention idea into a commercially viable innovation. Thus, it was not until 1879 that Thomas Edison’s R&D laboratory was able to produce a long lasting light bulb that had commercial possibilities for adoption (Israel, 1998). Two elements are needed to transform an invention into a successful innovation. One is a technology system that supports the invention, e.g. with the light bulb there was the R&D laboratory to refine the idea and electric generators to ‘power’ the idea; this is the role of the entrepreneur. The other is government support and encouragement through infrastructure and skill acquisition; this is the role of institutions and culture. In this paper the concern is with the innovation process.

The role of innovation stems from Schumpeter (1939)'s long-run perspective, but incorporates the more dynamic short-term cycle and trend perspectives of Michał Kalecki. This allows the introduction of the role of government in innovation via an approach to political economy devised by Kalecki for employment policy. Rothbarth (1942), in his review of Schumpeter (1939), rejects the strict procedural linkage between innovation and investment. Instead, Rothbarth argues that uncertainty created by the innovation process leads to strong dependence of physical investment (whether by equity funds or by leverage with debt funds) on current profits. To Rothbarth, it is this argument which connects Schumpeter to the work of Kalecki. Synthesis between Schumpeter and Kalecki, identified by Rothbarth, provides the starting point for this critique of the role of innovation and public innovation policy in the current situation where there is a struggle between the monopoly power enshrined in evasive carbon polluting innovation, and the emerging transformative power of new radical eco-sustainable technologies.

Critical realism methodology, as propounded by Lawson (1997), is the approach taken in developing a theoretical critique of the current situation in innovation policy and performance. This is done by first providing an overview of PAI in context of sustainable development. The antecedents of PAI are then described, leading to the detailed exposition of PAI and its implications for innovation in a world desperately requiring a new technological and organisational path for a sustainable future.

2. Overview of the PAI Framework and Sustainable Development

The PAI framework enables tracking of business innovation over the period of a business cycle, and identifying the role government policy plays in supporting innovation within the context of the cycle. This framework can be used to evaluate the innovation process in a country, region or specific industry. Governments in advanced developed economies have the policy tools and techniques to encourage and support innovation as a driver of ecologically sustainable development (ESD) during long periods of economic growth (see Courvisanos, 2005). From the private sector, strong profits and consumer demand could promote what can be identified as *transformative innovation*, redirecting the trajectory of economic development towards ESD. Yet the dilemma from the PAI perspective is that this form of radical innovation is highly unlikely.

PAI sees the encouragement of marketing-based incremental innovation during the boom. This can be identified as *evasive innovation* in pursuit of a traditional economic development growth path by externalising environmental and other negative spillovers. The economic prosperity of the boom brings with it strong profits and rising economic wealth that should support ecologically sustainable innovation, yet the political economy rationale explains why during a long economic boom a shift to this particular form of transformative innovation is highly unlikely. After a deep recession, the opportunity for transformative innovation is much greater, given a period of slow economic development and the maturation of technologies. Yet, the lack of profits and demand are constraints on the innovation process at the time when it is seen as most conducive. This is the dilemma that is investigated here.

The PAI approach identifies three fears that capitalists have with innovation that result in conservative innovation strategies that sustain evasive innovation: (i) Loss of economic control - where innovation encourages new entrants to the market, thereby jeopardising incumbents market control and the value of their innovations; (ii) loss of policy control - as innovation becomes distributed across a wider society; and (iii) loss of industrial control - where innovative processes dissipate industrial relations management and control away from the monopolistic power source, while altering the power balance between factions of capital. These fears vary in their effect on business innovation strategies over the course of the business cycle, and also influence strongly the implementation of public innovation policies that support incumbent capitalists' powers. The strong economic boom of the first decade of the 21st Century is an example of how incumbent power in the financial sector and electronic information technologies enabled the development of a strong financial innovation system that was supported by public policy. Such incumbent power has emerged as a powerful force to prevent the type of Schumpeterian radical innovation to eco-sustainability that is required out the Global Financial Crisis recession of 2007-2010.

The aim of this critique is to understand the political economy difficulties of business innovation management towards ESD. Further, to appreciate the role of public innovation policies in developing innovation systems with ecological sustainability which can work effectively within a politically acceptable range of inequality and

instability. The paper's adoption of the PAI framework aims to derive political economy implications for an eco-sustainable innovation system into the future. Also, this approach allows for any conjectural economic history of an economy, sector or industry to be researched in order to reveal how innovation strategies and policies impact through the course of a business cycle and the consequence this has for long-run development of innovation. Application of this framework is provided in the following three papers in this session.

3. Schumpeter and Kalecki on Innovation

Still the best definition of innovation comes from Joseph Schumpeter, who began the modern-day research into innovation. Schumpeter defined innovation in five forms: (i) new products unfamiliar to consumers, (ii) new methods of production or new ways of handling commodities (processes), (iii) opening up new markets not entered into previously, (iv) new sources of supply of raw materials or half-manufactured goods, and (v) new organisation of the competitive structure of an industry (Schumpeter, 1938, pp. 63-66). In the context of the discussion that follows, it is interesting to note that Kalecki (1954, p. 158) identifies innovation with a very similar list of phenomena to that of the five forms by Schumpeter. All five forms are transformational as they lead to what Schumpeter called, "creative destruction" – destroying the old forms of accumulation and replacing it with new forms. These transformations work through innovation processes which are bounded by the specific institutions and political frameworks (or political economy) that influence the development of any particular innovation.¹

Schumpeter (1939) is a massive two-volume thesis on the processes of innovation and their absorption into the capitalist business cycle mechanism. For Schumpeter, this mechanism is a complex interaction between three classes of cycles. Major innovations initiate long wave (Kondratieff) cycles in which the boom develops from thorough far-reaching changes of the "technology system" (Freeman and Perez, 1988, p. 46). The roughly ten-year Juglar investment cycles provide the accumulation of capital stock to impel technology systems forward. Schumpeter saw the trend of Juglars forming the long waves, with a strong accumulation process carrying the

¹ For example, the innovation path of military technology is heavily circumscribed by the particular needs of warfare, from Spartan hoplite to USA stealth bombers. Jones (1987) explains these processes.

technology system on the upswing of the long wave. The roughly forty-month inventory (Kitchin) cycles reflect demand for the end products and whose trend forms the Juglars. Coincident trough in all three cycles results in deep recessions. In essence, Schumpeter argues that there would be no business cycles with deep recessions if not for the clustering of innovations around technology systems that leads to bunching of investment in order to implement (or commercialise) these innovations.

In his review of Schumpeter (1939), Rothbarth (1942, p. 227) argues that the profit link to investment, so crucial in all of Kalecki's work, is the "adaptation mechanism" that enables the bunching of investment (in Juglars) behind some long-run innovation "impulse". This turns Schumpeter's long-run supply-side process into one that is centred on effective demand. Thus, the influence of effective demand is based on the speed and strength of diffusion of innovation as determined by the ability of firms to invest in innovation out of profits. Time lags in investment are crucial in the innovation process, as Kalecki emphasises but Schumpeter rejects.

Rothbarth's assessment of Kalecki's work was based on the complete re-investment of profits in Version I of Kalecki's business cycle model from the 1930s. This was only the beginning of a major lifelong investigation into cycles and growth. In this version, a dampened cycle results with growth coming from exogenous shocks. Cycle Version II in the 1940s introduced semi-autonomous development factors, notably innovation, to "...engender a long-run upward trend" (Kalecki, 1954, p. 151). Finally (two years before his death) in Kalecki (1968), cycle Version III makes innovation specifically endogenous to the investment process, thus integrating the cyclical short-term with the long-run growth trend. Thus, the trend and cycle should not be considered separately. For this final version, inventions that are commercialised through investment "...add to profit expectations over and above those generated by the movement of demand in the course of the cycle" (White, 1999, p. 347), leading to a cumulative process of cyclical growth. White (1999) identifies two reasons in Kalecki (1968) to account for this. One is increased productivity in the form of process innovation that incorporates technical progress in new capital equipment, making the previous capital stock technologically obsolete. The other is product innovation coming from the stimulus to investment arising from entrepreneurs

wanting to be the “...first to avail themselves of the technical novelties” and thus adding a new level of demand (Kalecki, 1968, p. 269).²

At this point of the analysis when effective demand has been clearly established in the innovation process, Kalecki’s approach can be linked back to Schumpeter. White (1999, p. 350) recognises “...the stream of inventions underlying the process of innovation could be sufficiently erratic to provide the irregularity in economic behaviour necessary to produce deviations in demand and output from those anticipated by producers.” With the diffusion of successful innovations, Courvisanos (1996, pp. 114-39) shows that these deviations can be seen as triggers for cyclical investment turnarounds in periods when commitment of orders to investment is highly susceptible, either as too high (over commitment at expansion peak) or too low (under commitment at contraction trough). There can be reinforcement of this process by the inventory mechanism, in that any small upswing of an inventory cycle at the trough of a business (or Juglar) cycle provides a favourable climate for the spread of investment embodying innovation. This is particularly helpful for explaining the most difficult aspect of any cycle, the rise out of a contraction. In this respect bunching of investment occurs as per Kalecki, with the stimulus from clusters of “basic” innovations as per Schumpeter (Courvisanos and Verspagen, 2002).

From the effective demand perspective, it is the accumulation process which forms a chain of short period situations that determines the long-run economic growth path (Kalecki, 1971, p. 165). In support of this perspective, Lowe (1976, p. 10) explains that the long-run “secular process is, in fact, an abstraction derived from a sequence of short-term movements, the latter being the only ‘real’ processes”. Courvisanos (1996, pp. 156-9) specifies how the accumulation process, stimulated by innovation, unfurls a long wave trend line out of the short-term investment cycle whilst impacting on profit returns at the margin. The susceptibility concept of tension felt by entrepreneurs in relation to their fragile confidence is the mechanism that drives accumulation in innovation and provides the link from short-term business cycles to long waves. A “constellation” of successful incremental and radical innovations that cluster together, applying new basic

² White (1999, p. 350) identifies a third reason from a Sraffian perspective. This is the stimulus to investment “arising from changes in relative profit rates as a result of changes in technology.”

scientific principles (Freeman and Perez, 1988, pp. 4607), ameliorates the susceptibility of entrepreneur-owners to accumulation, providing strong investment expansions and pushing up the long-run trend of economic activity. On the other hand, monopoly control of technology systems by relatively conservative entrepreneur-managers intensifies susceptibility to provide less potent expansions and possibly even reducing the long-run path of economic activity.

Effective demand also has important consequences in terms of the innovative potential of an economy. Demand-pull innovation theorists, led by Kaldor (1966) at the macroeconomic level and Schmookler (1966) at the microeconomic level, have produced a plethora of studies identifying the causal sequence from scale economies achieved through expanded demand that increase the rate of investment and thus determine the rate of innovation. Fontana and Guerzoni (2008) distinguish between the Schmookler market size demand-pull hypothesis that induces primarily process innovation and the Myers and Marquis (1969) user-led demand-pull hypothesis popularised by von Hippel (2005) which induces chiefly product innovation. Kalecki clearly recognises this sequence, despite having identified the innovation-driven process. Kalecki places demand-pull innovation into an appropriate effective demand context by viewing both hypotheses as “part and parcel of ‘ordinary’ investment” demand (Kalecki, 1954, p. 158). This occurs, for example, when there is R&D investment by large firms stimulated by strong sales or investment in the user industry, both demand-inducing innovations evidenced through intellectual property rights. Courvisanos (1996, p. 42) calls this “endogenous” innovation.

Within this innovation-investment Kaleckian process is the basic model for cycles and trend of a capitalist economy with no state apparatus. Governments, by becoming heavily involved in innovation and investment policies add a political economy element to this cycle and trend which Kalecki did not explicitly develop. However, there is a political economy model that Kalecki developed in relation to employment policy and its impact on cycle and trend. The next section outlines this model.

4. Kalecki’s Political Aspects of Full Employment

What does “political aspects” mean in terms of economics? Let us first examine it from the perspective that Kalecki wrote about it in 1943 in the context of the Great

Depression experienced through the 1930s. In his extensively quoted article, *Political Aspects of Full Employment* (1943) – referred to as PAFE - Kalecki developed a Marxian class analysis where the capitalist class prevails over the political institutions of society. As such, this approach to full employment policy and its inability to be sustained appreciates the causal mechanism that exists behind the cognitive veil of the reality of continued unemployment (Jespersen, 2009). It takes critical realist ontology to recognise at the analytical level an economic landscape that is not conducive to maintaining full employment, despite the economic tools to achieve it, and all the goodwill of policy makers to bring it about.

Kalecki identified various political “stop-go” actions operating over the period of a business cycle. That is why this analysis has been dubbed “political business cycles”. Profits begin to be squeezed at the top of the boom as consumption spending slows down. Capitalist entrepreneurs have the exclusive control of accumulation, and under these profit squeeze conditions they make the decision to reduce their investment spending, which turns the pure capitalist business cycle into a contraction phase. Keynesian macroeconomic policies provide the method by which this contraction can be prevented and full employment maintained. This is through stimulation of effective demand *via* raising government spending, reducing taxes and lowering interest rates (with increased money supply). These three policy instruments can be employed to affect an expansionary impact on the economy. This policy troika again has been implemented in the aftermath of the 2008 Global Financial Crisis (GFC).

Keynes (1936) expressed faith that the power of his effective demand idea will be used to stabilise the business cycle at full employment. Kalecki (1943) also recognised the powerful tool of effective demand management by government (since he developed this same analysis in 1933), but he also recognised the stronger power of business interests to prevent this from occurring. Kalecki specified three fears that capitalists have with Keynesian full employment: (i) Loss of *economic* control when demand management policies aim for stability, thus effectively depriving capitalists of both their power to influence economic conditions through their investment decisions and also their power to influence governments themselves. (ii) Loss of *policy* control as governments extend their impact through their own investment spending into areas regarded as business’s legitimate sphere of influence (e.g.

transport, public utilities). (iii) Loss of *industrial* control of the workforce if governments are able to maintain full employment over the long-run, so that ‘the sack’ ceases to play its disciplinary role for businesses.

Applying these three fears, a political business cycle (PBC) emerges. Towards the top of the expansion phase of the cycle, the combination of profit squeeze and inflationary pressures manifests itself in a significant negative shift in the state of business confidence. This is reflected in profit rates falling, financial gearing rising and capacity utilisation falling as large capital investment projects come on stream at the time when consumption rates are slowing down (Courvisanos, 1996). Business interests enlist rentier interests to support them in having mainstream economists identify the economy as “unsound” (Kalecki, 1971, p. 144). Pressure is placed on governments to renege on full employment commitments and introduce the ‘stop’ elements of fine-tuning by using policy instruments to dampen effective demand. This ensures the demise of old capital stock and the reduction in real wages, essential in the renewal of capitalism.

The ‘go’ policy elements of government stimulation in effective demand are then used when business interests enlist workers to support them in having mainstream economists declare a slump as detrimental to the economy. There would, however, be strong debate between all these supporters of stimulation as to the precise instruments and extent of their use. A stimulation package allows the cycle to move into a new expansionary phase, with new capital stock coming forward on the basis of innovation in newer technological developments. Old capital stock can then be decommissioned so that utilisation rates are manageable in relation to new investment spending (Galbraith and Darity, 1994, pp. 459-68). Kennedy (1973) provides empirical support in the U.K (1953 to 1971) for a “predominantly” planned ‘stop-go’ policy approach, with technical errors due to poor forecasting playing only a relatively minor role.

Bhaduri and Steindl (1983), Catley and McFarlane (1981) and Steindl (1979) use PAFE to explain the long-run implications of the PBC in terms of a “political trend”. These studies draw on the historical developments in advanced capitalist economies to show that the shift in economic policies in the early 1970s from Keynesian “stop-go” policies to Friedman’s monetarism and neoliberalism is due to the same three

fears Kalecki identified in PAFE. The difference is that in this version of the class-based PBC a longer timeframe allows what Mair and Laramie (2002) refer to as "...feedbacks between capitalists and workers over the political and social tensions of full employment to work themselves through." These feedback effects generate rent-seeking behaviour by powerful monopoly control interests who form "distributional coalitions" to shift profit shares upwards by establishing obstacles in the road to full employment. These coalitions reduce efficiency and depress the adoption of new technologies in an effort to skew the income shares. Mair and Laramie (2002) provides empirical evidence to reveal the end of the post-war full employment stop-go strategy in the early 1970s coincided with the only significant period of income share turbulence. Aschauer (2000) sets out empirical evidence for the USA that supports this contractionary political trend with the decline of public investment since the early 1970s. Catley and McFarlane (1981) and Otto and Voss (1994) are two studies that provide similar historical evidence for Australia.

The contractionary political trend enabled the capitalist class to assert its economic and social dominance over labour and to cleanse capital of inefficient and oversupplied old stock. This process varies in time over different economies, with the USA leading the way after the 1990-92 recession into a new age of active innovation, stimulating large private investment spending and generating a new expansionary political trend. This expansionary trend consists of a new dynamic in public policy governance that has a PBC perspective as governments support rearmament (and war), tax cuts for the rich, innovation-supported subsidies and allowances, and 'cheap money' in a fragile financial system. Kalecki (1945) identified these stimulatory policies which have been reactivated by the USA at the start of the 21st Century.

PAFE raises in policy terms what Harcourt (2006, p.147) calls the "Kaleckian dilemma". As economists, Keynes and Kalecki both provided the policy tools and techniques that have the potential to ensure full employment, even with rising inflation concerns as the economy reaches towards full capacity. Both recognised this inflation threat and developed approaches to manage it. Yet, from a political economy perspective, Kalecki recognised that full employment is unattainable. Having Marxist perspective and critical realist ontology, he accepted this dilemma as inevitable since it exists because of the contradictions of capitalism itself.

5. Political Aspects of Innovation

In this section, the PAFE approach is appropriated to critique the process of public innovation policy-making using the same critical realist ontology. Whereas above in the PBC story innovation played only a minor role, in this section innovation is the central character around which policy revolves. Immediately after World War II (WWII) all the developed economies pledged allegiance to attainment and maintenance of full employment as the panacea for the inherent crises of capitalism. This approach was rejected in the 1970s, with emergence of the contractionary political trend as described in the previous section. This, however, raised a significant concern. With no direct employment public policy stance in advanced capitalist economies, conservative budget-balancing fiscal policies provided no (or limited) stimulus out of business cycle troughs. The policy framework thus became one that was more closely related to Kalecki (1945), with government policy aiming to stimulate private investment that incorporates some level of technological innovation.

Innovation is incorporated into investment theory as innovation alters the incentive to invest by changing the cost of production or altering product demand to raise profitability. Kalecki (1968) and Laramie and Mair (2007) both imply technical progress in their investment function specifications but only indirectly, the former by theory and the latter by empirical estimation. Salter (1966) links the inducement to invest to new technology by utilising a vintage capital model in which innovation is embodied in capital equipment. Thus, governments have developed innovation policies aimed at stimulating investment with innovation, which Porter (1990) has seen as crucial in building a nation's competitive advantage. Such policies work through various approaches like rearmament, R&D subsidies, technology park infrastructure like incubators, tax credits, and supportive income tax cuts for the higher income groups. This shift from direct employment policies to stimulating investment policies is exemplified by the reduction in emphasis on tariff protection policies that support employment in mature protected industries. Reduction in tariffs aims to stimulate innovative activity (Sener, 2001), while innovation public policies aim to guide and support transformation of the economy into a new technological age, with employment seen in the role of a useful spillover (or externality) to the technological imperative.

PAI can be recognised throughout all historical periods of capitalism, but it took on a more significant role with the shift from protection to innovation. Appreciating how the PAFE analysis works, the PAI approach adopts the same approach by identifying three fears that capitalists have with robust innovation. Specifically they are:

- (i) Loss of *economic* control with respect to individual market power as innovation encourages new entrants that have the potential to reduce the incumbents' market share and ability to control the market. Along with this comes the fear of the lack of adequate financial capital to support incumbents' innovations. Governments have various innovation policies to support the incumbents; notably, R&D subsidies and tax concessions for incremental innovations, patent protection and other intellectual property rights (IPR).³
- (ii) Loss of *policy* control as innovation becomes distributed across society through the public institutions and public infrastructure that create the national innovation system. Governments have developed various strategies that support incumbents to regain some policy control, notably deregulation, privatisation, public-private infrastructure programs and public contracting.⁴
- (iii) Loss of *industrial* control of the workforce if governments maintain industrial relations policies that reflect the full employment-type high-union membership structure of the first twenty years after WWII. Governments have introduced new industrial relations policies aimed at supporting and encouraging 'flexibility' in the workplace in the name of innovation. This flexibility relates to the ability of firms to lower labour cost and structures which reduce marginal costs of old technologies, delaying introduction of new product and process innovations.⁵ Such flexibility includes established firms engaging in enterprise bargaining contracts with employees and unions to ensure stability without industrial action (for the firms) and job security (for employees/unions). Innovative new entrepreneurial firms in related industries (e.g. renewable *c.f.* fossil fuel energy) are factions of capital that threaten this cosy industrial management deal. Therefore, the focus of 'industrial control' is not only on industrial relations with employees *per se*, but also on how innovation

³ For evidence of this, see Perez (2002).

⁴ For evidence of this, see Patel and Pavitt (2000).

⁵ For evidence of this, see Harcourt (1997).

and its flexibility in labour processes affect the power balance between different factions of capital

As with PAFE, PAI is a class-based approach over the PBC. It is based on rent-seeking “distributional coalitions” formed in specific industries by established powerful firms in the context of the three PAI fears that vary in intensity and effect over the phases of the business cycle. Towards the top of the expansion phase of the business cycle, the negative shift in the state of business confidence identified above has implications for innovation. Incremental innovation is strongly working through all the industry sectors in order to reinforce benefits of prior significant innovation with minimal new investment. Pressure is placed on governments to underpin minor innovation by increasing their efforts to ensure minimising capitalists’ loss of economic, policy and industrial power. Strengthening policies (and more effectively enforcing existing policies) that support incremental innovation can be applied in a boom period with minimal negative political repercussions. Such policies include increased privatisation of established areas of the public sector with easily available funding; stronger pro-business industrial relations with increased efforts to lower wage share (not necessarily lower absolute wages) and thus retain old technology; greater IPR support for established large companies emboldening them against increased competition from new small entrepreneurial players. In booms, there is a coalition between powerful industry players (both firms and unions) to ensure benefits of the boom continue to accrue to the incumbents. This also includes attempts to ensnare employees/unions support with enterprise contracts that include higher wages, even if the wage share is falling.

All actions above undermine ‘true’ transformational innovation and encourage ‘spindoctoring’ by powerful commercial organisations. This ensures the sedation of radical innovation that could be transformative, preventing stimulation of new activity during the cyclical expansion. Renewal is delayed. Any delay in transformational innovation means that much of the financial resources in the boom are siphoned away to create financial bubbles. This “bubble mania” has been identified in two different decoupling mechanisms that separate the real and financial economic sectors. Both mechanisms are influenced by Schumpeter’s recognition that the roles of entrepreneur and financier as interdependent (Schumpeter, 1939, p. 104). Perez (2002) identifies

the *first* “bubble mania” as a hiatus between installation and deployment of new technology. This is a period when the new technology is exploited in a reckless frenzy of “irrational exuberance” for capital gains on any business plan that has a link to the newly installed technology (e.g. 1840s USA railway boom and the late 1990s global dot.com craze). Perez sees this period as an inevitable delay in the ubiquitous deployment of the new technology. In terms of Kalecki’s PBC, government innovation policy support through the boom for the newly established capitalists sows the seeds of the cyclical contraction that follows the inexorable bursting of the bubble. The trend of the cycle remains on the upward part of the long wave as this contraction is only a hiatus in the unfolding technological trajectory (or diffusion) of the new technology system (e.g. information and telecommunications in the post-WWII period; Freeman and Perez, 1988, p. 53).

Minsky (1982) identifies the *second* “bubble mania” that follows the maturity of the new technology, as financiers search for alternative highly speculative (or “Ponzi”) schemes. As the PAI framework explains the continued public innovation support for mature technology, then significant installation of radical innovation in new technology systems is delayed. Despite expansionary monetary policy to ameliorate the previous “installation” contraction, government support for mature industries makes financiers wary of investing in new basic innovations (e.g. green innovations in the early 2000s), and instead support “old” technologies (e.g. petrol-guzzling automobiles in the early 2000s) which augment excess capacity already building up in the latter. Mature industries will not be able to soak up the available funds, so another round of Ponzi financing develops around financial assets (e.g. sub-prime mortgages and collateralised debt obligations in the early 2000s). Again, Kalecki’s PBC operates as governments’ PAI approach provides the deregulatory space and financial wherewithal for non-productive financial innovations (Kregel, 2008). This bubble sows the seeds of the “deployment” contraction and further delaying the deep installation of new technology systems, with monopoly capital arguing that the economy can not afford governments providing support and stimulus to new, untried and expensive activities like climate change based eco-innovations. The trend of the cycle is more problematic in this contraction, with the depth of the contraction impacting on the long wave trend downwards (e.g. electrical and heavy engineering in the Great Depression; Freeman and Perez, 1988, p. 51).

When the business cycle is well into contraction, the circumstances for innovation substantial alter. Limited new capital investment during the downturn from peak activity results in very little innovation. This is despite much R&D and patenting still going on. There is a large corpus of knowledge that is not being commercialised, with attendant concerns that rates of return are falling from old capital stock. As some companies fail to sustain themselves through the contraction, the remaining firms begin to feel the pressure of potential new entrants eager to test themselves in the market that has been comatosed. Distributional coalitions start to fray. Employees and unions pressure their constituent politicians for intervention. Support for government stimulation in effective demand by economists and business commentators manifests itself by significant initiatives in the area of innovation policy. Strong debate on the nature and extent of this innovation-based stimulation will result in some form of stimulatory package (but within institutional constraints such as the contractionary “political trend” identified earlier). The question arises whether new capital stock will come forward on the basis of transformational innovation incorporating newer technological developments. The PAI framework provides a critical realism focus on the delay in transformational innovation, despite the recognised need for such a change in an ecologically unsustainable world.

6. Implications for Innovation in an Ecologically Unsustainable World

In this section, implications of the PAI cyclical framework are examined against the present backdrop of an ecologically unsustainable world. This world is distinguished by increased frequency of droughts and dramatic storms, with indisputable international scientific evidence that has identified human activity through technological innovation as the source of greenhouse gas emissions (IPCC, 2007). These carbon emissions will significantly deteriorate the economic viability of nations and the economic cost of action is much greater than the costs of addressing the problem (Stern, 2006). Together with resource depletion (especially peak oil) and general pollution of nature, these three human activity factors have clearly pointed to capital-embodied technological solutions resulting in decreased ecological sustainability (Meadows *et al.*, 1992). Thus, the technological trajectories that have been established since the First Industrial Revolution, and the supporting organisational innovations, have not only provide stunning economic progress (von

Tunzelmann, 1995), but also endangered our “Spaceship Earth” in which we live in (Boulding, 1966). These citations clearly indicate that this problem of an ecologically unsustainable world arising from innovation is not a recent phenomenon coming out of the use of the term “climate change”. In fact, this critique has been well researched and deep-rooted in the science community for over 40 years. The problem with all previous analyses of innovation and the environment, excellent as they are, do not get to the nub of the political economy issue: What is the casual mechanism that delays the renewal process in innovation that would allow capitalism to lead the way to ESD? Or in more common terms: What are the barriers under capitalism that prevent the seizing of the business opportunity to innovate for a “green” economy?

There are always some intrepid innovative entrepreneurs that march to a ‘different drum’, and such entrepreneurs (like Anita Roddick of *The Body Shop* and Ray Anderson of *Interface Carpets*) have been shining the light for 20 years on a new potential eco-sustainable innovation path to the future for this Spaceship Earth. However, the PAI provides a framework of analysis that sees behind the cognitive veil of limited action and much “talk” on sustainable development. The lack of a critical mass of business action translates into political inaction. The most dramatic example of this is the collapse of any global commitment at the Copenhagen Climate Change Summit in December 2009. A weak non-committal accord was hurriedly put in place to save all the politicians “face” (Müller, 2010). PAI recontextualises the innovation/environment space to explain what causal mechanism exists in this space that allows for a plethora of evasive innovation to be put forward as false panacea, instead of truly ecologically sustainable transformational innovation.⁶

A short historical stroll through the recent political economy landscape provides re-context for the barrier question. Until the mid-1970s, Keynesian macroeconomics aimed to stabilise the business cycle (Fusfeld, 1994, p. 155). Governments used a combination of fiscal, monetary and incomes policies to counter the business cycle and mitigate macroeconomic uncertainty. Business cycles were less volatile in this post-Keynesian world. This approach allowed private investment decisions to be

⁶ This question is a specific reframing of the original question asked by Bhasker (1978) in his initial formulation of the critical realist ontology.

based on reliable information, thus lowering the amplitude of cyclical peaks and troughs. In essence, countercyclical fiscal policy by governments offset fluctuations in private investment with public investment (Kalecki, 1945, pp. 89-90). Further, cost-benefit analyses of environmental market failure at the microeconomic level operated in tandem with Keynesian macro-stabilisation policy. Government use of taxes and charges to internalise the social costs of production allowed private investment decisions to be based on full marginal costs when calculating rates of return benefits on specific investment projects (Helm and Pearce, 1991). This led to benefit-cost valuations in determining outcome for policy decisions affecting the environment (Hoehn and Randall, 1987). This neo-Keynesian position provided limited innovation fears in loss of economic, policy and industrial control; and with it mass consumerist innovation that supported the energy-based technology system, without major recessions that would destabilise the established economic power bases.

The major economic stagnation period of the late 1970s changed all that as identified by Steindl (1979). With this came the rise of the neo-liberal contractionary approach which also has dominated the economics profession. The neo-liberal position shifted emphasis away from government control and towards greater market control. On this approach, governments only set broad parameters within which the private sector operates. At the macroeconomic level, the government sets medium-term targets for fiscal (balanced budgets) and monetary (minimum inflation) policy, so that market forces can respond flexibly to market signals. Coupled with this, deregulation fosters a private investment strategy that moves away from protected mature industries to growth industries with higher value added. This approach seeks to provide investment decision makers with better market information, while removing interventionist public policies that distort market information. For environmental protection, this approach recognises the efficiency gains from market-based instruments (tradeable resource and pollution permits) over direct regulation (Godal and Klaassen, 2006). It allows private decision makers to incorporate environmental costs as a marginal adjustment to the scale and form of investment projects, rather than as a fixed regulated cost. With past decisions inordinately shaping future investment decisions, such marginal adjustments lead to myopic selection decisions in the context of a strong economic boom. This situation makes it impossible for the price mechanism to allow a critical

mass ecologically sustainable technology system to come forth (Rip and Kemp, 1998, pp. 372-9).

In this neo-liberal world, booms in the business cycle bring forth evasive marginal incremental innovation providing limited responses to the unsustainable ecological situation, despite the obvious business opportunities that exist for transformational innovation. Neo-liberal economic policies ended the world of macro-economic stability and exposed capitalism to the harshest elements of uncertainty and instability which make transformational innovation highly risky and exceedingly uncertain. The economic boom of the 1990s information technology system reinforced the energy-based consumerist path of development. This boom also brought with it the speculative capitalism that eventually created the GFC (Kregel, 2008). Without Keynesian counter-cyclical policies in place, what emerged was a set of *ad hoc* bank bail-outs, stimulus packages and increased financial liquidity that masked the underlying problems. This restricted severely the Schumpeterian transformational innovation out of a deep GFC recession, further delaying the ESD path away from the consumerist-debt model that drove the economic boom (Stiglitz, 2010). The lack of recovery in Europe and the USA (as at August 2010) raises questions about the effectiveness of the *ad hoc* public policy support of the current technological regime (Halligan, 2010), pointing to the need for transformative innovation in all areas: technological, social and financial.

The PAI framework identifies the economic, policy and industrial elements of public control that provide a cosy competitive model within the parameters that monopoly capitalists can conduct their investment rates of return (Baran and Sweezy, 1966). Incremental innovations by small innovative entrepreneurs will also be able to attract finance when these smaller firms are symbiotically in lock-step dependence on related large firms that support the dominant technology system (Parker, 2001). Thus, the global economy is emerging out of the GFC with PAI support for the dominant unsustainable technology system with examples like: (i) R&D support for clean coal technology (economic control), (ii) public-private partnerships for major tollways to extend automotive technology (policy control), and (iii) flexible labour processes supporting high wages in fossil fuel mining (industrial control). As Costanza and Daly (1992, p. 45) acknowledge “[u]ncertainty itself is one of the critical factors that must

be addressed in designing sustainable policies". The PAI framework clearly shows it is not. There is a need for policies like natural capital depletion tax (incorporating a carbon tax) with some form of refundable assurance scheme to handle uncertainty. This requires not only public policy leadership, but also strong regulatory mechanisms to prevent any speculative pressures arising from any financial assets built around ecologically-based targets.

7. Conclusion

This paper adopts Kalecki's political economy approach to develop the Political Aspects of Innovation (PAI) framework. With this approach a conjectural economic history of an economy or industry could be used to reveal how innovation policies impact through the course of a business cycle and the consequence this has for long-run development of the innovation(s). PAI is then employed for addressing the barriers to transformative eco-innovation. At this point in the history of humankind on this planet earth, the clearly recognised ecologically unsustainable technology systems pervading the global economy *must* be replaced by the sixth wave of technological revolutions based on eco-sustainable General Purpose Technologies. However, the barriers to this transformative eco-innovation are visible in different ways across the globe. The barriers are not chiefly technical, as the knowledge, creativity and skills for successful eco-innovation exist, and they are in operation throughout the world in small niche markets; nor are they chiefly social barriers, as there is large grassroots support for eco-sustainable action. There are also suitable economic tools that can be employed by the private sector (e.g. carbon trade-off markets) and public sector (e.g. carbon taxes) to incorporate into their risk management algorithms. What is missing is the appropriate political economy structure and systems that are conducive to this transformation. The PAI framework paints on a broad canvas the essential elements that have resulted in these barriers to transformative eco-innovation. The next three papers in this session are applications of this PAI framework to specific case studies of industries and their engagement with the political economy of innovation. The specific implications arising from these empirical studies raise important public policy and corporate strategic issues on the role of innovation in an ecologically unsustainable world.

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