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Technological innovation: Galbraith, the Post Keynesians, and a heterodox future

Abstract: *Galbraith, in his work on* The New Industrial State, *provides the crucial institutional base from which to appreciate corporate technological innovation. This approach is modified by the work of other institutional writers in the context of changing industrial realities, including the rise of start-up entrepreneurs. Post Keynesians have developed a monopoly capitalist research agenda that implies certain important elements of human agency that institutionalists have left unstated. Finally, this paper sketches out important elements of a future heterodox analytical framework on innovation that incorporates Galbraithian and Post Keynesian features for understanding corporate business strategy and public policy management.*

Key words:

Technological innovation is an extremely visible and politically charged concept. When John Ettlie did a Web search (in February 1999) on the scientific database of titles and abstracts in the business and economics literature, he came up with 3,011 entries. A Web search of the same two words in cyberspace produced 248,840 "hits" (Ettlie, 2000, p. 30). This visibility is on the basis of much political debate on many issues related to the positive and negative aspects of new technology. Evidence from research on these issues is mixed and actually relates to how new tech-

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nology is managed in the economic environment in which it is being introduced.

Technological innovation has many definitions in the innovation literature. For the purposes of this paper, the following is most appropriate: the creation, development, and implementation of an idea from problem solving or opportunity identification that alters *(innovation)* the current state of theoretical and practical knowledge, skills, and artifacts in the production and delivery of economic activity *(technology).* In the context of innovation, technology matters because it is the engine that drives change and economic growth. This is in response to society's needs or in the conceiving of new economic opportunities that induce demand. Without effective demand generating the commercialization of new technology, the idea remains merely an invention without exploitation.

Underlying the incessant drive in capitalism to technological change are the agency processes of technological innovation that introduce and manage this change. These agency processes need to be clearly understood and appreciated for policy relevance to the public, private, and third (nonprofit) sectors. The economic analysis of technological innovation is diverse and unsystematic. Scholarly works related to technological innovation have many ideological and functional intentions, and, as a result, there is little intersection or dialogue between them. This creates a problem for analyzing technological innovation per se. The objective of this paper is to sketch a generic political economy framework of analysis for technological innovation.

A political economy approach initiates this investigation by first rejecting the promarket perspectives (neoclassical and neo-Austrian) of the individual capitalist-entrepreneur agent initiating and managing change. John Kenneth Galbraith provides the initial critical perspective from which to appreciate the development of large corporate agency in technological innovation. Then, the Post Keynesian contribution provides a macroeconomic demand-oriented view of innovation that helps to appreciate the economic development and volatility of modern neoliberal capitalism. Finally, in the paper, the work of Galbraith and the Post Keynesians informs a broader heterodox understanding of technological innovation for the more diverse capitalist future that applies in the twenty-first century.

Political economy approach

The political economy approach adopted in this paper centers the innovation decision-making processes of economic agents within institutions

and how they react to the different levels of political power in society. This approach ensures a critical analysis of technological innovation in the economic environment in which both the positive and negative aspects of new technology are examined. The positive aspects of new technology have become a persuasive marketing tool, whereas the negative aspects have become a source of dread (the "Frankenstein hypothesis"). Common negative aspects are technological unemployment, information (technology) poor, technological determinism, environmental nonsustainability of new technology, false technological indestructibility (the "Titanic effect"), technological trade deficits in export commodity-based countries, a long and unpredictable process of developing and commercializing, labor deskilling and dehumanizing, and increasing stress and social limits to technological growth.

The parameter that sets up this political economy approach is the dynamic model of technological change based on Marx's laws of motion. Essentially, the circulation process under capitalism must overcome the limits of production by expanding over the barriers of declining additions to surplus value time (Lallier, 1989). This determines the drive to technological innovation in three forms: (1) opening up new markets, (2) creating new needs and demands, and (3) investment in increasingly technologically efficient means of production. These forms are endogenously linked to instability, unemployment, inequality, and unsustainable development that create an economy with fundamental uncertainty. In fact, it is the attempt to "control" this uncertainty that drives all agents of innovation. The political economy "power to control" approach leads to the rejection of the promarket—neoclassical and neo-Austrian—perspectives, which do not address this issue.

Crucially, the economic agents of institutions are the central decision-making actors in the process of technological innovation. These agents have the power to affect the way society adapts to such innovations in three ways: (1) the ability to determine the nature of the technology employed; (2) the monopoly power that resides with the entrepreneurs who install the innovation that can stifle other innovations as well as promote their own; and (3) the force society through organizational (politics), property (rights), and individual (charisma) elements to adopt the innovations they promote. This power view of innovation has two dimensions. One is the power to manipulate production in a way that technological innovation alters the physical aspect of the economy. Adam Smith, followed by Ricardo and Marx, developed this dimension around specialization (Smith), employment (Ricardo), and exploitation (Marx) on the basis of what happens to the economic surplus (Dasgupta, 1985,

p. 15). Braverman (1974) applied this dimension to monopoly capitalism as it developed through the mass production age of the twentieth century. The effects of technological innovation on the degradation of work was the essential element identified in Braverman and carried out further in the "deskilling" literature (see Callus and Quinlan, 1979). The other dimension is the power to manipulate demand in a way that promotes one innovation while stifling another. Sraffa (1926) first recognized the power of marketing, which was subsequently developed by many economists—notably, Galbraith (1958), Robinson (1933), and Sylos-Labini (1962).[1]

The innovation process is the generation of ideas and their implementation (often called "commercialization" when it occurs in a private sector business environment). Jolly (1997) calls this process of getting ideas from the "mind to the market," and he identifies in his research five interconnected stages in the process: *imagining*—which generates technological solutions with problem-solving skills (invention); *incubating*—which develops concrete applications of the technological solutions; *demonstrating*—which tests designs and validates outcomes of technological applications; *promoting*—which positions the demonstrated technology into appropriate market(s); and *sustaining*—which improves functionality through incremental improvements. The diverse bodies of literature that discuss technological innovation emphasize different aspects of this five-stage innovation process and recognition of this clarifies the political-economic context in which the investigation below is conducted.

Galbraith and the critical institutional perspective

Heidegger (1977) identifies "laws" that drive capitalism to technological innovation through a sequence of technical knowledge encapsulated in technological trajectories. One technological development is instrumental in generating complementary innovations while destroying the integrity of older technologies. This, however, should not be seen as

[1] Kingston (1984) provides (to my knowledge) the first attempt to synthesize these two political economy dimensions to innovation.

[2] Technological determinism has many different strands. Smith and Marx (1996), in their introduction to their edited volume, categorize these strands across a spectrum from "hard" to "soft." The degree of human agency in the technological innovation process increases from hard to soft. The neo-Schumpeterian school tends to be close to the "hard" end as it works with mathematically identified technological trajectories. For a sympathetic overview of this literature, see Bryant and Wells (1998). For a critical evaluation, see Phillimore (1998).

some mechanistic technological determinism.[2] All technological change is contingent on how technology is "shaped" by human agency processes as social groups manage technological, social, and economic conflicts (MacKenzie and Wajcman, 1985).

The rise of big business in the twentieth century moved the dynamic of agency away from the individual entrepreneur. Galbraith (1967), in *The New Industrial State (TNIS),* provides a way of understanding this dynamic on technological innovation by recognizing the laws of motion within the large corporations, but incorporating into this trajectory a strong agency story. The agency that is central to the determination of technological innovation in *TNIS* is the *technostructure.* The technostructure is seen as the decision-making basis of the large corporations, which forms "the planning system" of advanced capitalist economies and which guides economic development. This agency group embraces specialized knowledge, talent, and experience in specific technology-based areas where the market system (and its small enterprises) is symbiotically subservient to the decisions of large corporations, while governments need to acquiesce to the planning system's power and influence. *TNIS* developed this large-firm–dominance approach from Schumpeter (1942), where the small-firm entrepreneur of Schumpeter (1911) gives way to a managerial class who are concerned with protecting and supporting increasingly sophisticated technology in a planned approach. Power lies with the technostructure inside large corporations that serve partly the capitalist-owners through share price and dividend sustainability, with an increasingly generous serving to themselves via remuneration packages and perquisites of office (Stilwell, 2002, p. 232).

TNIS forms the basis of a critical institutional school response to the power of big business, reaching back to the seminal early works of Thorstein Veblen and linking with contemporaries like Clarence Ayres.[3] Although clearly having an institutional focus, *TNIS* has a sophisticated methodological inquiry that is evolutionary, emphasizing the role of major institutions in shaping economic and social development. In the context of technological innovation, it is the technostructure that is the major agent of change that results in corporate dominance, environmental stress, deep military–industrial complex, financial instability, as well as globalized market and cultural penetration. All this can be described as an

[3] Ayers (1952) has been described as a strong case of technological determinism. However, Lawson notes "on closer reading, as with Marx, the point that emerges is that some technological development may be a necessary condition for some other technological development (or indeed social development)" (2004, p. 5).

interlocking complex set of innovation systems operating at global, national, and subnational (or regional) levels.[4]

The source of creativity in technological innovation is a double-edged sword for the technostructure. The technology imperative demands from the technostructure two actions. First, the technostructure needs to stifle competing radical innovations from individual entrepreneurs of the classic neo-Austrian variety (see Lessig, 2004). Second, the technostructure needs to commit funds for internal research and development (R&D) in the incremental innovations of existing corporate technologies (see Chiesa, 2001). These two actions tend to limit innovation to what a bureaucracy can produce in a planned system. Schumpeter (1942) expresses concern that the dynamism of innovative entrepreneurship will be eroded by the technostructure sheltering their large corporations from "the gales of creative destruction."

The large corporation bridges internally the investment–innovation gap by first funding R&D and then commercializing the projects that are deemed by the technostructure as having the potential for success (see Jolly, 1997). This leads to circular and cumulative causation,[5] where the dynamic forces of innovation support certain forms of innovation to the detriment of other innovations. Self-perpetuation through monopoly control in the physical dimensions of innovation leads to a virtuous cycle of incremental innovation by large corporations. This is perpetuated in MBA courses that develop models for managing technological innovation (e.g., Ettlie, 2000). On the other hand, there is also the vicious cycle of disadvantage, prejudice, and legal constraints that prevent the investment–innovation gap from being met by small start-ups through funds and other assistance. Support to traverse this gap does not easily trickle down to small innovative entrepreneurs (see Kingston, 1984; Lessig, 2004).

Galbraith (1958) develops the concept of producer sovereignty to replace consumer sovereignty—the neoclassical term to express consumer choice in the market. Under a planning system, the large corporation needs to reduce fundamental uncertainty of new innovations by channeling huge resources into market research (or "wants–creation" process) and developing a marketing plan that creates product acceptance and brand loyalty. This is the promotion aspect of innovation that has

[4] For an outline of complex economic dynamics, using the new complexity methodology, see Rosser (1999).

[5] This concept was originally outlined by Veblen and developed across a broad range of issues by Gunnar Myrdal (see Argyrous, 1996).

been developed by the critical institutionalists who have followed Galbraith, and it implies an acceptance of a strong consumerist ethos as a necessary precondition for producer sovereignty to work in the aggregate. There will always be specific examples of failures in marketing, but its overall success is evident from the continual development of consumerism both in advanced economies and now spreading through to strongly developing economies such as China.[6] Galbraith often quips: "It is the exception that proves the rule."

Another cumulative causation aspect emerges with the role of investment and effective demand in innovation. Heilbroner identifies that capitalism's investment rests on the shoulders of technological progress alone, which carries with it an inherent instability:

> The great inventive contributions of mankind had always come in sudden bursts: an era of industrial revolution; an era of railroadization; an era of electrification; another of automotive building [and yet another era of information technology building]. Each cluster of inventions had resulted in a spurt of investment, but when each had run its course, the hectic activity of building was succeeded by a period of quiescence. (1961, <<page>>)

This instability of innovation has been dubbed the "clust–bun" effect; *clustering* of inventions leads to *bunching* of investment to intensify existing business cycle activity. The virtuous "clust–bun" effect requires effective demand stimulus through widespread diffusion of the clustering phenomenon that can only be achieved through the availability of profits for investment, or through public sector funding.[7]

Impediments to the "clust–bun" effect reside in the institutional frameworks of nations (national innovation systems [NIS]), particularly those with still-dominant mature industries utilizing older technologies (Freeman and Perez, 1988, pp. 58–65). Increased uncertainty arising from large investment in the new technology systems also adds an impediment through increased macroeconomic volatility, which Toivanen et al. (1999) empirically identify as slowing down the diffusion process. R&D (and technology transfer thereof) provides large corporations with the potential means to overcome these impediments and set up their own

[6] For an evaluation of Galbraith's work as it applies to fundamental uncertainty, see Dunn (2001). For a psychology-based research that supports producer sovereignty and the consumerist context, see Kahneman (1999).

[7] See Courvisanos and Verspagen (2004) for empirical support on the "clust–bun" effect.

NIS, with profits determining the volume of R&D that firms can undertake. Thus, the size of firms will reflect how successful the technostructure is in overcoming impediments in their own terms. The greater this success, the larger and stronger monopoly control will be exerted by large corporations. Then, there would be less space for small enterprises to prosper, unless they are symbiotically linked to the large corporations (e.g., component makers for automobiles and computers). This provides a clear and consistent adaptation and modification to Galbraith's technostructure concept in light of capitalist developments in technological innovation since the publication of *TNIS.*

The cumulative causation process has a regional inequality dimension to it. So, firms that cluster in one industrial location, strongly supported by one or a few large corporations, create strong regional innovation systems (e.g., Saxenian, 1994). Meanwhile, peripheral industrial regions without large and expanding corporations will tend to lose their entrepreneurial people to strong cluster regions. This is what Myrdal (1957, p. 27) calls the "backwash effects" in regional economies, from an economic development perspective.

The role of government in technological innovation from the institutional perspective is strongly based on Galbraith's interventionist position. The power imbalance in monopoly capitalism clearly needs to be addressed by reformist public policies that aim to provide more balanced development by supporting regions, industries, unions, communities, and innovators that do not have the support of the technostructure. The innovation policies need to be active and positive in the direction of encouraging variety, fostering experimental behavior, supporting new developments, focusing on system building, enhancing diffusion, promoting learning organizations and their skills training, as well as assisting to influence expectations (through grants, tax concessions, mentoring, supporting business services).[8]

Galbraith's major contribution is the holistic approach to analysis and policy, recognizing interdependencies within dynamic forces. This foundation leads to complex economic dynamics that can identify systemic (rather than market) failure and interventionist policies to overcome such failures. Many examples of success in this innovation approach can be noted: war-based economy, reconstruction from major devastation (e.g., the Marshall Plan), national sports-based academies, and regional clus-

[8] Modern neo-Schumpeterian economists spell out such policies in detail (see Bryant and Wells, 1998). For a neo-Schumpeterian overview from one of its leading lights, see Nelson (1987).

tering around universities and technology parks. Three major criticisms can be identified: (1) Given the large monopoly planning power of the technostructure, it is unclear how a government can escape from their acquiescent policy framework into the more balanced approach advocated by Galbraith. In fact, this planning power will ensure that any "balanced" attempts will be skewed to favor the large corporations through special interest lobbying and pleas by neoclassical economists of the erroneousness of profligate state spending on picking "winners." (2) The vast majority of job-creating companies are fast-growing innovative start-ups (or gazelles), independent of the technostructure (Birch et al., 1999), especially with the downsizing of large corporations through the 1990s. (3) Affluent electoral majorities in advanced capitalist economies are enjoying the fruits of a consumerist society and no longer look to government for social betterment of society in a balanced way, but instead demand security to protect their materialist gains from what Galbraith calls "the underclasses" that exist both inside and outside national borders (see Lasch, 1995).

A variant of the institutional school, inspired by Penrose (1959), is the strongly empirically oriented resource-based view (RBV) of the firm.[9] This view could be incorporated into the Galbraithian analysis of technological innovation to address the criticisms outlined above. Penrose identifies the precise circumstances and actions of the firms that determine innovation champions. Scherer warned 25 years ago that "the search for a firm size uniquely and unambiguously optimal for invention and innovation is misguided" (1980, p. 418). There is strong theory and evidence to support both small and large firm innovation propensity. In fact, medium-sized firms tend to be the most disadvantaged, because they lack the dynamism of small entrepreneurship and the wherewithal of large firms to conduct R&D. However, "unequivocal evidence is found that [market] concentration exerts a negative influence on the number of innovations being made in an industry" (Acs and Audretsch, 1991, p. 14). This means that innovations can emerge as much from small firms as from large firms, thus industrial and regulatory policies cannot be

[9] Despite this empirical disposition, the RBV uses many measures and they are all acknowledged as unsatisfactory, especially in trying to identify innovations themselves and the core competencies that create them (Acs and Audretsch, 1991). Core competencies can also be limiting when they become core rigidities, and then firms underestimate or neglect emerging core competencies arising in the economy. This leads to ignoring market demand, leading to the problem of effective demand and its limitation on innovation.

based on simple rules about firm size but more related to market power through high concentration in particular industries. In general, this implies that the role of government needs to be active and supportive (e.g., removing monopoly rents).

Collaborations between firms are a crucial element of the learning process in RBV, and empirical studies have identified the technological and marketing innovative benefits that emerge (see Coombs et al., 1996). Networking from collaborations by (and with) small and large firms has significant implications for regional clusters (or industrial milieux) both in geographic and cyberspace. In this way, innovation diffuses over space through the process of knowledge spillovers that operate at different rates of diffusion across technology gaps. The laws of motion that RBV concentrates on relates to the evolution of technological innovation. The initial approach was the life cycle (or S-curve) from birth to decay (or transition). Since then, more sophisticated approaches have emerged for large firms, particularly punctuated equilibrium and jolt theory; whereas small firms still tend to resemble Alfred Marshall's "forest of firms."[10]

RBV has a distinct lack of analysis of market power in the innovation process, despite the occasional reference to market concentration strength as a negative influence on innovation. Thus, from the political economy approach, the empirically rich RBV can only supplement the strongly power-based Galbraithian analysis. One aspect that could reflect a fresh RBV angle on power is the neglected notion of an "innovation mechanism" by Downie (1958), "whereby laggard firms have a greater incentive (the need to survive) to undertake risky R&D work that might provide them with ways to re-establish their competitive position" (Bloch and Finch, 2004, p. 12).

The Post Keynesian contribution

A macroeconomic perspective on the technological innovation process is lacking in Galbraith and the institutional school. Their emphasis is on the industrial organization of innovation as a critical response to the

[10] This is the biological analogy of firms as trees, where they "gradually lose vitality; and one after another they give place to others, which . . . have on their side the vigor of youth" (Marshall, 1920, p. 316). This implies that firms do grow, but then decay, so that no firm becomes too large over a long time so as to dominate the industry. The role of regional clustering and industrial location is linked to this biological need to group together in order to be sustainable. This sustainability is only in a quasi-equilibrium state such that there is "dynamic balance between progressive and declining firms, with today's progressives inevitably becoming tomorrow's decliners" (Bloch and Finch, 2004, p. 5). For empirical support, see Ettlie (2000, pp. 76–82).

neoclassical microeconomic market faith. Galbraith's own Keynesian predilections gave him a strong effective demand macroeconomic view, but this has never been wedded to his technostructure and the political economy of technological innovation. A small group of economists working in the Kalecki–Steindl tradition have made a significant contribution to the macroeconomic demand-oriented aspects of technological innovation that helps to appreciate the economic development and volatility of modern neoliberal capitalism. On the scale of technological determinism, this contribution is further to the soft end than the institutional school because of its emphasis on the power of capitalists' own behavioral decision making.

The agency that is central to the Post Keynesian determination of technological innovation is the "capitalist." The capitalist links innovation to investment decision making so that the elements of effective demand and cyclical volatility at the broad base are related to the cumulative processes in all forms of innovation at the firm/industry level. This perspective derives from Keynes (1936) and his clear view that investment (in capital stock) is the essential, but "undependable" drive wheel for the economy. Coprogenitor of the Post Keynesian perspective, Michal Kalecki, identifies historically determined profit levels as generating the ability to invest in capital goods and in innovation knowledge enhancement. Profits (or surpluses in nonprofit organizations and public authorities) not only provide the wherewithal to invest but, through their extension of the capital funds owned by the organization ("entrepreneurial capital"), it also allows for access to loans and share issues ("rentier capital"), which can further extend capital and knowledge-based investment (Kalecki, 1991, p. 279).

Capital accumulation is embedded in the endogenous (or induced) innovation generated from within the organizations (via R&D expenditure and knowledge spillovers). Such innovation is of secondary importance from the scientific standpoint, coming as it does from: (1) slight adaptations on previous capital equipment, (2) cosmetic improvement in old products, and (3) extension of previous raw material sources. Kalecki calls the "innovation effect" a "development factor," which creates the following dynamic process:

> innovations prevent the system from settling to a static position and engender a long-run upward trend. The accumulation of capital, which results from the fact that long-run investment is above the depreciation level, in turn increases the scope of the influence of the development factors and thus contributes to the maintenance of the long-run trend. (ibid., p. 327)

Kalecki, then, sees "exogenous" innovation as representing the intensity of innovation with given capital investment levels. This means that any change in the intensity of the innovation effect originates in the scientific invention or basic business opportunity identified as the source of the innovation. So that a "reduction in the intensity of innovations . . . will also initially cause a disturbance in the cyclical fluctuation and, by means of a slump more pronounced than the boom, will make for a lower long-run level of investment" (ibid., p. 328).

This would lower the long-run trend, where an increase in innovation intensity would raise the long-run trend in economic growth. Such an approach has close links to the Schumpeterian "clust–bun" effect and how innovation intensity varies with clustering and its impediments.

R&D amounts in aggregate to a large body of investigation going on continuously (at different rates of intensity). This large R&D spending and related innovation effects are bound to lead to some major new "discovery" or "invention," which is related to the total aggregate R&D, rather than any particular one R&D project. This discovery is linked to possible small developments in various laboratories and informal networks between firms and industries, eventually coming to fruition in some way divorced of any specific competitive behavior. New technological paradigms come out of such aggregate developments and are the basis of structural change to a new long wave of boom and prosperity (Freeman and Perez, 1988, pp. 47–58). Changes in technological systems and paradigms arise only after all the minor improvements (endogenous innovation) are squeezed out of the old systems and paradigms by "monopoly capital" entrepreneurs who want to protect existing capital stock and delay the new paradigm taking over. There is also "logjam" in endogenous innovations based on the new paradigm, which compounds the latter's slow initial adoption. This occurs when established powerful capitalists, with much old capital stock, cannot justify the entire shakeup of industries, since not enough interrelated clusters have been formed. This approach to R&D places the technostructure into a broader capitalist context that reflects the stronger clustering of innovations that has been developed by large corporate interests since publication of *TNIS*.

As the institutional framework slowly adapts to the new technological system, capitalists' reactions against uncertainty of profits come from competitive pressures and growing inefficiencies of old capital stock. This induces adaptation (by industries) and imitation (within industries) to technological trajectories that are totally new, establishing the new investment upturn. It creates a new investment boom and, at the same time, reestablishes the conditions for a new phase of steady develop-

ment. A paradigm shift occurs when the new adapted technological systems pervade the whole economy.

This analysis links together the two types of innovations described by Baran and Sweezy (1966)—namely, "normal" (or endogenous) and "epoch-making" (or exogenous). A period of secular decline in economic development can now be associated with the limitations of scale production in oligopolistic competition, as the old technology systems are running out of possible new adaptations. Diffusion of the old systems through endogenous innovation slows down and imitators become considerably fewer. The large powerful corporations attempt to protect existing capital values and ignore the new technological systems being developed on the fringe of the corporate world. This tends to exacerbate the mismatch between new technologies and a powerful institutional framework based around monopoly capital. It was Steindl, back in 1952, who inspired this type of stagnation analysis that arises from intraindustry competition. He recognized this secular decline as the incentive to reduce surplus capacity and invest in established and mature monopoly capital sectors. However, in his 1976 introduction to the 1952 book reprint, Steindl stated that he was "ready to admit a possibility which I denied in my book: that it might be the result of exhaustion of a long technological wave" (1976, p. xv). This raises the question of how the new wave of technological innovation develops.

Shapiro explores technological innovation using the Steindl model of competition in two papers. Shapiro (1981) identifies Steindl's progressive firms as the large corporations with strong saving out of profits that are prepared to support their technostructure in innovation-based investment in R&D, means of production (processes), and new product development. These progressive firms have the ability to develop substantially new products on the "wave" of a new technological system in process innovation. The most recent example of a process innovation that has spawned a large product innovation phase is information technology (IT). As Kingston (1984) recognizes, the marketing of an innovation needs to follow the initial technological accumulation process, and the Post Keynesian perspective can explore in much detail the crucial demand-creating nature of marketing new product development. Shapiro (1981) identifies conditions that determine whether capitalists will prefer investment in their present mature industries (intraindustry competition) or diversify into new industries developed by smaller innovative start-ups. New industry innovation through interindustry competition is explained in Shapiro (1986), when large firms diversify into markets not "clogged" up by oligopoly. This enhances these firms' own growth pros-

pects as well as developing an acceleration of aggregate growth if the diffusion of the new technological innovation becomes widespread. Eichner (1976) describes this innovation process as the form of competition that drives large corporations while endogenously "oligopolizing" new industries.[11]

Monopoly capitalism suffers from systemic failures of stagnation or instability, depending on the combined effects of oligopoly innovation and investment decisions. From this Post Keynesian analysis of innovation, Courvisanos specifies the need for three public policies: (1) demand management to regularize investment cycles at the macroeconomic level, (2) encouraging innovation into new technological systems at the microeconomic level, and (3) "socialization of investment" through perspective planning at the mesoeconomic level as countervailing power to the planning system of monopoly capital (1996, pp. 225–230). Such policies allow governments to match or counterplanning decisions made in the corporate sector.

The technostructure and its accompanying institutional forces and innovation systems allows one to understand the physical production side of innovation. The Post Keynesian contribution provides a potent demand-oriented response to innovation issues set within the dynamics of oligopoly-based competition. However, not being able to identify and explain entrepreneurial start-ups (à la neo-Austrian) and strategic collaborations (à la RBV) in the innovation process opens up the criticism of Post Keynesian that despite the appropriate demand conditions and public support, without these two dynamic elements of firm innovation, the innovation process could be heavily stymied as it was during the command economy period of Eastern European economies (see Marangos, 2004).

A heterodox future

The role of power in technological innovation is central to any complete endogenous account of business and economic development. The promarket (neoclassical and neo-Austrian) perspectives are limited in their analysis of power to the role of the entrepreneur within some abstract notion of the market. This lacks the contextual reality of monopoly capitalism and how this distorts the entrepreneurial decision making into

[11] See also Thomson (1986). For a recent restating of this Post Keynesian position on competition, see Shapiro (2003, pp. 65–67).

innovation. Essentially, what is lacking is a political economy context. Galbraith was instrumental in introducing such a political economy context through agency of the technostructure in the innovation process. This has been modified and adapted by many institutional-based economists since Galbraith, but without resolving the three major dilemmas (skewed power, innovative start-ups, and consumerism). The Post Keynesian contribution comes at the political economy innovation issue from another direction entirely, examining agency of monopoly capitalists in the accumulation process through dynamic competition. The hard end of technological determinism tends to limit the agency power of the technostructure in the context of less monolithic and subtler monopoly capitalism regimes that are developing in the early twenty-first century. These more complex aspects have been developed by the Post Keynesian and RBV views, providing more ontological human agency (or the soft end) to technological determinism.

The diverse, and often incompatible, analytical tools and processes used to explain technological innovation in the scholarly works described in this paper means that there is no clear political economy path to praxis within the modern capitalist economy. This was the concern raised by Kingston in 1984 by his insightful but largely ignored book, and it still remains 20 years later. Technological innovation has had enough divergent approaches, what this issue needs is a heterodox future that combines and integrates the important themes running through these critical approaches.[12]

A heterodox synthesis needs to provide a strong generic framework to understand and appreciate the capitalist forces that underlie technological innovation and its commercialization process. A deeper policy analysis that emerges could form the basis of appreciating the corporate planning system and its implications for public policy strategies. This could also provide improved ability for entrepreneurs, workers, public servants, and politicians to cope with the uncertainty that arises from the dynamics of technological innovation and accompanying capital investment. At the same time, this generic framework can be used to take advantage of the susceptibility of other firms in a dynamic competitive environment in order to innovate and develop competitive strengths. Finally,

[12] The heterodox interface has become an important part of communication among many nonneoclassical schools of economics—in an effort to develop dialogue, learn from alternative approaches, and find common threads of analysis. For example, the inaugural conference of the International Confederation of Associations for Pluralism in Economics (ICAPE), University of Missouri, Kansas City, June 2003.

and crucially, such a framework enables some rigorous guidelines to be established for further empirical research on the political economy of technological innovation.

Any heterodox synthesis needs to contextualize the innovation process within an institutional setting that is realist and relevant. In *TNIS,* Galbraith provides a holistic and interdependent innovation system, centered on the technostructure and the power of large corporations. As a start, the institutional contributions that follow Galbraith should provide a foundation to this political economy heterodox approach. The Post Keynesian contribution has strong dynamic and market-based themes that are lacking in the Galbraithian perspective and need to be included. The following elements should be built on the Galbriathian structure:

- *Endogeneity:* The concept that innovation arises from within the systematic model constructed is the relevant perspective developed by Galbraith's institutional setting and implicit in the Post Keynesian profit-based investment analysis. The dynamics of a complexity model with recursive effects and increasing returns should be the feature of a heterodox framework.
- *Uncertainty:* There needs to be some mechanism that attempts to "manage" the problem of uncertainty, pervasive as it is in the innovation process. The neoclassical and neo-Austrian perspectives have mechanisms that assume the change agents can handle uncertainty automatically. The institutional and Post Keynesian perspectives are more open-ended, identifying various political and social elements that "manage" uncertainty through power and influence. Complexity dynamics is the most effective way to model this uncertainty into a heterodox framework.[13]
- *Evolutionary:* The concept that innovation is a process of change that evolves from some embryonic revolutionary idea to different types of innovation: infant (radical), growth (incremental), maturity (stagnant), and then either decline or transition (diversify). Both institutional and Post Keynesian perspectives support this concept.
- *Individualism:* The concept that innovation requires some one person (or a team) to drive the innovation process through entrepreneurship. The process can be based on competitive or collaborative arrangements in the commercialization of the innovation. The Post Keynesian perspective tends to imply that it exists without focus-

[13] See Courvisanos and Richardson (2004) for an attempt at complexity modeling.

ing on the elements that make it work. Galbraith's technostructure is the corporate team-based approach, whereas the RBV and neo-Austrians have a stronger human agency element.

- *Strategic planning:* The concept that the innovation process needs to be managed and strategized in a planned approach is a strong antidote to the idea that it just happens by the power of individualism. Both institutional and Post Keynesian perspectives support this concept. Neoclassical economics ignores this concept completely, with even the neo-Austrians discussing the role of strategic routines in innovation.
- *Investment:* The central Marxian concept of capital stock driving the innovation permeates both institutional and Post Keynesian perspectives. Neoclassical economics sees investment only as some automatic response to market signals. Empirical evidence on the basis of sound Keynesian principles shows that investment decision making needs to be analyzed explicitly, ideally using a basic Post Keynesian foundation.[14]
- *Supportive state policy:* The need for public policy to support the innovation process. The institutional response is strong in terms of political economy and the need for reformist active intervention, despite the fundamental contradiction identified earlier. Post Keynesians have strong active support but without the political-institutional depth of Galbraith. Some studies have combined institutional and Post Keynesian elements into a public policy framework to address these political economy concerns.[15]

Conclusion

By examining critically the economics of technological innovation through the prism of power and politics, the industrial and political realities of dynamic economic development can be better appreciated. By identifying what Galbraith and the Post Keynesian can contribute to a heterodox synthesis on technological innovation, a framework for understanding corporate business strategy and public policy management can be offered. The framework is only a thumbnail sketch, hopefully

[14] See Courvisanos (1996).

[15] See Courvisanos and Verspagen (2004), Freeman and Perez (1988), and Lima (2000).

providing the basis for further research into a substantial political economy model of technological innovation.

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