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Science fiction and innovation: A response[☆]

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ABSTRACT

Daniele Archibugi's use of the film *Blade Runner* to discuss future prospects for techno-economic paradigm change is considered in relation to several questions. Is science fiction a literature of prediction and, if not, what role might it have in developing insights about possible futures? Is the current economic malaise predominantly due to a shortcoming of technological opportunity or to a fiscal paradox and political decisions about how to deal with this paradox? Might the present day equivalent for techno-economic paradigm change be more about the innovations necessary to rebuild or retrofit our existing technologies than about producing new growth sectors?

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1. Introduction

Daniele Archibugi's article takes the film 'Blade Runner' as a foil for discussing how Schumpeterian economics may be related to epochal changes in the direction of long-term economic growth. He explores whether an exhaustion of technological opportunities is part of the explanation of the financial crisis of 2008 and the continuing shortcomings in the recovery from it, and, ultimately, what opportunities exist for future economic growth and technological innovation. This is a heavy burden for a film, the central theme of which is the equally weighty question of what it means to be human. In the film, this theme is developed using artificial human beings or 'replicants,' who are violently 'retired' (somewhat gratuitously since they are past their sell-by date and programmed to self-destruct anyway) by the film's anti-hero who develops divided loyalties. The film offers rich visual detail of an imagined future but a rather sparse account of how that future came to be. As Archibugi observes, while the film is set in a distant future, it recapitulates features of our contemporary world such as the physical stratification of wealth and social class, the continuation of war (although conflicts seem to have been relocated to certain 'off world colonies'), the migration of people, and, perhaps, the consequences of climate change. Thus, the film offers elements of both discontinuity and

continuity which Archibugi argues are characteristic of Schumpeterian growth processes.

1.1. Epochal changes in the direction of long-term economic growth – part I

In considering epochal technological change, Archibugi focusses our attention on two groups of technologies that feature in the film – information and communication technology (ICT) and biotechnology. He observes that since the film was produced, our accomplishments have outstripped the film's vision with regard to the first, but barely progressed against the second. As technological prediction, therefore, the film is not very helpful (the predictive value of science fiction will be considered further in the conclusion). Archibugi seeks to explain this disjunction in the rate of progress in these two groups of technologies since the film's original release in 1982 by recourse to technological uncertainty and technological opportunity, and the complementary role of investment and entrepreneurship. Biotechnology's technological potential, and the opportunities to transform it into a general purpose technology that might be used to grow plant or animal 'replicant' tissues for our food, fibres for our clothing, or even, as in the film, companions and soldiers, have not (as yet) materialised. Instead, as Archibugi observes, most of the realisation of biotechnology's potential is in a relatively small segment of the pharmaceutical industry. In this industry, instead of creating giant new firms such as the film's Tyrell Corporation, biotechnology has most often augmented the size of incumbents and clearly has not achieved 'creative destruction' that portends epochal technological change. A large part of the poten-

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tial of ICT has materialised in contrast, with corresponding inflows of investment and outflows in the form of diffusion and adaptation which imbue everyday objects with increasing information processing and display capabilities – be they phones, cars, home appliances, and so forth. In terms of entrepreneurship, if we take the film to represent a vision of a few decades into our future, the man in the high castle of the film may be more akin to an aging Elon Musk, rather than Eldon Tyrell, the film's mastermind of replicant production.

1.2. The 2008 crisis and the recovery

The deeper issue that Archibugi addresses is the contributory role of technological opportunities to the slow recovery from the 2008 crisis experienced to date. Crises of the magnitude of 2008 have many sources. The leading technology of our era, ICTs, certainly contributed to the instabilities and volatility that provided the tinder for this conflagration. ICTs, in combination with other technologies such as containerised shipping, accelerated global merchandise and service trade, enlarged the accompanying financial flows at risk of financial instability. ICTs, in combination with a neoliberal faith in the economic rationality of markets, helped to create and to gain acceptance for financial instruments that subsequently became toxic banking assets. Institutions meant to regulate risk-taking, again under the influence of neoliberal ideology, demonstrated their incapacity to adjust to this changing landscape. More positively, the same landscape conditions also supported a huge expansion in market access for rapidly growing developing countries and with it the resulting transformation of millions of peoples' lives, generally for the better but, in some cases, for the worse.

The widespread belief that innovation will restore economic growth to the robust levels of an earlier era is, indeed, worthy of critical examination. Archibugi portrays the engine of this restoration as being fuelled by expectations and this leads him to the question of where opportunities are opening up to fuel those expectations. In other words, with positive expectations, investment that would restore jobs and boost final demand should follow. Contrasting with this entrepreneurial explanation, (Mazzucato and Perez, 2015) argue that surges of technological innovation are fuelled by government investments that demonstrate the feasibility of new market opportunities – with private sector entrepreneurship following the lead of the entrepreneurial state (Mazzucato, 2015). For Perez and Mazzucato, the absence of bold 'productive' government investments is the source of both the weak aggregate demand and the weak levels of entrepreneurial initiative underlying the current malaise. A third, fiscal policy oriented approach is that it is the insufficiency of aggregate demand (for both investment and consumption) that requires state action at a level resembling America's New Deal or the Marshall Plan for the reconstruction of Europe. The persistence of low long-term interest rates offers the opportunity for the state to borrow in order to make productive investments – not only in innovation, but also in aging infrastructures. Unfortunately, public debt has become a toxic political issue under several narratives including that based on the notion of inter-generational equity. Yet, as Summers has observed in the United States context, future generations might actually prefer owing the debt to inheriting an infrastructure with an enormous deferred maintenance bill (Summers, 2016). Similar opportunities may exist in other rich nations, while the infrastructure investments required to 'modernise' in middle and low income countries offer enormous opportunities for both investment and innovation. These positions recapitulate the persistent debate regarding the origins of technological opportunity – whether it can be manufactured by stimulating demand, whether it arises naturally from research investment or whether it requires the particular visionary

skills embodied in entrepreneurs who also have a fanatical commitment to opening up and exploiting these opportunities. In order to determine what policy or mix of policies might be of value, evidence about the current levels of expectations and technological opportunity is required.

1.3. Epochal changes in the direction of long-term economic growth – part II

In commenting on current global economic conditions, Archibugi offers a pessimistic short-term outlook comparable to, and citing, Robert Gordon's recent case for pessimism (Gordon, 2016). In short, Gordon's argument in the United States context is that productivity-improving innovations beginning in the late 19th century and extending to the first decades of the 20th century have become a spent force. In Gordon's view, the late 20th century innovations related to the ICT revolution may similarly have exerted most of their impact already, with no new technologies of comparable effect on the horizon. Archibugi is rather more optimistic than Gordon, predicting growth through a consolidation and a deepening of the current paradigm. This, however, seems to be matter of faith rather than of evidence, since the primary support for his optimism is a Delphi-like study from McKinsey which assesses the main medium-term opportunities that will stem from ICT applications including robotics. His own work (Archibugi et al., 2013a,b) on expectations suggests a more pessimistic prospect. This stems from the continued business hesitancy in Europe to invest in R&D in order to bring about the consolidation and deepening of the existing (ICT) paradigm (or anything else for that matter). Europe, however, has been afflicted by its own overdue structural crisis arising from the institution of a common currency without correspondingly forceful regulatory institutions to govern the effects of economic disparities within the European Union.¹ This crisis is ongoing with European banks continuing to have a propensity to hold assets rather than to make loans.² Outside Europe, the processes of modernisation and adaptation to globalisation are, in fact, sustaining growth rates in some countries (e.g. China) that would, twenty years ago, have seemed astonishing and very acceptable in others (e.g. India). It is also remarkable that the nearly universal slower pace of inflation means that the real gains from growth are larger. The story on expectations, therefore, is mixed – perhaps weak at the traditional frontier where new and large opportunities would be helpful, but stronger behind the frontier where catching up processes are still vigorous.

The elephant in the room, however, is the seemingly inexorable march towards a set of crises – catastrophic climate change, spiralling inequality, and an ever-expanding movement of people fleeing war or poverty. These emerging issues challenge the prospects for innovation investments continuing as usual and may be exerting strong effects on expectations shaping long-term business investment. The threat of climate change means that most of the world's agricultural and industrial systems, including transport and housing, need a massive retrofit to avoid catastrophic changes in the earth's environment. This requires an accelerated depreciation of many fixed assets. Barring science fiction type solutions such as Blade Runner's emigration to 'off world colonies', this will require major investments, a means to make returns on those investments (which will probably involve significant tampering with market prices) and innovations that will improve the return on, and reduce

¹ Moreover, the EU faces important constraints stemming from its limited fiscal position relative to its Member States (see Dabrowski, 2010) for a useful overview).

² Although bank lending generally is not a principal source of R&D investment, its absence means that fixed investments and working capital levels compete with R&D for company cash flows.

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