Creative Destruction

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1 Old Thoughts on Creative Destruction

1.1 Marx and Schumpter

This section introduces creative destruction. Creative Destruction has its roots in economics, and as such, this section will present creative destruction in its economic form. In effect, this section lacks philosophical rigor.

Creative destruction is an economic idea that refers to how new products, firms and innovations destroy old products, firms and innovations. Neoclassical economic theory, the most popular economic theory, is built on top of the idea of equilibrium. Most simply, an economy has supply of things and demands of the same things. Supply and demand interact with each other, creating tension between economic processes. The economy remains in flux until supply and demand reach a happy equilibrium. At a happy equilibrium, supply and demand remain more or less constant until something disrupts the system.

The supply and demand theory has had strong explanatory power over the years, but it doesn't expalin one crucial observation: economies grow. In a neoclassical economic framework, an economy reaches equilibrium and stabilizes. Once an economy stabilizes, the only for it to grow is via exogenous inputs, for example, imperialism, increased supply of raw materials.

However, we observe that economies grow faster than the net exogenous inputs. What could explain this? Better worded: what explains endogenous growth in an economy? After a close reading of Marx, Schumpeter came to the idea that innovation and entrepreneurship are the drivers of endogenous growth. Innovation and entrepreneurship introduce new value to the economy that did not previously exist, contributing to an overall increase in social wealth. However, Schumpeter also observed that new technologies (that is, the result of innovation) and new firms often displace old technologies and old technologies. The new technologies and new firms are better -

specifically they have a lower margincal cost or are more desirable widgets - and the old technologies lose economic value and the old firms lose profits.

This the idea of creative destruction. The old displaces new; there is not room for both of them. Marx and Schumpeter had interesting concern: what if there is too much destruction by new technology such that society destroys itself. The capitalist system is a cycle of creation and destruction, and it seems possible, on a theoretical level, that the destruction may overwhelm the construction, spelling disaster for society. While on a social level this is hard to imagine, it is somewhat easier to fathom on technological level.

This paper will explore the idea of creative destruction and its philosophical implications on technology. To whet the appetite, a few questions that will be addressed are:

- New technology technically does not "destroy" old technology; rather, it makes the old technology lose economic value.
- But, what effect does new technology have on old technology? Does it make it obsolete? Does the "idea" of the old technology change? Does the "meaning" of technology, which is contextual and socially constructed, changed due to a change in society or due to a change in technology? That question implies that technosphere, as one might call it, is distinct from society, which social constructs persuasively argue is not necessarily the case.
- Is technology still cumulative? Or in what nuanced sense is it cumulative?
- How does this idea fit into evolution?
- What role does this play in selection?
- Any effect on combination? gut says no, but not sure

1.2 Caballero and Jaffe

In our readings for philosophy of technology, Caballero and Jaffe introduced us to concept of creative destruction. Their aim is to formalize the idea of creative destruction and knowledge spillovers and complete empirical investigations:

> Our aim in this paper is to create a framework for incorporating the microeconomics of creative destruction and knowledge spillovers into a model of growth, and to do so in such a way

> that we can begin to measure them and untangle the forces that determine their intensity and impact on growth (90)

Caballero and Jaffe view the economy in a schumpeterian way: "Schumpeter recognized that innovation was the engine of growth, and that innovation is endogenously generated by competing profit-seeking firms" (90). More formally, they say the economy consists of "a continuum of monopolistically competitive good indexed by their quality $q \in (-\infty, N_t]$". In the economy, a firm that operates with constant marginal cost, i.e. a firm that does not innovating, will see their profits decline. If new good are more substitutable for old goods, then the firm will see their profits decline more quickly.

Beyond innovation, they are interested in knowledge spillovers, believing that increases in public knowledge contribute to economy wide returns. They distinguish between knowledge and technological obsolescence and creative destruction:

> "Old knowledge eventually is made obsolete by the emergence of newer, superior knowledge. We call this phenomenon 'knowledge' or 'technological' obsolescence, and distinguish it from the obsolescence in value represented by creative destruction. That is, new ideas have two distinct effects on the current stock of ideas. They make the products represented by those ideas less valuable (creative destruction or value obsolescence), and they make the knowledge represented by those ideas less relevant in the production of new knowledge (knowledge or technological obsolescence). The strength of knowledge spillovers, and hence the growth of the economy, will depend on the parameters of the processes of knowledge diffusion and knowledge obsolescence." (92)

Creative destruction is specifically the effect of new innovation on the economic "value" of products.

From a philosophy perspective, it seems overly limiting to only consider creative destruction as the impact that new creations have on the economic value of old technology. As a contrived example, consider Intel who sells CPUs. If Intel creates

2 Creative Destruction in the Theory of Technological Evolution

The aim of this section to situate creative destruction in the theory of technological evolution. Many authors have different ideas of technological evolution; however, the important component for this discussion is that there is some selection process by which fit technologies remain relevant to society. The aim of the selection process is an open question. Economists like Jaffe believe that technologies are selected because of their potential usage for economic profits [**?**]. Social constructivists believe that technologies are selected because of a complex causal web involving society, social conventions, economics, history, psychology and so on [**?**]. For our treatment of technological evolution, we do not believe it be too important how selection, but rather, it is important that selection occurs. With this in mind, we use Brian Arthur's simple explanation of selection: a technology is useful to humans [**?**]. We say that a particular technology has a use-value corresponding to how useful the technology is to society, humans, or the economy.

We now give a formal description of the selection process using the idea of use-value. At a point in time, there exist a set of technologies in society - call this set of existing technologies $\mathcal{T}$. Each technology $t \in \mathcal{T}$ has an use-value at this point in time. Suppose that a new technology u is created. Upon the creation of u, the use-value of each technology t in $\mathcal{T}$ is subject to change. The use-value of t may increase, indicating that u complements t: u and t function well together and make each other more valuable. The use-value of t may stay the same, indicating the u and t are not related. Or the use-value of t may decrease, indicating that u substitutes t: u may perform that same job as t, and hence decrease the use-value of t, or something along these lines (u may be complementary to a replacement of t - the causal relationship can be complicated) [1].

Creative destruction is concerned with the third case: where a new technology u reduces the use-value of an old technology t. Biologists identify a similar process to creative destruction occurring in the selection of species. The phenomenon is called *competitive exclusion*. Competitive exclusion is the idea that if two species are competing for the same resource, then one of the species will overcome the other, forcing the other species to adapt or die [**?**]. In recent years, observational, experimental and simulation-based

[1] We assume that use-value is 1-dimensional value: a use-value can go up or down, but not left and right. This simplification appears to be fine, but in the future, it may be useful to think of useful as a vector in vector space, allowing for more abstraction relationships and changes.

evidence has surfaced to cause Biologists to question the simplicity of competitive exclusion. We did not examine the new evidence close enough to explain here.

There is a strong a parallel between creative destruction and competitive exclusion. To use the terms of Biology, two technologies cannot coexist and rely on the same resources for their use-value, so one must either die or adapt. Technologies do not die or adapt per se, rather they either become irrelevant. And it is still an unanswered question whether a technology adapts. To Biologists, the subject which is adapting is the species, and there is no straightforward analog of a species in technology. We ignore the issue and say there is no concept of a species in technology); rather, when a technology adapts in response to competition, the technology is really giving birth a new technology, and that new technology is more fit than its parent.

The story of competitive exclusion applies well to the story of creative destruction. Does the opposite hold true? A technologist (us) would say that upon the creation of a new species (or upon the creation of a new adaptation of a species) the use-value of all other species are affected, and species whose use-values decline are in some sense destroyed. The use-value in this context is fitness - reproductive success. The species whose fitness declines sufficiently may become extinct; otherwise, the species adapt, changing their fitness. The story seems of creative destruction also seems to apply well to competitive exclusion.

The one caveat in both stories is the usage of use-value and fitness. The definition of use-value given at the beginning of this section focused on how useful a certain technology was to society. This idea has no direct relation to the reproductive power of a given technology. A technology that is more likely to reproduce is likely correlated to its use-value (although that would need to be tested empirically), but there exist technologies whose use-value remains high but they do not reproduce. The best example of this is the MRI. The MRI was invented in the 1970s, and since then it has been used widely (i.e. high/constant use-value), but few people have innovated on top of it (i.e. low reproductive success). It is quite possible that the MRI is an anomaly, and that in general, reproductive success is strongly correlated to use-value. We believe this to be true. Use-value is highly correlated to reproductive success, and use-value is a sufficient metric of fitness.

If use-value and reproductive success are not highly correlated, then there are a number of steps one could take. First, one could use reproductive success instead of use-value when describing selection and creative destruction. The theory would likely hold, but there many be detailed differences. Second, one could use this as support than technological evolution

is not darwinian: the important factor in technological evolution is not reproduction but rather the use-value of a technology [2].

2.1 Implications on the Theory of Technology

3 Philosophical Considerations of Creative Destruction

[2]This is an interesting idea. Reproductive power may not be a central component of evolutionary systems.