



Involuntary technology adoptions: How consumer interdependencies lead to societal change



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ABSTRACT

It is now well known that the technology adoption decisions of consumers depend on the number of existing adopters (Arthur, 1989) and so, the adoption decisions of consumers are interdependent. This paper investigates the societal implications of two interdependency types that are not adequately addressed in the existing literature: early adoption advantages (EAAs) and institutional change (IC). EAA corresponds to the use-value that agents create with the innovation, if they can adopt it earlier than others. Institutions are shared routines in society following the definition of Veblen (1919) and IC can be regarded as the changes in institutions that are induced by increasing levels of diffusion. In both EAA and IC, the adoption decisions of consumers depend on the number of existing adopters and this paper demonstrates that these interdependencies can lead to involuntary technology adoptions. That is, for some individuals, adoption is a worse state than their initial state before the launch of the innovation. Once it is launched, however, non-adoption becomes an even worse state. Hence, the agents adopt the innovation, albeit not happily. This implies that a society can 'lock-in' to inefficient, partially harmful or destructive technologies that entail these particular forms of consumer interdependencies.

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1. Introduction

A fundamental debate in the philosophy of technology is about the degree of control people have over technological and social change (Marx and Smith, 1994; Kaplan, 2004). On one side of the debate is technological determinism which holds that social change is driven and history is made by technological innovations, which are largely autonomous from social pressures and are following an imperative of their own (Heilbroner, 2004). On the other

side is social constructivism that holds that people are actively involved in the development and use of technology. Technology, therefore, is built with political and economic agendas and within cultural processes (Pinch and Bijker, 1987; Feenberg, 1991).

These considerations are only partially reflected in economic theories of innovation, where innovations are defined as changes in production functions or the knowledge base of agents and are regarded as the primary means of economic development (Rosenberg, 2006). Researchers focus on the value-added provided by innovations and the common perspective in the field is, almost always, optimistic. Arguably, the only concern in the field with regard to innovations is not having enough of them due to market failure (see Metcalfe, 1994 for a review). Hence,

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providing policy alternatives for supporting innovativeness and speeding up diffusion of innovations are among the major research objectives.

This paper attempts to bridge economics of innovation and philosophy of technology literatures by addressing the debated issue of control over technology within an economic framework. This framework builds upon the issue of consumer interdependencies, which is central in recent diffusion models in economics. Technology adoption decisions of consumers in a society are thought to be interdependent when costs and/or benefits of adoption vary with the number and/or characteristics of existing adopters, and so, adoption decisions of individual consumers depend on the decisions of others. In this respect, individual consumers influence and are influenced by the macro-level process while trying to maximise their own utility. By using a model of rational decision making process with consumer interdependencies, this paper demonstrates both the societal implications of such micro-level interactions and the relevance of the abovementioned considerations in philosophy to economic analyses of innovation, *even when* rationality of consumers is taken for granted.

While most of the existing literature on consumer interdependencies concentrates on increasing returns to adoption, where adoption of a particular innovation becomes more attractive as more agents adopt it, the current study puts emphasis on other interdependency types namely, early adoption advantages (EAAs) and institutional change (IC). EAA corresponds to the use-value that agents create with the innovation if they can adopt it earlier than others. The institutions modelled in this study are *shared habits of thought* and routines in a society, following the definition of [Veblen \(1919\)](#). IC refers to changes in such habits, induced by the increasing levels of diffusion of an innovation. EAA and IC are types of consumer interdependencies as in both contexts, the adoption decision of a consumer depends on the number of existing adopters. While EAA is closely related to competition between society members, the need to coordinate in new shared habits is at the core of IC.

This paper presents an agent-based simulation model of diffusion and studies societal implications of these interdependencies under different scenarios. The results of the simulation experiments provide new insights about the diffusion process. The results indicate that EAA and IC can have counterintuitive effects both at individual and societal levels. At the individual level, they can create *involuntary technology adoptions*. This concept, which is central for the main thesis of this paper, may seem unusual and obscure within the context of rational decision making. Hence, it may be helpful to clarify what is meant by it at the beginning. If an adopter of an innovation would have in fact preferred that this innovation was never launched, her adoption will be called involuntary for the purpose of this study. At the societal level, EAA and IC can lead a society to lock-in to an innovation even when it is not creating any value-added. Here, the paper distinguishes between the value of innovations at the individual and societal levels. It points out that innovations can re-distribute existing values in a society and thereby attract adopters without creating any additional value at the societal level.

The rest of this paper is organised as follows: the next section presents a review of the theoretical background of this study covering some of the major considerations in the philosophy of technology literature and the diffusion of innovation models in economics. The third section introduces the agent-based model used in the simulation experiments by explaining the way pseudo-societies are generated and the innovation decisions of agents are modelled. The fourth section reports the results of the simulation experiments under different scenarios. The fifth and sixth sections cover discussions on the results and the conclusions respectively.

2. Theoretical background

This study develops ideas and findings from different disciplines and this section presents a summary of this synthetic background. The section consists of two subsections. First, it presents a short review of the abovementioned debate in the philosophy of technology literature. Second, it presents a critical review of diffusion of innovations models in economics and identifies the gaps in the literature, which are addressed in the current study.

2.1. Technological determinism versus social constructivism

The importance of the issue of control over technological change has become evident at least since destruction of our world has become technologically possible. [Heidegger \(1969, p. 56\)](#) famously said that progress of history could not be broken by any person, leader, group or organisation in the atomic age. The issue, however, is not limited to potentially catastrophic effects of weapons of mass destruction. Many, if not all, aspects of daily life are shaped by technology and the viewpoint that a well-diffused technology generates a new kind of society is implied in popular expressions like the *steam age* or the *information age* ([Murphy and Potts, 2002](#); see also [Marx and Smith, 1994](#)).

While control over technology is a multifaceted issue, the idea that technological developments are autonomous from social reality is at the centre of many determinist views. For [Heilbroner \(2004\)](#), for example, technology follows a determinate course, which means that there is “*a necessitous path over which technologically developing societies must travel*” (2004, p. 8). Heilbroner suggests existence of law-like causal links between the impact of technology and history. [McLuhan \(1967\)](#) recognises the role of people in the development of technology. However, for McLuhan, this involvement cannot be taken as control, since it is people who are serving for the development of technology and not vice versa. He argues that people serve the development of new types of machines just like bees help plants to reproduce. [Ellul \(2004\)](#) recognises the political and economic impacts on technology. Yet he argues that in a conflict between politics and technology, politics would undoubtedly lose out and a political intent going against the technological imperative will be self-destructive. Therefore, the autonomy Ellul describes does not necessitate being completely detached from social contexts.

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