

Paper Session

[H15] Taking giants by the hand: Simulating policy mixes to drive technological transitions of incumbent firms

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This paper investigates how applying different combinations and sequences of innovation policy measures affect the direction of technological development by incumbent firms and its implications for socio-technological transitions.

First, the paper uses technology design theory to conceptualize technological development. Technologies are seen as modular entities that can fulfill a variety of services. For example, gasoline and electric cars are both complex automotive technologies that fulfill the service of individualized transportation across longer distances. Yet, the routines, processes, and technological components from which and through which these products are made differ, and so do several ancillary services, such as providing low-emission transportation, or permitting driving long distances.

Second, the paper takes the view that the agents that develop these technologies are primarily incumbent firms that search a technological design space for new service-enhancing innovations. In addition, these agents are also a source of social capital, employment, and knowledge and have the resources and power to contribute to a socio-transition. Incumbent firms affect the process of technology development when they focus their development efforts on a specific direction of technological development, or when they diversify their technology portfolio. These choices affect the firm's likelihood of survival. Policy measures and mixes thereof can influence the direction of technology development by incumbent firms by affecting the relative value and appeal of the various technologies. In this way, policy can align firms to contribute to a specific technological transition.

Third, the paper develops a generic framework on how policy measures affect the direction and degree of diversification of firms' technological development. The framework consists of two generic policy dimensions that can be used positively or negatively: binding regulations (i.e. forbidding or obliging) or incentivizing (i.e. favoring or disadvantaging). These policy dimensions can be applied to the routines of the firm and/or to technological services that their products provide. Importantly, policy mixes can affect different dimensions at the same time, or in sequence. We illustrate these measures in the context of two industries with large incumbent players for which there is a need for transition: the car industry and the food industry. Lastly, the socio-technical landscape in which these firms operate can fluctuate and thereby influence the direction of technological development.

We test the effectiveness of various binary sequences and combinations of policy measures under different landscape dynamics on technology development using an agent-based model that is based on Kauffman's NK-model. In this model, agents represent the incumbent firms. Different combinations of firm routines lead to different services. The combination of services provided by a firm's products affects the firm's fitness and, in turn, influences its likelihood of survival.

Our results shed light on the micro-level processes through which policy measures can immediately and cross-temporally interact to affect the prevalence of desired and undesired technological services in a socio-technical system. Successful policy mixes, do not just lead to high levels of technological desired services, but also minimize the disruption of social systems by maintaining a high level of incumbent firm survival.