Chapter 7
Science Policy in a Socially Embedded Economy

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What happens to science policy when neoclassical economics loses its dominant grip over the economic policy debate? To take on this question, one needs to consider differences in policy implications between traditional economics and its main alternative, the idea of a socially embedded economy. For at least a century, economists have developed a specific way of analysing social reality, separating them from most other social sciences. Since the late nineteenth century, with inspiration from the contemporary natural sciences, in particular physics, they have sought to impose a rigorous methodological paradigm on the study of economic phenomena. Deductively departing from assumptions of maximising and perfectly rational actors that possess perfect information as well as perfect cognitive abilities, economists could construct mathematically elaborate models for how the economy *would* work – *if* economic actors really were rational in that sense. Of course, neoclassical economists admit that real-life actors do not conform to this stylised image of rationality, but they find simplification and abstraction to be acceptable steps in order to analytically isolate the essential causal relationships in the economy (see, e.g. Friedman 1953).

This emphasis on the design of counterfactual and ideal-typical models among economists has distanced them from actual empirical occurrences of economic action and thus also from other social sciences that may be significant to understanding the economy. Business economists, economic historians, sociologists, anthropologists, economic geographers and political scientists cannot help but take on the economy as an important part of the reality they study, but their more empirically oriented

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research results are not easy to integrate with a focus on deductive modelling. As a consequence, not much communication takes place between neoclassical economists and other social sciences.[1]

The economic sphere that emerges from the deductive methodological paradigm is to a large degree abstract and separated from complex issues like culture, institutions, historical legacies and sociological dynamics. For the formulation of economic policy, this has some interesting consequences. As the stylised abstract economy is viewed by neoclassical economists as a self-regulating system gravitating towards equilibrium, if it is left alone, the general policy prescription is that the government should abstain from interfering. But if the government wants to conduct economic policy, there are a limited number of levers to pull on: the manipulation of the government budget through fiscal policy, the setting of interest rates and exchange rates and the adjustment of monetary supply. Neoclassical economic thinking can offer little legitimacy for the government to venture outside this narrow definition of the economic sphere when it formulates public policy.

Although the idea of an abstract economic sphere that is distinct from its social surroundings maintains a strong position in academic departments and among policymakers around the world, it has not gone unchallenged. In 1944, Karl Polanyi argued in *The Great Transformation* that the separation between the social and the economic was a fiction that had emerged in the historically specific period of nineteenth-century industrialisation, a fiction that it would be impossible to sustain in the long run. Land, labour and capital were not the freely mobile commodities that economic theory expected them to be, but deeply embedded in social relations. The project of severing those social relationships and making the world conform to theory risked destroying workers and capitalists alike, creating powerful forces intent on re-embedding the economy in its social context (Polanyi 2001 [1944]).

Polanyi was undoubtedly a source of inspiration when sociologists in the 1980s stopped leaving the economic sphere alone and employed their sociological toolbox to understand the social relations that underpinned economic phenomena, launching the research programme of economic sociology (see Granovetter 1985; Smelser and Swedberg 1994). At roughly the same time, some heterodox economists began exploring the possibility of changing the foundations of economic theory and make it increasingly incorporate the social and institutional aspects of reality. Richard Nelson and Sidney Winter (1982) wanted to analyse economic development as analogous with biological evolution, focusing on how firms developed different routines and faced selection mechanisms. Their aim was to move economics closer to the empirical world and to facilitate cooperation with other social sciences. Douglass

[1] On the emergence of neoclassical economics and its separation from other social sciences, see Hodgson (2001). Of course, this image of economics is partly a caricature. Some economists have interested themselves in problems of bounded rationality (Simon 1955), institutions (North 1990), path dependence (David 1985; Arthur 1994) and stylised versions of technological change (Romer 1990). While this has increased complexity in the assumptions underlying some of the constructed models, economists still remain wedded to abstract deductive thinking more than other social sciences.

North (1990) made an influential effort to include institutions in economic analysis that awarded him a Nobel Memorial Prize in Economic Science.

In short, from the late 1970s and onwards, a group of scholars questioned the distinction between economic and social spheres, arguing that they were both deeply embedded in each other. Economic analysis had to take the social and institutional into account, even if it meant increasing complexity and making advanced modelling more difficult. Being an economic historian, I have a lot of sympathy for the idea of a socially embedded economy. This chapter, though, will rather discuss the often-unanticipated effect that this change of view has on policy. As we saw, traditional economic theory prescribed a quite limited field for government intervention. However, in a socially embedded economy, the whole social world is opened up for potential policy manipulation. Proponents of social embeddedness have so far mainly fought against neoclassical economics. They have paid little attention to the possibility that their increased influence in the debate could be used to legitimise policy intervention in new areas, a development they do not necessarily find desirable.

The Marxist sociologist Bob Jessop (2002, 2008) touches on this expansion of the policy sphere in his analysis of different modes of capitalist regulation and accumulation. According to him, a transition is occurring from a Keynesian welfare national state (KWNS), based on Fordist mass production and mass consumption, to a Schumpeterian competition state, emerging as a response to the crisis of the Fordist production system. This new form of state is in general more globalised, deregulated and focused on facilitating competitiveness, entrepreneurship and innovation. As a consequence, he argues that previously accepted distinctions between economic and extra-economic spheres have disintegrated and that an economic logic increasingly is colonising areas that once were considered to be residing outside the economy, such as science policy or social policy. However, this trait is only one of the many components in the type of capitalist state he discusses. While he links the whole aggregated transformation into a Schumpeterian competition state to broad changes in the mode of production and in economic discourse, the interesting process of colonisation into extra-economic spheres and its relation to economic theory still remains to be singled out for deeper inquiry.

In general, science has received relatively less attention from neoclassical economists than technology and innovation. In the few instances that science was more directly discussed, there was no inclination to support the kind of economistic colonisation that Jessop described. This is illustrated in how economists (and other social scientists) applied thought models and analogies from economics, when they tried to understand the scientific system in the 1960s. Drawing on the theory of public goods, some economists were concerned that private business would underinvest in research, leading them to support government investments in basic science (Nelson 1959; Arrow 1962). Other analysts viewed the scientific community as similar to a self-regulating market, where an invisible hand automatically coordinated scientific activities in the most efficient possible way and where government intervention would only serve as a distortion (Polanyi 1962; Tullock 1966). In sum, the neoclassical approach to science policy appeared to consist of generous funding for

the scientists, who were then left alone.[2] Later on, the economists Partha Dasgupta and Paul David attempted a more thorough analysis of the inner workings of scientific knowledge production, but they still cautioned that "[…] the social mechanisms that allocate resources within the Republic of Science are still too little understood, and remain vulnerable to destabilizing and potentially damaging experiments undertaken too casually in the pursuit of faster national economic growth or greater military security" (Dasgupta and David 1994, p. 518).

In the following, I will address the evolution of innovation thought since World War II, an area where the idea of a socially embedded economy was particularly efficient in dislodging neoclassical economics and gaining the attention of policymakers. Then I will take a look at Swedish research and innovation policy to illustrate that theoretical shifts in how the economy is perceived can be used to legitimise policy intervention outside the traditional economic sphere.

Development of Innovation Theory

After the Second World War, statistical measures of national income greatly improved in quality (Vanoli 2005). This became a stimulus for economists to study the causes of long-term economic growth, as well as the difference in growth rates between countries. For neoclassical economists, factors of production like labour and capital determined the level of output. Increasing those inputs led to growth in production, but that growth was subjected to diminishing returns that eventually evaporated the usefulness of adding additional units. Technological change was however expected to shift the production function and overcome the diminishing returns, enabling continuous growth. Economists thus admitted that technical change was of vital importance to economic growth, but at the same time, it was residing outside their models. They could not explain how and why technological change occurred using their standard neoclassical methodology and had to accept it as given by exogenous factors. Empirical studies of the causes behind long-term growth, so-called growth accounting, showed that inputs of labour and capital could only explain a small part of the growth rates, leaving a large residual that was assumed to mainly consist of technological change (Nelson 1997).

Neoclassical economists found themselves in a peculiar situation. Economic growth was the main source of prosperity, yet the factors that resided inside their deductive models could only account for a minor part of it. Technological change, supposedly the most important factor behind growth, was such a complex phenomenon that it was virtually impossible to stylise and incorporate into economic models.[3]

[2] For a similar analysis of the relationship between neoclassical economics and science policy thinking, see Guston (2000), pp. 66–70.

[3] Endogenous growth theorists like Paul Romer and Robert Lucas would try, but without impressing more empirically oriented students of innovation. Richard Nelson (1997) argued that whatever insights those models produced, they had already been known by empirical innovation research for years. Moreover, endogenous growth theorists only selected those aspects of technological change that was possible to model, disregarding the institutional framework and the organisation of production in firms.

During the golden years of economic growth in the 1950s and 1960s, this did not appear to be a very urgent problem. However, the 1970s saw a period of low growth, high unemployment and high inflation. For the Keynesian economists that had dominated the economic policy debate during the growth years, the combination of unemployment and inflation (stagflation) had been theoretically unlikely. This contributed to delegitimising their way of perceiving the economy and opened up the stage for new and alternative viewpoints.

The field of innovation studies soon emerged as a participant in that debate. In the 1960s and 1970s, there was an increase in empirical research of innovation processes, which pointed out their chaotic and variable nature, as well as how they crucially depended on institutional and social factors. Nathan Rosenberg in particular repeatedly demonstrated the complex and interactive feedback loops between various institutions and actors as new technology was developed and diffused (see Rosenberg 1976, 1982; Kline and Rosenberg 1986). For these empirically oriented scholars, the neoclassical paradigm did not seem to have much useful to offer when they tried to understand the nuances of innovation. Instead, most of them adopted Nelson and Winter's evolutionary economics and North's institutional economics as a more suitable theoretical foundation for their project.

Starting in the 1980s, Bengt-Åke Lundvall and Christopher Freeman began using the concept of *innovation system* more or less independently of each other. Lundvall (1985) was interested in the communication between users and producers in the innovation process and how social, cultural and institutional factors could affect the quality of that communication. He expected that culturally homogeneous settings were particularly beneficial for innovation, as the important actors were likely to speak the same language and share the same cultural codes. Writing before the Japanese sluggish growth in the 1990s, Freeman (1987) dealt with the causes behind its comparative success in the 1980s. While not so good at producing radical innovations of its own, Japan excelled at receiving technology from abroad and incrementally improving it. Behind this accomplishment lays a rich history of technology import and reverse engineering, cultural similarities between production and R&D departments, a good educational system and workplace training as well as an activist government that identified and supported promising technologies.

For both Lundvall and Freeman, the innovation system was the social, cultural and institutional environment that supported the aspects of innovation they were interested in, be it user-producer communication or the successful import and improvement of existing technologies. Soon the concept aroused the interest of other social scientists and became a focusing device for a number of anthologies on innovation and policy (e.g. Lundvall 1992; Nelson 1993; Edquist 1997). Simultaneously, international organisations like the OECD and the European Commission picked up the concept and incorporated it into their policy recommendations. These organisations were less hierarchical than the World Bank or the IMF and were more likely to accept the coexistence of heterodox innovation thinking alongside neoclassical economics (Mytelka and Smith 2002). In particular, the Directorate for Science, Technology and Industry at the OECD became a haven where economic theorists critical of the neoclassical paradigm could thrive. Many of the leading innovation scholars worked at the Directorate, and Bengt-Åke Lundvall served as its deputy

director between 1992 and 1995 (Mytelka and Smith 2002; Sharif 2006). From the outside, the innovation system concept seemed to come with an OECD seal of approval, filled with legitimacy from the organisation as well as from its academic founders (Albert and Laberge 2007). Many countries adopted it in their policy rhetoric, with Finland using it as a foundation for its technology policy as early as 1990 (Miettinen 2002).

While the concept has been enormously successful in the academic and policy world, it is notoriously difficult to pin down the precise definition of an innovation system. Although it can be loosely defined as the socioeconomic environment's effect on the quality and direction of innovative activity, different analysts focus on different aspects of innovative activity, as well as on different parts of the surrounding environment.[4] Therefore, the concept should rather be viewed as a broad research programme, assembling a wide assortment of social scientists from various disciplines, all of them wanting to bring some combination of institutions, history, culture or sociological dynamics into the field of innovation studies. In that way, the concept embodies the very idea of a socially embedded economy that started to challenge neoclassical economics at roughly the same time.[5]

The success of the innovation system concept has encountered some criticism, in particular with respect to how it affects government science policy. Benoît Godin argues that "[t]he National Innovation System framework suggests that the research system's ultimate goal is innovation […]." (Godin 2009, p. 476).[6] Mathieu Albert and Suzanne Laberge (2007, p. 226) make a similar claim:

> The […] IS [innovation system] approach is essentially based on an "economistic" vision of ST [science and technology] and, broader still, an economistic worldview. The IS approach emphasizes the economic value of ST knowledge and sees business as the primary tool for increasing the prosperity of the population. ST are thus primarily regarded in an instrumental capacity, as a way of fostering economic growth through enhancing the competitiveness of business.

Some of the early proponents of the concept, many of them with a background as Marxists and with sympathies for the political left, would be disappointed by descriptions of the innovation system concept as a business-friendly "economistic" approach that treated the research system instrumentally and reduced it to facilitating innovation. In the late 1980s, the founding fathers of the concept rather saw themselves as presenting a centre-left alternative to the neo-liberalism of Margaret Thatcher and Ronald Reagan (see Sharif 2006). In particular, Bengt-Åke Lundvall

[4] This is demonstrated in the extensive variety of innovation systems, including national, regional, sectoral and technological innovation systems.

[5] It should be noted that the diversity of the research programme translated into a rather heterogeneous relationship with neoclassical economics. Some innovation system scholars with a background in economics could import many of the neoclassical assumptions, while adding the importance of institutions. Other scholars were more likely to make a radical departure from the neoclassical way of viewing the world.

[6] See also Widmalm (2008, 2009).

had for a long time warned about the dangers of transforming the academic mode of knowledge production and incorporating it into a system focused on innovation:

> If the academic mode of knowledge production is undermined and replaced by a profit-oriented mode of production, where pecuniary incentives become more important and where secrecy regarding the output becomes more frequent, the academic mode of behaviour may lose one of its principal merits – the tradition for world-wide diffusion of knowledge. […] National Systems of Innovation may temporarily become strengthened when universities become subordinated to industry. In the long run, the production and world-wide distribution of knowledge may become weakened. (Lundvall 1988, p. 364 f., see also Lundvall 1985 and Lundvall 2006)

For Lundvall, it was important to maintain a degree of autonomy that protected university knowledge production against interference, both from economic interests and from the state. A too close relationship risked damaging the credibility of research. He made a comparison with the autonomy given to central banks in order to safeguard the credibility of money (Lundvall 2006).

In later years, Lundvall expressed dissatisfaction with how the innovation system concept had developed as it travelled from the academic world to the policy world. He complained over how it had "degenerated" and how it had been "abused" and "distorted" compared to the connotations he originally intended for it (Lundvall 2006, pp. 2, 10, 14). The creators of the innovation system concept and their ideals, contrasted against later descriptions of the concept as economistic and instrumental, serve as an example of the "death of the author" in the social sciences. Especially when concepts come into use in the policy world, their creators can no longer claim exclusive ownership over them or expect to control the trajectory of their historical development.

Legitimising Swedish Research Policy

Swedish research and innovation policy constitutes an interesting example of how the idea of a socially embedded economy, as embodied in the innovation system concept, can be used to legitimise policy intervention in areas outside the traditional economic sphere. Of course, efforts to regulate and govern the university sector predate such shifts in economic theory. For example, consider John Bernal's (1939) Marxist argument for the planning of scientific research as part of a generally planned economy. But I will show that the idea of a socially embedded economy provided a new source of legitimacy for these attempts. Also, it shifted the focus from scientific research as a solver of wider societal problems to research more narrowly defined as a factor behind innovation and economic growth.

Since the Second World War, Sweden differed from most other countries in its research policy. In order to avoid a separation between education and research, policymakers discouraged the growth of research institutes. Instead, universities were expected to act as research institutes for all societal needs. This dual role as both university and research institute was to introduce some strain in the Swedish research

system. In the 1960s and 1970s, government agencies increasingly asked universities to perform research in order to improve performance in their policy areas, such as education, spatial planning, agriculture, environmental preservation, energy or working life issues. This type of research became known as sectoral research, and it was instrumentally oriented towards solving societal problems. In the 1980s, some university researchers started to criticise the universities' increased reliance on sectoral research money, arguing that it threatened university autonomy and that sectoral research tended to be of poor scientific quality. To create a workable balance between regular university activities and externally funded sectoral research, it was argued that free basic science needed an additional boost and that university researchers rather than bureaucrats should control the funding of sectoral research. As a consequence, many government agencies funding sectoral research were instructed to implement structures similar to research councils within their organisations (see Stevrin 1978; Nybom 1997; Persson 2001).

While proponents of a research system oriented towards the solving of societal problems had been forced into defensive positions in the 1980s, they gained more influence in the 1990s. In 1994, the Social Democrat Carl Tham took over as minister of education and set out to reform the university sector and make it more receptive of societal needs. To him, universities were hierarchical and old-fashioned institutions, whose practitioners worked in a tradition that made them disregard the social implications of their research. If researchers were left to follow their own curiosity, areas of vital importance to society risked being neglected by research. The solution was to regulate the university sector and bring it firmly under "democratic" control. In the research bill he presented in September 1996, there was a general emphasis on promoting the social relevance of research. Still, the intention was to make research relevant to *all* of society, and there was no privileging of industrial needs or innovation. In fact, the word innovation was rarely mentioned in the bill (Prop. 1996/97:5, see also Benner 2001; Eklund 2007).

Attempts to strengthen public control over the university sector were met with furious opposition from some researchers. In November 1998, a government investigation considering reforms of the public research funding system largely sided with the researchers that wanted to defend their autonomy (SOU 1998:128). The report, named *Research 2000*, argued that it was impossible to predict the usefulness or relevance of research in advance. Instead, researchers should increasingly be free to follow their scientific curiosity, which in the long run would be most beneficial to societal needs. More specifically, the investigation argued that the sectoral funding of research from government agencies should be transferred to research councils controlled by academic researchers. When the report was published, Carl Tham had already resigned as minister of education, and it was uncertain if his ministry could be relied on as a partner for proponents of socially relevant research. The ministry of industry and several of the agencies sorting under it risked having large parts of their research funding transferred to research councils.

A loose coalition soon formed, consisting of the ministry of industry, the agency for industrial and technical development (Nutek) and the trade unions and industry organisations that were associated with the industrial sector. When they mobilised

to protect the future of sectoral research, they found inspiration in the innovation system concept that had become increasingly popular in the OECD. Critics of *Research 2000* introduced the concept into the Swedish research policy debate and were able to rhetorically frame the universities in a new light. Replacing the traditional notion of universities as autonomous institutions where scientists followed their curiosity wherever it led them, universities could instead be presented as components of a system whose main function was to promote innovations. If the performance of the system depended on collaboration and communication between its components, it was not advisable to encourage the kind of university autonomy that *Research 2000* had suggested. Moreover, it was argued that other countries in the OECD had transformed their research policy into an innovation policy and that Sweden risked falling behind if it did not follow their example.[7]

The introduction of the innovation system concept into Swedish policy discourse was quite successful. In January 2001, the Swedish Governmental Agency for Innovation Systems (VINNOVA) was founded, taking on large parts of the sectoral research funding (the rest was transferred to research councils, just as *Research 2000* had proposed). Thus, an organisation remained where bureaucrats rather than researchers could control the funding of research based on relevance, fittingly named after the concept that had served so well in the defence of societal influence over research funding (Benner 2001; Eklund 2007).

Conclusion

It may seem ironical, but university autonomy was for a long time protected by the unrealistic assumptions of neoclassical economics. The construction of an abstract economic sphere that was separated from its social surroundings, coupled with the near-hegemonic position of economists in the policy debate, is to thank for this state of affairs. With a self-regulating economy (sometimes fine-tuned by government policy) presented as the only theoretically endorsed source of wealth, neoclassical economics effectively suppressed discursive linkages between elements in the extra-economic sphere and prosperity. This separation of spheres was also reinforced by the application of thought models from neoclassical economics, such as the theory of public goods and the self-regulating market, which encouraged policymakers to fund scientists and then leave them alone. However, as the idea of a socially embedded economy gains ground, these protective walls are gradually coming down. More and more social science models emerge that declare university research to be the main source behind innovation and economic development, going under various headings such as Mode 2, Triple Helix – or innovation systems.

It is not necessarily a bad thing that proponents of university autonomy increasingly will have to live without the artificial protection of neoclassical economics. First of

[7] For an example of this argumentation, see Arnold et al. (1999).

all, I think it is scientifically fruitful to incorporate the social world into economic analysis and to create a more pluralistic field, where the neoclassical approach is only one of the many legitimate ways to study the economy. An increased vulnerability to economistic thinking, which exclusively views science as a source of innovation and crowds out its other functions, may be a price worth paying for that development. Second, the case for university autonomy and the preservation of free curiosity-driven research is strong enough in itself and does not need to be safeguarded by neoclassical economics. What is needed is rather an awareness of the new situation that is emerging after the end of neoclassical dominance, a situation that is characterised by both risks and opportunities.

References

Albert, M., & Laberge, S. (2007). The legitimation and dissemination processes of the innovation system approach: The case of the Canadian and Québec science and technology policy. *Science, Technology & Human Values, 32*(2), 221–249.

Arnold, E., Whitelegg, C., & Thuriaux, B. (1999). *Research 2000 or research 1950? Forskning 2000 and the future of state research funding in Sweden*. Brighton: Technopolis.

Arrow, K. (1962). Economic welfare and the allocation of resources for invention. In R. Nelson (Ed.), *The rate and direction of inventive activity* (pp. 609–626). Princeton: Princeton University Press.

Arthur, B. (1994). *Increasing returns and path dependence in the economy*. Ann Arbor: University of Michigan Press.

Benner, M. (2001). *Kontrovers och konsensus: vetenskap och politik i svenskt 1990-tal*. Stockholm: SISTER.

Bernal, J. (1939). *The social function of science*. London: George Routledge.

Dasgupta, P., & David, P. (1994). Toward a new economics of science. *Research Policy, 23*(5), 487–521.

David, P. (1985). Clio and the economics of QWERTY. *The American Economic Review, 75*(2), 332–337.

Edquist, C. (Ed.). (1997). *Systems of innovation: Technologies, institutions and organizations*. London: Pinter.

Eklund, M. (2007). *Adoption of the innovation system concept in Sweden*. Uppsala Studies in Economic History, 81. Uppsala: Acta Universitatis Upsaliensis.

Freeman, C. (1987). *Technology policy and economic performance: Lessons from Japan*. London: Pinter.

Friedman, M. (1953). The methodology of positive economics. In M. Friedman (Ed.), *Essays in positive economics* (pp. 3–43). Chicago: Chicago University Press.

Godin, B. (2009). National innovation system: The system approach in historical perspective. *Science, Technology & Human Values, 34*(4), 476–501.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *The American Journal of Sociology, 91*(3), 481–510.

Guston, D. (2000). *Between politics and science: Assuring the integrity and productivity of research*. Cambridge: Cambridge University Press.

Hodgson, G. (2001). *How economics forgot history: The problem of historical specificity in social science*. London: Routledge.

Jessop, B. (2002). *The future of the capitalist state*. Cambridge: Polity Press.

Jessop, B. (2008). A cultural political economy of competitiveness and its implications for higher education. In B. Jessop, N. Fairclough, & R. Wodak (Eds.), *Education and the knowledge-based economy in Europe* (pp. 13–39). Rotterdam: Sense Publishers.

Kline, S., & Rosenberg, N. (1986). An overview of innovation. In R. Landau & N. Rosenberg (Eds.), *The positive sum strategy: Harnessing technology for economic growth* (pp. 275–305). Washington, DC: National Academy.

Lundvall, B. (1985). *Product innovation and user-producer interaction*. Aalborg: Aalborg University Press.

Lundvall, B. (1988). Innovation as an interactive process: From user-producer interaction to the national system of innovation. In G. Dosi, C. Freeman, R. Nelson, G. Silverberg, & L. Soete (Eds.), *Technical change and economic theory* (pp. 349–369). London: Pinter.

Lundvall, B. (Ed.). (1992). *National systems of innovation: Towards a theory of innovation and interactive learning*. London: Pinter.

Lundvall, B. (2006). *Innovation systems between theory and policy*. Paper presented at the Innovation Pressure Conference, Tampere, March 2006.

Miettinen, R. (2002). *National innovation system: Scientific concept or political rhetoric*. Helsinki: Edita.

Mytelka, L., & Smith, K. (2002). Policy learning and innovation theory: An interactive and co-evolving process. *Research Policy, 31*(8/9), 1467–1479.

Nelson, R. (1959). The simple economics of basic scientific research. *Journal of Political Economy, 67*(3), 297–306.

Nelson, R. (Ed.). (1993). *National innovation systems: A comparative analysis*. Oxford: Oxford University Press.

Nelson, R. (1997). How new is new growth theory? *Challenge, 40*(5), 29–58.

Nelson, R., & Winter, S. (1982). *An evolutionary theory of economic change*. Cambridge: Cambridge University Press.

North, D. (1990). *Institutions, institutional change and economic performance*. Cambridge: Cambridge University Press.

Nybom, T. (1997). *Kunskap, politik, samhälle: essäer om kunskapssyn, universitet och forskningspolitik 1900–2000*. Hargshamn: Arete.

Persson, B. (2001). *Motsträviga myndigheter: sektorsforskning och politisk styrning under 1980-talet*. Stockholm: SISTER.

Polanyi, M. (1962). The republic of science: Its political and economic theory. *Minerva, 1*(1), 54–73.

Polanyi, K. (2001 [1944]). *The great transformation: The political and economic origins of our time*. Boston: Beacon.

Prop. 1996/97:5. *Forskning och samälle*.

Romer, P. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5), 71–102.

Rosenberg, N. (1976). *Perspectives on technology*. Cambridge: Cambridge University Press.

Rosenberg, N. (1982). *Inside the black box: Technology and economics*. Cambridge: Cambridge University Press.

Sharif, N. (2006). Emergence and development of the national innovation systems concept. *Research Policy, 36*(5), 745–766.

Simon, H. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics, 69*(1), 99–118.

Smelser, N., & Swedberg, R. (Eds.). (1994). *The handbook of economic sociology*. Princeton: Princeton University Press.

SOU 1998:128. *Forskningpolitik*.

Stevrin, P. (1978). *Den samhällsstyrda forskningen: en samhällsorganisatorisk studie av den sektoriella forskningspolitikens framväxt och tillämpning i Sverige*. Stockholm: Liber.

Tullock, G. (1966). *The organization of inquiry*. Durham: Duke University Press.

Vanoli, A. (2005). *A history of national accounting*. Amsterdam: Ios Press.

Widmalm, S. (2008). History of science in the age of policy. In M. Beretta, K. Grandin, & S. Lindqvist (Eds.), *Aurora Torealis: Studies in the history of science and ideas in honor of Tore Frängsmyr* (pp. 259–275). Sagamore Beach: Watson Publishing International.

Widmalm, S. (2009). Innovationssamhället. In M. Benner & S. Sörlin (Eds.), *Forska lagom och vara världsbäst: Sverige inför forskningens globala strukturomvandling* (pp. 108–133). Stockholm: SNS.