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Technology clusters: A cross-national analysis of geographical differences

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Abstract

The study explores a topic almost neglected by geographers, providing a conceptual framework to analyze factors affecting technological inertia or change of regions. Path dependence is a concept able to explain how the past shapes the future also in innovation studies. Despite the key concept that in a sequence of events, the latter decision to adopt a technology depends on past decisions, the literature highlights the two main models of path dependence. The study offers some interesting elements for future research.

Keywords: Cross-National Analysis, Economic Geography, Technology

1. Introduction

Neo-institutionalist theorists and geographers embraced path dependence perspective in order to explain how institutions affect the development of some regions (De Vecchis and Salvatori, 2015; North, 1990). Path dependence is a concept able to explain how the past shapes the future also in innovation studies. According to this view, in a sequence of events the latter decision to adopt a technology depends on the past decisions of actors. Embracing neo-institutionalism's perspective that path dependence affects trajectories of innovation diffusion, we raise the question of which factors can explain the technological change or inertia of some regions of the world (Salvatori, 2005).

The literature highlights two main models of path dependence. The first model stresses that innovation diffusion and its subsequent persistence leads to technological inertia. The second model shows that the combination of several events leads to changes (Prezioso, 1993). In both cases policy-makers can assume a central position in influencing the social diffusion of one technology rather than another. Specifically, policy-makers can support the diffusion of innovations through general, supply-side and demand-side policies (Vecchio, 2012; Suriñach et al., 2009).

Combining path-dependence models of technology diffusion and government policies we

offer a general framework to explain the success and failure of new technology diffusion. Then, we present a typology of regions in which we relate the deterministic path dependence model and the development approach with success and failure in the diffusion of new technologies (Baumann, 2003; Collinson, 1994). Thus, we use our framework to discuss Venezuela, Germany, England and Silicon Valley as cases of success or failure.

The study explores a topic almost neglected by the geographers, providing a conceptual framework to analyze factors affecting the technological inertia or change of some regions in the world. In so doing it also offers some interesting elements for future research. In section I we present two path-dependence models. In section II we discuss some cases of success and failure. Finally, in section III we present the conclusions.

2. Theoretical framework

The deterministic path dependence model shows that when a technology becomes dominant, the likelihood that the actors will divert from that path progressively declines. Once a critical mass of individuals has adopted the technology, a positive feedback process will stabilize what Ebbinghaus (2005) calls the "trodden trail", as ever more people orient their decisions based on the perception that a sufficient number of other people have already done so. Several conditions are crucial for the deterministic path dependence model as this model assumes an equal starting point with the same probability of adopting all technologies. Among multiple options, the technology that will be most adopted depends on chance during the early stages of diffusion (Ebbinghaus, 2005). Social mechanisms of self-reinforcing are responsible for one alternative to take a lead over others. Thus the diffusion of a technology occurs through network effects (Hall and Khan, 2003). The once established institutions become locked-in through path dependent self-reinforcement. As a consequence of this social process, the adoption of a technology will become stabilized. As more and more people adopt a technology, the return to its use will increase and social processes will continue to reinforce its inertial diffusion even though an alternative technological route might be possibly more efficient (Cotesta, 1999; Galieni 2000). For the continuity of our argument, it is important to state, however, that path dependence explains the institutional characteristics of a certain country (Coccia, 2004; Faccioli, 2004). Boyer (2005), for instance, argues that countries combine the diverse coordinating mechanisms that exist in different proportions: as well as states and markets, also communities, networks, associations, and private organizations. These different proportions at which coordinating mechanisms are combined by each country to a certain extent explain what each country specializes in producing.

In contrast to the deterministic path dependence theorem that assumes that chance events will have long-term consequences on technology inertia, the developmental approach – or what one may alternatively call "nondeterministic path-dependence" (Ebbinghaus, 2005) – focuses on the possibility of social actors bringing about change. While in the deterministic path dependence model change happens due to exogenous shocks, in the developmental approach a new technology may emerge as dominant in a critical juncture at which collective strategic actors make new choices. In a similar way, Crouch (2009) reconstructs the path dependence theory in order to propose what he calls "recombinant governance". According to this concept, strategic actors may use their influence in order to steer institutional change into new directions, hence creating new path dependencies. Hence, in the developmental approach technology may become dominant because of conscious choices by collective actors (Landuzzi et al., 1995; Lizza, 1991). The selection of a pathway is, thus, the result of a collective choice in a window of possible alternative opportunities. Earlier decisions, once institutionalized, structure the alternatives of later ones creating a new path (Rokkan, 1999). At this point collective actors decide which of the available alternative technologies they want to adopt. Thus, the subsequent process of diffusion depends on a self-reinforcing process. In this case, the self-reinforcing processes of diffusion of previous technology come to an end and innovations are established in its stead (De Rubertis and

Lazzeroni, 2005). Thus, positive feedback allows for the societal acceptance of a new technology affecting regional development.

3. A geographical analysis

In this section we present a typology of countries/regions in which we relate the deterministic path dependence model and the development approach with success and failure in new technological diffusion, as it appears in the literature.

The example that relates deterministic path-dependence with failure in technological diffusion is that of Venezuela. Oil resources mould the structure of organized interests and the state itself. When a petro-state is awash with oil revenues while at the same time not organizationally mature, there is fertile terrain for the action of "rent seekers". The most probable outcome is then the so-called "resource curse", when a country is not able to transform its mineral wealth into generalized well-being. As a matter of fact, it is known that until President Hugo Chavez's presidency, who took office in 1998, Venezuelan oil revenues were largely wasted. Chavez started using those revenues in order to improve social indicators, such as health and education, having achieved great success. Venezuela is very rapidly constructing cultural capital that may lead to change in the future (cultural measure, on the demand side). Nevertheless, Venezuela still suffers from economic malaise, as it still has not managed to significantly diversify its economic activities away from the oil industry. An interpretation for that can be found in Medeiros (2012). He argues that states which were able to construct a reasonably solid industrial base at an early stage have greater chances of escaping the "resource curse". Unlike Russia, Venezuela never managed to do that in the history of its petroleum industry. When oil prices fall abruptly, as is happening at the time of the writing of this article, the public budget gets severely constrained, which decreases the possibility even more of pursuing the alluded policies that could support technology innovation (Amato, 1995).

We now relate deterministic path dependence with a case of success, citing the case of Germany. In order to explain the German case, we refer to Linda Weiss and the Varieties of Capitalism literature. Since the 19th century, argues Weiss (1998), the German state has possessed transformative and distributive capacities which have permitted it to build a very solid industrial base and a very consistent welfare state. By then, the country's objectives were to catch up with its competitors – notably England – and to build a war economy. Hence, since early on Germany has taken a number of measures to steer its industry, which became internationally known for its quality and robustness, An example is Germany's success in bringing about the so-called "Energiewende", where alternative energy sources are being fed into the grid at a very rapid pace. Perhaps the success of the Energiewende can be explained by a combination of measures, such as: tax incentives and financial support (economic and legal measures, at the general level), of a network of top-notch research institutions, such as the Max-Planck Institutes (structural measure, at the supply side), and of a very well trained workforce (cultural measure, on the demand side). Nevertheless, more recently, Varieties of Capitalism, which compares Liberal Market Economies – where the US is the paradigmatic case – with Coordinated Market Economies – where the paradigmatic case is Germany – states that while the former excels in radical innovations, the latter is better in incremental innovation. That is, companies such as Daimler Benz and Siemens, although internationally recognized for the quality of their products, would not have the ability to bring radically different goods and services to the market. In short, it is claimed that the Germany industry is locked in a certain pattern of technological diffusion, in which innovations do not diverge significantly from the current pattern. A radical change in this pattern is very unlikely to happen because Germany's physical expenditures and social investments – which include R&D – have been dramatically slashed (Streeck and Mertens, 2013).

We now relate the development approach with failure, citing the interlinked cases of England and Scotland. It is an example of a change of path dependence which did not lead to

a new pattern of technological diffusion. The United Kingdom was the first country to fully industrialize and London's city was always a very important financial hub. In its surroundings, Great Britain sustained a complex hybrid between a Keynesianism and a laissez-faire approach. The former was concerned with the production of goods in the productive industries, as well as public services that served individuals with the capacity of pursuing activities beyond the financial sphere. By the 1970s, when the parameters of the Keynesian system were proving increasingly difficult to sustain, the City was also at one of its weakest moments. In the 1980s, a series of major innovations in the financial realm propelled the City to a new global importance, especially with the liberalization of capital movements (Crouch, 2009). Hence, the Keynesian model was completely abandoned, being replaced with neoliberal structures. This process led to a new path dependence. In the realm of the production of oil in the North Sea, which took place notably in Scotland, in the late 1970s and 1980s decision-makers used oil revenues to bolster (monetarist) macro-economic policies – in order to boost the city of London as a financial hub – and to provide a "friendly and accommodating" environment for foreign companies with the appropriate expertise to develop North Sea resources as fast as possible, rather than pursuing an interventionist industrial strategy. What concerns an innovation policy that might have led to a new pattern of technological diffusion, Mazzucatto (2013) explains that in the last three decades Britain got it all wrong, with negative implications for growth in the long run. She explains that taxpayer support is misdirected and that opportunities are being missed. In her view an innovation policy needs to focus on creating the conditions that allow innovation to flourish, both by demand and supply side policies, as well as through direct commissioning and procuring innovative solutions. Besides being a powerful hub in which innovators from all the world may connect and have access to finance, in which knowledge creation has found almost a "natural habitat", little has been done in the last decades by the government to support technology innovation. In short, British policy makers rely too much on laissez faire policies that may pay off well in certain contexts but may relegate entire regions of the Kingdom to relative economic backwardness.

To conclude, we now relate the development approach with extreme success, citing the example of Silicon Valley. Mazzucatto (2013) argues that since the 1970s Silicon Valley has become the American "computer innovation hub" due to a number of public-private partnerships and due to the government's leading role in funding and research (both basic and applied), that was harnessed by innovative entrepreneurs and private industry in the so-called "Silicon Gold Rush". What may be called the "American developmental state", and whose existence not many recognize, has always offered a fully-fledged toolkit of measures to support technology diffusion, in all the realms presented in the previous section. But perhaps the most important measure taken by the "American developmental state" to support its industrial development, given the risks involved, was economic and financial, as government authorities directly commissioned and procured innovative solutions, especially for war purposes.

What distinguished the experience in Silicon Valley from everything else that was observed in the world is that a downturn like the burst of the "dot-com" bubble in the early 2000s, could easily be reversed. In that sense, Mazzucatto (2013) shows that the creation of the IPhone was only possible because Apple managed to astutely assemble a number of technologies that the "computer innovation hub" and the American developmental state had created.

In short, Silicon Valley is an example of an innovation hub in which the assembling and creation of further technologies practically knows no limits, and in which state intervention in some cases no longer proves necessary. For our purposes, it is the most clear-cut example of a combination of the developmental approach with possibilities of successful technological diffusion.

4. Conclusions

Embracing the neo-institutionalism perspective that path dependence affects trajectories of

innovation diffusion, the objective of this paper was to investigate factors that by affecting this process lead to technological change or inertia.

For this aim, in section 1 we presented two models of path-dependence diffusion of an innovation. The first model stresses that innovation diffusion and its subsequent persistence leads to technological inertia. The second view highlights that the combination of several events leads to technology changes. In section 2, we presented a typology of regions in which we relate the deterministic path dependence model and the development approach with success and failure in the diffusion of new technologies. Thus, we use our framework to discuss Venezuela, Germany, England and Silicon Valley as cases of success or failure. Before reaching the end of this paper, some final remarks are worth making, that may even extend this debate to further works. Although we have shown some cases that currently fit the models we presented very well, it must be acknowledged that, strictly speaking, the term "path dependence" is a synonym of "history matters". Although it is a powerful term to explain why the institutions of some countries appear in a certain way or why certain countries produce what they produce, it must be discounted that history has a dynamic of its own that does not always fit into models or preconceptions. This is what Streeck and Thelen (2009) had in mind when they argued that institutional change is a never ending, many times subtle, never fixed, dynamic process. In turn, Pierson (2004) had argued that an important characteristic of path dependence is that relative timing matters, that is, a newcomer's probability of being the chosen path is bigger than a latecomer's. However, in the same book he had also argued that in the very long run institutions may change a lot. In short, obsolescence is too easily a characteristic of institutions, in such a way that the cases we presented in this article may have a very different performance in the future.

To cut a long story short, there is an almost endless debate whether what matters most are institutions or capital accumulation. In that vein, Glyn (2007) writes that:

> *capital accumulation is the fundamental driving force of the economy. Increases in investment are usually the most dynamic element in aggregate demand expansions, particularly in a world scale, where one country's exports are another's imports. (...). Investment has a symbiotic relation with new technology, being made more profitable by it and at the same time being the route through which it enters the production system* (Glyn, 2007).

In this sense, nothing guarantees that a massive increase of aggregate demand in Venezuela – the case which we presented as "locked-in" in a technological trajectory, say, through investments made by the newly found BRICS investment bank, may change the entire picture. Through Chávez's intervention, the country now possesses a stock of well-educated population. To conclude, when discussing the routes technological diffusion may take one should be very careful with the issue of resource endowment, that is, with the so-called "comparative advantages". Although they may rightly explain some strategies that countries pursue – as competition on a world scale is fierce – it is important to remember that, what matters is the dynamic comparative advantage, or comparative advantage in the long run, which can be shaped. A piece of advice for developing countries is that policies to support technology diffusion – economic and legal, structural and cultural – be it on a general, supply or demand side, should never be given up. Internal or external restrictions to pursue those policies, even though representing enormous challenges, have a chance of being overcome through political agency, as shown by Evans (2006, 2008).

References

1. Amato V., "Popolazione e lavoro nel bacino del Mediterraneo", *Orizzonti economici*, 1995, pp. 18-24.
2. Baumann G., *L'enigma multiculturale. Stati, etnie, religioni*, Bologna, Il Mulino, 2003.
3. Boyer R., "How and Why Capitalisms Differ", *Economy and Society*, 34, 4, 2005, pp. 509-557.

4. Coccia M., "Cultura, immigrazione e diritto alla salute", *Prospettive sociali e sanitarie*, 3, 2004, pp. 11-13.
5. Collinson S., *Le migrazioni internazionali in Europa*, Il Mulino, Bologna, 1994.
6. Cotesta V., *Sociologia dei conflitti etnici*, Laterza, Bari, 1999.
7. Crouch C., *Capitalist diversity and change: Recombinant governance and institutional entrepreneurs*, New York, Oxford, 2009.
8. De Rubertis S. and Lazzeroni M., "Geografia della conoscenza e dell'innovazione tecnologica", *Rivista Geografica Italiana*, CXII, 1, 2005, pp. 161-163.
9. De Vecchis G. and Salvatori F., *Geografia di un nuovo umanesimo*, Vatican City, Libreria Editrice Vaticana, 2015.
10. Ebbinghaus B., "Can Path Dependence Explain Institutional Change? Two Approaches Applied to Welfare State Reform", *MPIfG Discussion Paper 05/2*, 2005.
11. Evans P., *Extending the institutional turn*, World Institute for Development Economics Research, Research Paper 113, 2006.
12. Evans P., *In Search of the 21st Century Developmental State*, The Centre for Global Political Economy, University of Sussex, UK, Working Paper 4, 2008.
13. Faccioli M., "Territori locali e cultura globale", *Proceedings of Congress "Risorse culturali e sviluppo locale"*, Rome, Memorie della Società Geografica Italiana, 2004, pp. 27-46.
14. Galieni S., "Tra conflitto e accoglienza", *Rivista del volontariato*, 5, 2000, pp. 42-52.
15. Glyn A., *Capitalism Unleashed*, Oxford, Oxford University Press, 2007.
16. Hall B. and Khan B., "Adoption of New Technology", in J. Derek (Ed.), *New Economy Handbook*, Amsterdam, Elsevier Science, 2003.
17. Landuzzi C., Tarozzi A. and Treossi A., *Tra luoghi e generazioni. Migrazioni africane in Italia e in Francia*, Turin, L'Harmattan Italia, 1995.
18. Lizza G., *Integrazione e regionalizzazione nella C.E.E.*, Milan, FrancoAngeli, 1991.
19. Mazzucato M., *The entrepreneurial state*, London, Anthem Press, 2013.
20. Medeiros C.A., "Natural Resources Nationalism and Development Strategies", *Proceedings of 2012 ESHET International Conference* (St. Petersburg, 17-19 May 2012), 2012.
21. North D.C., *Institutions, Institutional Change and Economic Performance*, Cambridge, Cambridge University Press, 1990.
22. Pierson P., *Placing politics in time,* Princeton, Princeton University Press, 2004.
23. Prezioso M., "Ipotesi geografiche della relazione impresa/innovazione nel governo dell'ambiente", in VV.AA., *Servizi per l'innovazione e la qualità di impresa. Analisi metodologica e geoeconomica*, Rome, CNR, 1993.
24. Rokkan S., "State Formation, Nation-Building and Mass Politics in Europe", in Flora P., Kuhnle S. and Urwin D. (Eds.), *The Theory of Stein Rokkan*, Oxford, Oxford University Press, 1999.
25. Salvatori F., *Globalizzazione e modelli culturali. Contesti socio-economici per promuovere la cittadinanza democratica, Educare alla Pace*, Ed. Simone, 2005.
26. Streeck W. and Mertens D., "Public Finance and the Decline of State Capacity in Democratic Capitalism", in Schäfer A. and Streeck W. (Eds.), *Politics in the Age of Austerity*, Cambridge, Polity Press, 2012.
27. Streeck W. and Thelen K., "Institutional change in advanced political economies", in Hancké B. (Ed.), *Debating Varieties of Capitalism*, New York, Oxford University Press, 2009.
28. Suriñach J., Autant-Bernard C., Manca F., Massard N. and Moreno R., *The Diffusion/Adoption of Innovation in the Internal Market*, European Commission Economic Papers 384 September 2009.
29. Vecchio B., "Geografia accademica e associazionismo geografico fra Otto e Novecento", in Bandini G.F. (Ed.), *Manuali, sussidi e didattica della geografia. Una prospettiva storica*, Florence, Firenze University Press, 2012.
30. Weiss L., *The myth of the powerless state*, Ithaca, Cornell University Press, 1998.

