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THE GOVERNMENT'S ROLE IN INDUSTRIAL DEVELOPMENT AND TECHNOLOGICAL INNOVATION: FRANCE'S NATIONAL POLICY TOWARDS NUCLEAR ENERGY DEVELOPMENT

Abstract. This article attempts to answer the question, what would be the best perimeter to launch a sustainable and successful innovation policy? Policy towards nuclear energy in France is the principle focus to provide a partial answer to the question. The example of the French nuclear industry, whose creation and management pertaining to a state initiative at the end of World War Two, provides a typical example of a sector-based development on innovation resulting from a long term tradition of state interventionism and public initiatives, which can be described as a high tech Colbertisme. Considering those difficulties faced by such a prominent national champion in an economic milieu, it is questionable whether or not the adoption of the Lisbon Agenda in support of innovation and of its wide diffusion was realistic. French nuclear operators within their national boundary have been characterised as quasi-monopoly for such a long period of time. However, it is questionable whether it was worthwhile for sustainable innovation, or to the contrary, it constituted mere a cumbersome obstacle constraining further marketable value creation. Pitelis' comprehensive strategic model, – recognising government as an important actor as one of the determinants to sustainable value creation affecting both meso- and macro-environment at different time periods –, to some extent fills the theoretical gap in this area.

Key words: French industrial policy, energy, nuclear, Colbertisme, state regulation

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Үкіметтің индустриялық дамудағы және технологиялық инновациядағы рөлі: Францияның атом энергетикасын дамыту саласындағы ұлттық саясаты

Аңдатпа. Бұл мақалада тұрақты және табысты инновациялық саясатты іске қосу үшін оңтайлы формат қандай болар еді деген сұраққа жауап беруге әрекет жасалды? Франциядағы ядролық энергетикаға қатысты саясат бұл сұраққа ішінара жауап бере алады. Француз атом өнеркәсібінің мысалы екінші дүниежүзілік соғыстың соңында құрылуы және басқарылуы, мемлекеттік бастамасы ретінде сектордың дамытудың типтік мысалы, оның негізінде мемлекеттік араласудың көпжылдық дәстүрі және қоғамдық бастамалардың туындайтын инновациялар, оны жоғары технологиялық Кольбертизм ретінде сипаттауға болады. Экономикалық ортада көрнекті ұлттық көшбасшы кездесетін қиындықтарды назарға ала отырып, Лиссабон күн тәртібіндегі инновацияларды қолдау және оның кең таралуына қабылдау шынайылығына күмән тудырады. Француз ядролық операторлары өзінің ұлттық шекарасы шегінде ұзақ уақыт бойы квазимонополия ретінде сипатталды. Алайда, бұл инновацияларды тұрақты енгізу үшін орынды болды ма, әлде керісінше, ол нарықтық құнды одан әрі құруды тежейтін үлкен кедергі болды. Бұл сұраққа жауап беру және қазіргі бар теориялық вакуумды толтыру үшін – мақала әртүрлі уақыт кезеңдерінде мезо-, сондай-ақ макроортаға әсер ететін құнды тұрақты құру детерминанттарының бірі ретінде үкіметті маңызды актор ретінде танытын Пителистің кешенді стратегиялық моделін қарау ұсынылған.

Түйін сөздер: Францияның өнеркәсіп саясаты, ядролық энергетика, Колбертизм, мемлекеттік реттеу.

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**Роль правительства в промышленном развитии и
технологических инновациях: национальная политика Франции
в области развития ядерной энергетики**

Аннотация. В данной статье предпринята попытка ответить на вопрос, каков был бы оптимальный формат для запуска устойчивой и успешной инновационной политики? Политика в отношении ядерной энергетики во Франции является главным направлением для обеспечения частичного ответа на этот вопрос. Пример французской атомной промышленности, создание и управление которой относится к государственной инициативе в конце Второй мировой войны, представляет собой типичный пример развития сектора на основе инноваций, вытекающих из многолетней традиции государственного вмешательства и общественных инициатив, которые можно охарактеризовать как высокотехнологичный Кольбертизм. Принимая во внимание те трудности, с которыми сталкивается видный национальный чемпион в экономической среде, вызывает сомнение о реалистичности принятия лиссабонской повестки дня в поддержку инноваций и ее широкого распространения. Французские ядерные операторы в пределах своей национальной границы характеризовались как квазимонополии в течение столь длительного периода времени. Однако сомнительно, было ли это целесообразно для устойчивого внедрения инноваций, или наоборот, оно представляло собой лишь громоздкое препятствие, сдерживающее дальнейшее создание рыночной стоимости. Для ответа на этот вопрос и для заполнения существующего теоретического вакуума статья предлагает для рассмотрения комплексную стратегическую модель Пителиса, признающую правительство и важного актора в качестве одного из детерминантов устойчивого создания стоимости, влияющего как на мезо-, так и на макросреду в различные периоды времени.

Ключевые слова: Французская промышленная политика, энергетика, атомная энергетика, кольбертизм, государственное регулирование.

Introduction

Policies fostering innovation are the key elements of industrial policy. It is not easy to disentangle how to make these policies most effective and competitive. Is the state with its own traditions and bureaucracy the important factor, or rather the regional force? Regional pressure becomes a key factor in economic development and appears to be one of the most prevalent trends in our current international community (Ohmae: 1995). This essay attempts to answer the question, what would be the best perimeter to launch a sustainable and successful innovation policy? Policy towards nuclear energy in France is the principle focus of this essay to provide a partial answer to the question.

Among many examples of innovation policies, the French definition of industrial policy and the European building process are worth enquiring. Indeed, the example of the French nuclear industry, whose creation and management pertaining to a state initiative at the end of World War Two, provides a typical example of a sector-based development on innovation resulting from a long term tradition of state interventionism and public initiatives (Falck, Gollier, and Woessmann: 2011), which can be described as a high tech Colbertisme. Colbertisme

is a political doctrine coined after the name of Jean-Baptiste Colbert, the Finance Minister of Louis the XIVth, who developed national industries through state interference and the granting of a nationwide monopoly. To some extent, such a doctrine is considered as a legacy of protectionism and is based on a mercantilist conception of wealth. The “high tech” colbertisme refers to the tradition of State interventionism based on the very specific French workforce and infrastructures. (e.g. Stuart in Van Ness and Gurtov ed.:2017, 30)

Culminating into the building of a national champion – a position endorsed by the AREVA Group – innovation policy seems to be considered as a success on a national basis, however, with much less achievements, on a regional scale. As a matter of fact, the nuclear sector is diversely defined on the following two levels: nationwide, it encompasses a handful of operators, whose roots are those of a public service with long term stakeholders, such as national laboratories, national technical agencies combined with a technically-oriented educational system (via so-called French “*Grandes Ecoles*”) sharing the same system of values. Meanwhile, on a regional scale, the nuclear sector presents a couple of national champions whose erratic cooperation is to be more ‘monitored’ than ‘managed’ by

the EURATOM (The European Atomic Energy Community) organisation.

The difficulties faced by the French nuclear operator, AREVA on the European market apparently to highlight the limits of the duplication of the industrial and innovative policy. Considering those difficulties faced by such a prominent national champion in an economic milieu, it is questionable whether or not the adoption of the Lisbon Agenda in support of innovation and of its wide diffusion was realistic. It is important to ask the question whether nationalised way of adoption has any significance in the design and sustainability of innovation policy. Moreover, should it be the case, what should be the way, in light of the French and European nuclear case, to nurture an efficient “wheel of innovation” when the articulation between national and regional definition of the industrial policy seems to go awry?

The success of French nuclear sector is well-recognised pertaining to the principles of a long-term and specific conception of the state-led innovative operator, which will be explained in the following part of the essay, after evoking the evolution of the French nuclear sector. Followed by this, the theoretical explanations will be added of the high tech Colbertisme and finally the essay attempts to analyse the reasons for the discrepancy between the national success and its relative failure on the European level.

Evolution

The French nuclear industry provides a remarkable example of a national industrial policy aiming at the diffusion of innovation and the sustainable maintenance of the energetic landscape of an entire country.

Pioneered by the nuclear research ever since the discovery of radioactivity at the end of the XIXth Century by Henri Becquerel, Pierre and Marie Curie, the French government has first considered nuclear research for a more military concern. In 1945, the creation of the Commission for Atomic Energy (Commissariat à l’Energie Atomique (CEA) Ordinance n° 45-2563 of 18th October 1945), for Charles de Gaulle, the then president of the Council of the Provisory Government of the newly re-established French government, was considered as a way to combine science, industry and national defence. Relevant discussion includes “the dual technology strategy” pursued by great powers such as Japan combining security and technology for upgrading military power while securing technological development (e.g. Kallender and Hughes: 2019). Such a combination paved the way for launching the first French nuclear bomb without which France would not have recovered its lost rank as a super-power nation in the newly established world order arising from the Yalta Conference.

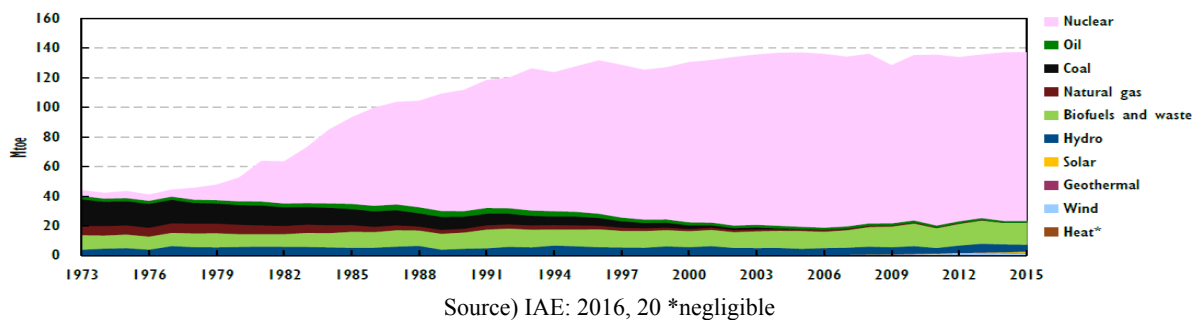


Figure 1 – Energy production by source, 1973-2015

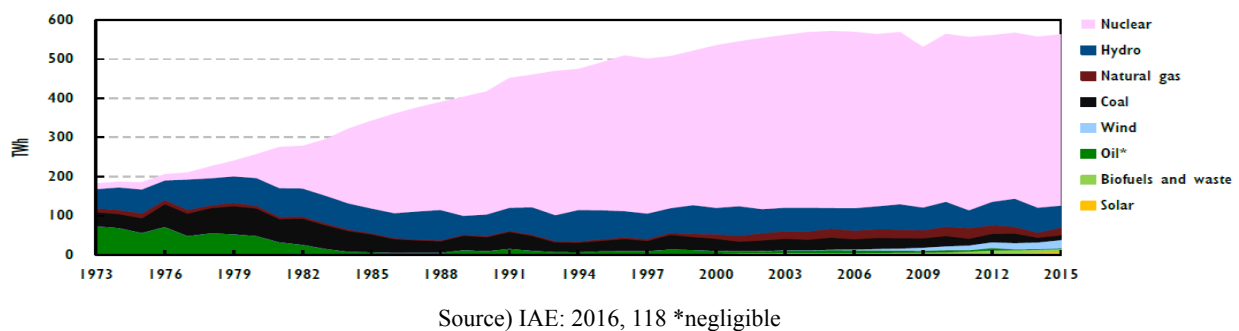


Figure 2 – Electricity generation in France by source, 1973-2015

Such an approach chosen by de Gaulle is therefore that of a public monitoring of the overall nuclear sector assured by rather exhaustive list composed by the five departments of the CEA: nuclear energy, technological research, life sciences, sciences of matter and military application. Such a state agency is viewed as the leading conductor of the whole creation of that sector in France in accordance with a very strict governmental goals and specific planning and with enormous workforce amounting almost 15,000 labour force by 2009. They are mainly composed of engineers recruited from the “*Grandes Ecoles*” and administrators from the civil service. In fact, the French nuclear landscape is mostly composed of two public operators. The state owns more than 87% of the shares of EDF and almost 90% of the shares of AREVA. On the one hand, the “*Electricité de France*” Group (EDF) remains in charge of the generation and distribution of the electricity while managing the 59 nuclear power plants built in France. On the other hand, AREVA, a multinational conglomerate created in September 2001 in the form of a fusion of two public operators, FRAMATOME and COGEMA, who are in charge of crafting and constructing nuclear plants as well as operating the entire system (See figures 1 and 2).

Colbertisme

The establishment of nuclear sector in France resulted from a specific industrial policy defined as *High Tech Colbertisme*, a sector based policy in the manufacturing industry by which industrial specialisation has been moulded (Cohen: 2007). Such an approach to industrial innovation is based on three principles. Firstly, the intervention of a sovereign state endorsed with the monopoly of general interest in the future industries. Secondly, the idea of a great industrial project brought actors from various fields including bureaucracy and research bodies but animated by the same set of shared values. Thirdly, a regalia approach to innovation and industrial development resulted in gains going much beyond the economic returns in fostering national autonomy and preservation. It was strongly legitimised due to the particular situation when the energy independence was felt threatened after the consecutive oil crises of the 1970s. Moreover, such a project must follow an industrial planning supported by ad hoc financial supports that are extended far beyond the national budget usually considered as the unique possible sources of national funding adopted by the Members of Parliament on a yearly basis.

The development of nuclear sector heavily relied upon the principle stakeholder, the state, as the results of the nationalisation process with some ebbs and flows since 1936 (Wiliarty: 2013). It has been amplified in 1981 with the election of François Mitterrand supported by a left-oriented coalition including the Communist Party. In this respect, shaping of the nuclear sector under the guidance of the state aimed at effective control of industrial dominant positions. It was a form of anti-trust policy implemented by a middle-sized country like France in pursuance of preventing private operators from seizing infrastructure industry that are reserved for the sake of general interest of wider public (Stoffaes: 1983). Innovation is therefore interpreted as the consequence of the state’s financial support granted to groups who are strong enough to contract debts and to maintain innovation. In this context, the nuclear sector was considered, especially in the 1980s, as the main investor of the whole French industry (Stoffaes: 1983).

The French nuclear sector has therefore benefited from a de facto monopoly as well as its recognition as a national priority. Therefore, the building of national champions, EDF and AREVA, is considered as an emblematic success of a national way of fostering innovation through ad hoc mechanisms. AREVA, while enjoying its international visibility as a creed among decision makers ever since its creation, has been regarded as incarnation of the success of the high tech Colbertisme. And yet, its implementation constantly ignored the political upheavals.

The existence and current situation of the group evoke some doubts whether their performance is worth taking as a real credential. Indeed, the fact that AREVA remains still under the governmental control shows the limit of the French conception of national championship. As Ellie Cohen (Cohen, 2007) points out, those companies have natural ends to be freed from the state’s intervention and to be privatised; thus being robust enough to face the market on an autonomous basis. In addition, the nuclear sector has a European dimension also that has considerably evolved over the past fifty years. Being included in the starters’ group of the European building process, the EURATOM organisation was launched on the same day of the Treaty of Rome and the nuclear sector has gained *de jure* recognition as a component of the future European market whose creation took almost 30 years. Nevertheless, such a regional dimension of the nuclear energy sector has been ignored by the French national authorities and consequently, EURATOM, until recently, has gen-

erated more a normative impacts than substantial industrial competitiveness in the market. An example is the Article 37 of the EURATOM TREATY on environmental issues and cross-bordering cooperation. The cautious and critical neoliberal approach covers more comprehensively the rise and erosion of nationalised industrial development, whereas previous research on French nationalised industrial policy highlights either national protectionism or the inevitable failure due to market inefficiency. Nor do regional governance theories sufficiently capture the limits of supra-national industrial policy. Commonly, theories on industrial policy do not comprehensively take into account external dynamics, which may lead to a hasty conclusion that regionalised industrial policy can unproblematically co-exist with nationalised industrial sectors, with very few exceptions. The important question seems to be which particular industrial sector is under inquiry, given that the nuclear energy sector requires enormous resources with well-“directed” scientific innovation strategy and constant resource inputs that are infeasible to sustain without strong state's policy intervention with clear national agenda (e.g. Croft: 1996, Kassim and Menon: 1996, Stuart in Van Ness and Gurtov eds.: 2017, 38-39). Nevertheless, the industry-security nexus, – the grounds for the state's choice of industrial championship – does not remain unchallenged due to external forces such as regionalisation and globalisation, along with the emerging norm of mitigating environmental risks associated with the energy sector. Therefore, the French dilemma today lies in how to maintain *a priori* contradicting national agendas: becoming a global leader in climate change mitigation and simultaneously maintaining her position as regional leader in nuclear industry, which is typically path dependent and quasi-private in nature.

Filling the theoretical gap

Beyond the practical goals claimed by governments, what else can be the theoretical explanations on how to lead an industrial policy to a successful path to foster and spread innovation? Would such a framework provide reasons why it seems that a nationally successful experience cannot be duplicated in the regional context? In fact, nuclear-related industrial sector is a good subject for those theories, for example, Porter (Porter: 1995), and Francis (Francis: 1993), whose beliefs basically support the idea that stronger governmental regulations would bring better results in technological innovation. Particularly in the case of nuclear energy, due to its

nature of a public good with potential military use, government's intervention would be inevitable and even desirable. The nuclear sector requires, more than any other technology intensive sectors, highly sophisticated governmental policy guides and constant regulations. Francis (Francis: 1993) provides an insightful explanation on how the French government could win public support in nuclear energy development. Among many factors, three were most decisive, namely, lessons from US experience, energy shortage of that time, and strong confidence in technological superiority.

Some important questions still remain unanswered. Would state intervention in high value sector like nuclear energy be continuously legitimised for a sound and long-run industrial development? French nuclear operators within their national boundary have been characterised as quasi-monopoly for such a long period of time. However, it is questionable whether it was worthwhile for sustainable innovation, or to the contrary, it constituted mere a cumbersome obstacle constraining further marketable value creation. The following points analyse the motives and consequences of the French government's engagement in this field of industrial policy.

Firstly, the state had to play its regalia part in defining the framework required to perform and diffuse innovation. As Zysman and Al (Zysman:1990) rightly pointed out, the state, unlike private operators, can spread desirable technology at a lower cost and achieve scale economies and positive technical externalities for the whole society. In this respect, the building of a national champion needs several conditions to be met which illustrate why nuclear energy per se is one of the most relevant sectors to become the topic of a national program. According to Paul Seabright (Seabright: 2006), such a policy requires large firms, high technology, a low variety of techniques available on the market, large scale economies, and strong commitment of stakeholders.

Secondly, innovation in such a high tech sector requires a risk-taker that can support potential failures. As Schumpeter observed, the less numerous competitors play in a given market, the easier may higher benefits be secured, so as to safely block other companies to enter the market. Therefore, the leading company shall keep innovating to maintain its leadership. As Arrow (Arrow:1962) rightly envisaged, only the state might be prone to invest in huge technological program. But the monopoly granted by the French Government to its nuclear operators had side-effects on innovation, although it was legitimised as the fuel of the European Building process and of its unique market development. Ac-

ording to the ‘substitution effect’, inasmuch as innovation creates value, it inevitably entails negative externalities for the origin of the innovation. Therefore, a monopoly is less prone to be innovative as it does not necessarily stand still with bearing the costs of any negative externality occurred by continuous innovation.

Thirdly, in the light of a more neoclassical approach, innovation must proceed from the competition among firms and should not therefore be the results of a direct intervention of the public authorities. Indeed, companies have direct knowledge of the market and benefit from some information whose acquisition remains costly for the state, which can be well described in the principle of asymmetry of information.

Finally, the initiative of the industrial policy for innovation and the origin of the French nuclear sector remain purely vertical-based (Cohen: 2006). Such a conception of industrial development tends to be outdated as for a main driving force of long-term growth. Sustainable innovation may be resulting from the stock of human capital (Nelson-Phelps: 1966), thus calling for a new conception of innovation policy on a broader base encompassing education and social structures, which will ultimately lead to the higher level of value capture. It seems to be clear that the recent decline of AREVA in the European market gives a message that the strengths of the French innovation model seems to be jeopardised as they no longer match the new regional deal of the European single market, in other words, more regional based horizontal model. In March 2009, the strategic alliance built between the French operator AREVA and its counterpart SIEMENS has been ceased. The German operator entering a partnership with the Russian company ROSATOM begins to develop its international platform. Such an episode can be interpreted as the difficulty met by the French national champion in transferring its knowhow and its way to foster innovation on an extended scale; namely the European Market and its competitor operators in the global market.

The European building process becomes contradictory with French authorities’ initial policy but it is still categorised under the national champion framework. The creation of the Unique European Market in 1986 and its progressive implementation have generated many issues, notably the agenda of cooperation between national champions from different member countries. As for an example, the German champions were built on social compromises rather than on a direct and continued state interventionism. Cultural differences in industrial policy-making

were discovered as a noticeable barrier pertaining to the market regulation between the European and the French legal systems (e.g. Shim, Park, and Wilding: 2015). In this respect, the notion of a relevant market defined by the European Commission could lead to the dismissal of the implementation of a national industrial policy calling for the creation of a national champion on a monopolistic basis relying on the consumer protection defence.

The decision to foster innovation through the setting of a regional agenda, as that of Lisbon in 2000, is based on a horizontal conception of industrial policies. By the Lisbon Agreement, the European Council (on 23rd and 24th of March 2000) articulated the aim, making Europe, by 2010, the most competitive and the most dynamic knowledge-based economy in the world. They were based on the premises that public authorities do not have the relevant information or required tools to allocate resources more efficiently than the market, which might support the inevitability of adopting purely market based Coasian bargain solution (Coase: 1960, Ellickson: 1989, Farrell: 1987). Nevertheless, without any political incentive to create European champions that can substitute for existing national champions, such a trend might create even further constraints.

Overall, European integration does not seem to put an end to the existence of ‘national’ economic policies confined to the origin of innovation. As shown by the Maurel Report (1999), increased regional specialisation and agglomeration have caused the spread of industrial activity across regions to be more uneven, thus rendering vain the project to build a balanced economic union and to create some European champions substituting themselves to already national companies in strategic fields, notably a sector like nuclear energy (Croft: 1996). How is it possible to overcome these difficulties faced by the duplication and the enlargement of what was successful, in terms of innovation and industrial dominance, on a national basis?

Pitelis’ comprehensive strategic model provides illuminating explanations and somehow fills the theoretical gap in this area. Pitelis recognises government as an important actor as one of the determinants to sustainable value creation. Government influences the institutional and macroeconomic context, through legal and regulatory tools (Pitelis: 2008). Its role affects ‘the meso-environment through its competition, industrial and regulation policies and the macro-environment through its macroeconomic policies’ (Pitelis: 2004, 218). It also generates and maintains fundamental values such as education and public health, which are crucial social capital for

long term innovation. However, as Pitelis' (2004) model (Figure 2 in his article on p.218) comprehensively indicates, all multi-layered structure has to be

scrutinized in order to have a completed picture of the industrial performance, as many factors interact on different levels at different time periods.

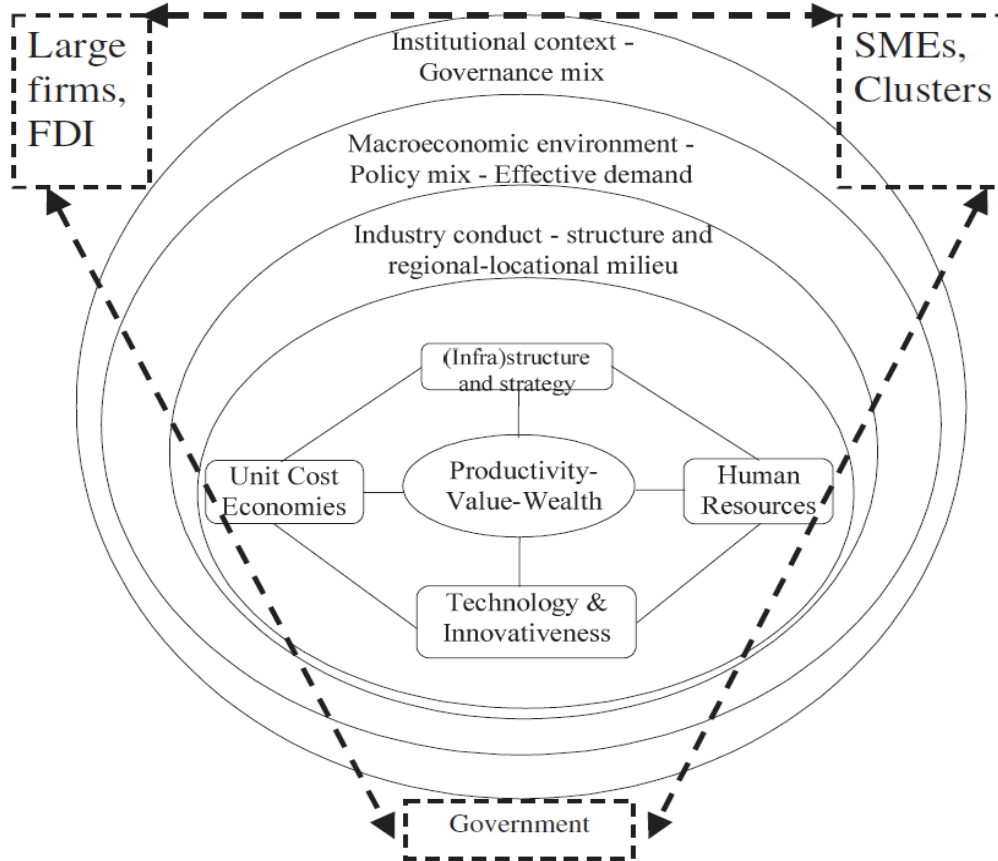


Figure 1 – Three ‘actors’ of productivity, value and wealth-creation

Conclusion

Nuclear in France is an example of a major success based on an interventionist policy aiming for the diffusion of sustainable innovation in a high value sector. However, many unexpected difficulties were faced in transferring the national model into regional model of development in the European context, and may consequently fail in the near future to remain as competitive as in the previous monopolistic situation. The evolution and development of French nuclear industry demonstrate that although to some extent, closed national border and protec-

tionist policy play a significant role for a while, many other factors have to be considered to keep fostering such a massive industry. The case clearly shows the necessity of diverse levels of interactions among core elements such as technological capacity, government's will, well-established institutions, planned but flexible regulations, and so on. All these factors may influence industrial changes but none of them is conclusive. In addition, for a European industry, regional approach is crucial while making a constant balance between regional level cooperation and preserving national competitiveness to survive the globalising economy.

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