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The atomic business: structures and strategies

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ABSTRACT

Nuclear energy was one among business opportunities brought by the take off in science and technology after the Second World War. The narratives of the milestones of atomic history neglect the commercial, industrial and organizational aspects that made it possible. This paper concentrates on what makes the nuclear business exceptional (or not). We undertake an analysis of the nuclear supply business (designing, manufacturing and installing nuclear facilities) distinct from the analysis of the demand side (business operating nuclear power plants). We identify a continuing role of the state in civil nuclear businesses and a symbiotic relationship with private atomic business. And yet, for the most part the nuclear business applies the usual criteria of cost minimization and profit maximization within the boundaries of a non-perfectly competitive market. We argue that the development of civil nuclear projects is core not just to business history as a discipline but to post-war history.

KEYWORDS

Nuclear energy; state as entrepreneur; varieties of capitalism

1. Introduction

As a consequence of the exponential increase in engineering and scientific funding brought forth by the Second World War, the immediate post war period witnessed a new era where science and technology became part of everyday vernacular culture. This ushered in new markets and business opportunities for a range of comparatively new industries such as electronics and telecommunications (radar and satellites) to aircraft (the jet engine), new materials and the civil uses of atomic energy (electricity, medical, industry and agriculture). The large-scale military industrial projects of the Second World War demonstrated how the fusion of science, engineering and large-scale management was possible, and how this became an accepted model for state led entrepreneurship (Balogh, 1991). The prime example of this was the Manhattan Project to build the first nuclear weapon, which employed thousands of individuals in the private sector to undertaken work for the government on a scale not witnessed in modern times. Commercial nuclear power is the consequence of this movement towards a synthesis of the will of the state with the ability of the private sector to

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delivered projects and is an industry that symbolises the variety of mixed, ordoliberal, dirigisme economies ('Colbertism' perhaps)[1] of the post war period that has been alluded to by Hall and Soskice in their seminar work, *Varieties of Capitalism* (2001).

In this paper we argue that the story of the development of nuclear power is part of the wider discourse on the role of the state in economic development after the Second World War and consequently of vital importance to the business history as a discipline. We will demonstrate that the 'Entrepreneurial State' view of Mazzucato (2013b) applies to the development of the nuclear industry, that the state acted as entrepreneur in bringing forth new technologies and industries that may not have evolved through the oft repeated orthodoxy of the market beloved of neo classical or mainstream schools of economic thought that place the market at the centre of any debate on innovation, the well know Solow-Swan model of exogenous economic growth (Solow, 1956, Swan, 1956, Dimand & Spencer, 2009). Therefore, the creation of the nuclear industry was not begat by a Schumpertarian process of Creative Destruction (Schumpeter, 1942) but rather - building upon an earlier attempt by Mazzucato (2013a) to define the process in as 'destructive creation'- an endogenous government led process of innovation consisting of a series of state-private hybrid institutions (to use the terminology of Douglass North's 1991 'Institutions') that could best be termed as Creative Construction in which the state guided and funded the research and development of the key technologies[2]. For example, in the US by contracting firms such as Westinghouse and General Electric to undertake core research followed by a system of preferential and relatively cheap finance to enable private companies build nuclear power plants. As per the variety of capitalism view advocated by Hall and Soskice nations engaged with nuclear power on a sliding scale of state – private relations, with private utilities and manufacturers in the US, private manufacturers and a state utility in the UK and in the case of France state led R&D, a state owned manufacturer and state owned utility company. However, the fundamental premise remains: nuclear power was brought forth through institutionalised state processes, whether in collaboration with the private sector or through a state owned nuclear-industrial complex and not through unconstrained market forces. This special issue illustrates this argument by outlining the business history of civilian nuclear power in countries that have attempted to engage with the technology to varying levels of success since the end of the Second World War.

This introduction argues that nuclear power is a business like no other in that it only came into existence through a state led process of innovation and implementation, in the same as many businesses that share several characteristics: first, the State's involvement (regulation and laws, financing basic research in high-technologies and subsidies for competitive pricing, training human capital, diplomacy to facilitate the technological knowledge transfers). Second, there were hardly any precedents in the history of science for such a rapid transition between the first experiments and their applied industrial diffusion (military and civil) (Hewlett & Holl, 1989). Third, the scale and scope of business (multinationals and intensive capital investment, high fixed costs and the promise of future high profits). In short, these are 'megaprojects' required a massive investment of resources and capital to create an industry from scratch (Flyvbjerg, 2014; Lethonen, 2019). And fourth, these new technologies were promoted by North America to forge economic and entrepreneurial bonds between the USA and its allies during the of Cold War. In Millward (2007) view, business was an instrument of the geopolitical strategy and nuclear power was no exception. The main difference was

the risks of nuclear accidents at the local level for civil and military uses, and the international level issue of Non-Proliferation during the Cold War.

Starting in 1955 until 1980 thirty countries began building and operating commercial nuclear reactors. Five American multinationals were dominate and built over one hundred reactors in the US, yet the global sales of nuclear reactors constituted a tight market and a potential opportunity for industrial economies such as the United Kingdom, West Germany and France (Rubio-Varas & De la Torre, 2017). However, the construction and operation of nuclear power plants presented a complex technological challenge, within the reach of only a few countries and reliant on state - private business relations. It can be argued, therefore, that a Schumpetarian logic cannot be employed to nuclear technology as compared to the existing and emergent fuels for power generation in the 1950s and 60s (Chick, 2007). Nuclear power fared badly in terms of cost, and complexity in comparison to the other, cheaper and ubiquitous resources available to electricity companies. Nuclear power was not a force of 'creative destruction' satisfying market forces through game changing innovation, rather it was a technology willed upon the economy through political forces where the state was the lead entrepreneur in the creation of an entire industry, again a process of 'Creative Construction'. This returns us to the work of Freeman (1974) and the 'Economics of Industrial Innovation'. The nuclear industry were the result of state forces; in the United States government research budgets and military procurement were behind the development of the two prevailing Light Water Reactor (LWR) designs, the Pressurised and Boiling Water Reactors (PWR and BWR, respectively) and in Britain the MAGNOX, gas cooled and graphite moderated reactors were the direct by-product of the British nuclear weapons programme (Pocock, 1977).

What were the economic incentives for business to invest in nuclear power? Who would develop nuclear power? State or private enterprises? We need to explain two historical phases: i) the Cold War 'Atoms for Peace' programme in context of relations between the USA and Western Europe during the 1950s and early 1960s (the 'nuclear optimism' time), and ii) the expansion of nuclear power programs around the Western World that led to larger plants which required greater safety measures and regulation from the 1970s onwards (the time of 'nuclear uncertainty'). After 1960, nuclear technology had become a part of the economic fabric of industrialized Western nations after 1960 and the relationship among public agencies (experts and research), governments and business created a 'seller's market' for American power reactors (and fuel) in Europe through Atoms for Peace and the Euratom plan (Hewllet & Holl, 1989; Armand et al., 1957). Within a context of opposition to nuclear power in response to nuclear proliferation in the 1960s, the European industry could not compete openly against the Americans on equal terms until the late 1970s. All of this affected business expectations and delayed the evolution of a specialized nuclear industry and therefore it is essential to understand the context in which nuclear corporations emerged and evolved, creating a global market for a new industrial sector.

This paper concentrates on what makes the nuclear business exceptional (or not) compared to other sectors. Nuclear exceptionalism has been a recurring theme in political discourse since the first bomb was dropped on Hiroshima (Hecht, 2010). Yet, within the discourse on nuclear exceptionalism as a business, the power technology is seldom mentioned – despite currently accounting for eleven percent of the world's electricity and historically being one of the largest single international commercial deals that can be transacted. This second type of exceptionalism applies to business history as the narratives of the great

milestones of atomic history tend to ignore the commercial, industrial and organizational aspects of the industry. Consequently, Hecht's nuclear exceptionalism is a pertinent theme in the business history of nuclear power in that whilst it is true that the state in the form of the military-industrial complex was principal agent in the development of the technology, the state also brought about the commercialisation of nuclear power through funding reactor development programmes, prototypes and underpinning the finance necessary to fund capital intensive nuclear infrastructure. Whilst Mazzucato's 'entrepreneurial state' hypothesis is applicable here, there is a further distinction that is important; whilst Mazzucato's argument about the role of the state in creating the electronics, chemical and computer industries (to name but a few) is relevant, emphasis has to be placed on the continuing role of the state in nuclear power long after the aforementioned industries had, mostly, transferred to a partial or wholly private sphere, further underscoring Hecht's exceptionalism.

It is an unfortunate truth that business history as a discipline has rarely touched upon the nuclear industry. This is surprising considering the number of seminal accounts of nuclear programs in capitalist democracies such as the United States (Balogh, 1991), West Germany (Radkau & Lothar, 2013), France (Hecht, 1998), and Britain (Hall, 1986) and in the communist world such as the U.S.S.R., East Germany [(Müller (2001) and Schmid (2015)], and under the military dictatorships in countries such as Argentina, Brazil or Spain during the 1960s and 70s [Mallea et al. (2015) and Rubio-Varas & De la Torre (2017)]. By their part, the business histories of the electricity utilities and regulation tend to treat only in passing (if at all) the nuclear endeavours (Chick, 2007; Hausman et al., 2008; Hausman & Neufeld, 2011; Madureira, 2017), with only few exceptions (Pope, 2011). This absence of a developed business history literature on the atomic power industry is surprising because from the beginning of the nuclear age there was a concern about the financing of atomic projects, national and international institutions considered the economic aspects as strategic, business consortia emerged and international transfer of knowhow became crucial [OEEC (1959); Maxwell et al. (1959); Federal Power Commission (1971)].

A business history approach has great potential to explain the economic and business historical development of nuclear energy. International business scholars have pointed to the potential effects of multinationals on host countries transferring technological knowledge and organizational capabilities (Buckley, 2009; Jones & Khanna, 2006; McKinstry, 1997; Smith, 1998). As a theoretical concept in business history '*learning by doing*' is defined as one of the processes by which firms, markets, and countries address uncertainty and imperfect and asymmetric information (Lamoreaux et al., 1999). Most recently, research enriches the debate by focusing on staffing strategies and knowledge transfer from advanced to developing economies including other variables (stock of human capital, corporate decisions, the ability of local partners to internalize the new knowledge) [(Meyer et al. (2011); Verbeke and Kano (2015); Álvaro (2014); De la Torre and Rubio-Varas (2018); Álvaro et al. (2020); Puig & Alvaro (2018)]. Neither is there a business history that explains the nuclear ecosystem (Scurlock, 2007), the industrial infrastructures, the markets, the attitudes of the entrepreneurs and the institutions that underpin the business.

The business history of the applications of nuclear technology – in medicine, agriculture, and industry (beyond power generation) – remains in its infancy despite the amount of research devoted to the history of national nuclear programs. The existing work has synergies with the economic history of the post-war period with the state at the core of all commercial nuclear activity to one extent or another and after the 1973 oil crisis determined national

energy policies that invariably placed nuclear power at the centre of future plans. Consequently, the debate on the development of nuclear power as an industry is central not just to business history as a discipline but the wider discourse on economic development after the end of the Second World War, such as debates on the nature of business and the firm (Penrose, 1959) or the 'varieties of capitalism' debate of the past two decades (Hall & Soskice, 2001; Hall & Thelen, 2008).

2. The pre-existing conditions and the traits surrounding nuclear business

Building nuclear power plants is a complex challenge in terms of macro level, technological, logistic and financial planning and these traits are generally shared by all civilian nuclear programmes (Valentine & Sovacool, 2010). As Rubio-Varas and De la Torre (2017) contend countries opting to include nuclear technology in their electricity mix shared similar economic traits, namely strong governments, and/or the support of a superpower to ringfence any risk involved. These countries also possessed an integrated electricity network and/or sufficient electricity demand to support a nuclear reactor; whilst having the industrial base to develop the nuclear technology and/or accommodate the technological transfer. Finally, these countries had the ability to tap into the financial resources required (whether nationally or internationally).

In Figure 1 we have mapped the main traits and evolution of the pre-existing conditions upon which the nuclear industry developed. First, any country aspiring to build a commercial nuclear power plant must possess a pre-existing industrial base able to adopt knowledge transfer with the objective to adapt and quickly use the new technology, possibly to produce industry related capital goods. This technological absorption could be possible thanks to the economic and financial capabilities and expectations of the host economy. In this light,

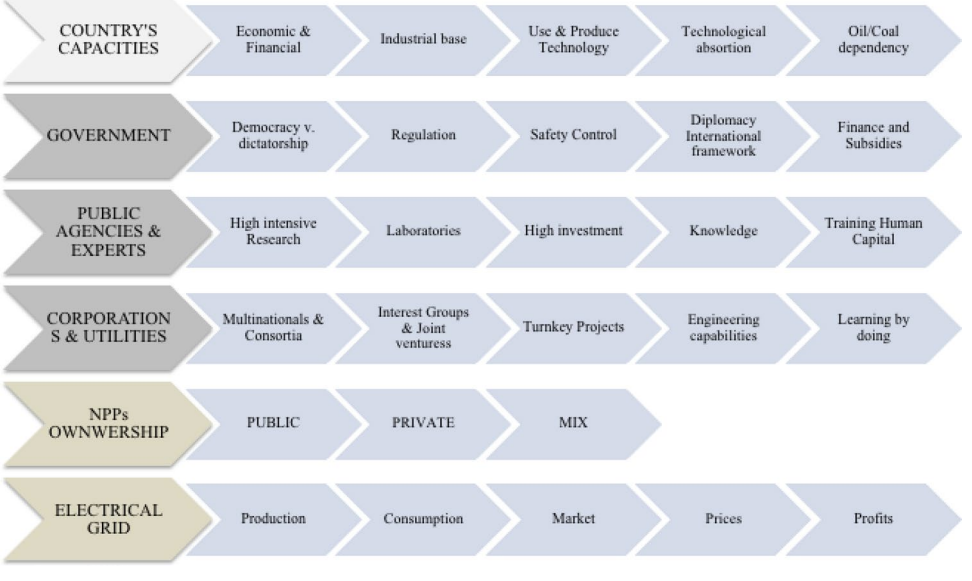

Figure 1. The backdrop for atomic business to arise: 1950–1979.
Source: Own Elaboration.

the new energy paradigm brought about by nuclear power was only available to developed and industrial countries, and therefore very far from the capabilities (if not desires) of developing countries (Drogan, 2016).

Second, government advocacy of the commercial benefits of nuclear power was key. The State assumed regulatory, safety and research functions, established the role of public utilities and established fiscal and financial support for the companies involved in the atomic program to promote a local self-sufficiency (see Figure 2 and Millward, 2007). At the same time, the government was the agent of economic diplomacy, which included inter-governmental relations and contacts among industry, banks and businesses. Finally, the ad hoc publicly financed collaboration between the state, industry and the scientific community was essential to the application and adoption of technical innovations. As a consequence of this R&D spending soared in North America and Western Europe, triggering an intense period of human capital formation and development of a nuclear business ecosystem.

3. A business like no other, a business like any other

Countries opting to build civil nuclear power plants had different types of business organizations involved in commercial decision making. In our analysis we separate the analysis of designing, building, and selling nuclear reactors (the supply side) from the business of procuring and operating nuclear reactors (the demand side). Both sides faced different sets of problems and have distinct strategies and structures. It is important to note, however, that many large foreign companies were established in other business segments of the host country (as shareholders or through the patent market) which determined the nature of potential commercial outcomes.

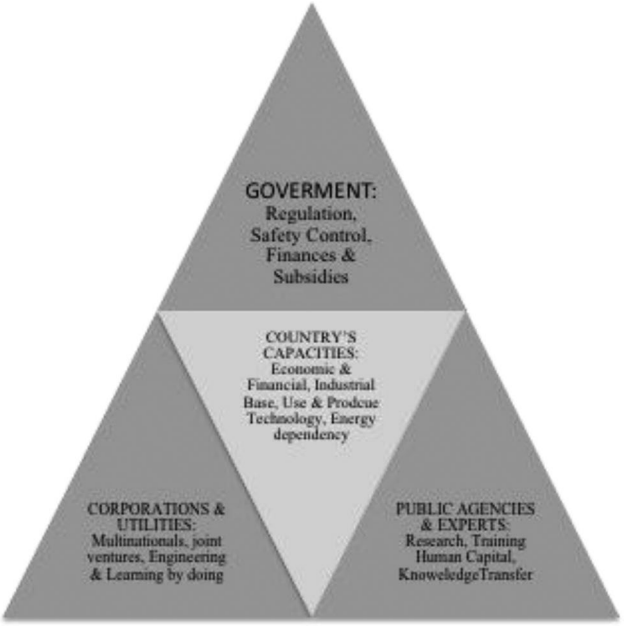

Figure 2. The iron triangle for atomics business.
Source: Own Elaboration.

The supply side of the nuclear industry shares many features with global, highly regulated and, non-perfectly competitive sectors such as aviation, aerospace or, satellite communications. These sectors are (i) technologically sophisticated, (ii) involve a large share of first-of-a-kind (FOAK) projects with limited chances to reproduce them in large quantities, (iii) require large-long-term financial commitments and, (iv) tend to have a symbiotic relation with governments.

These sets of characteristics already point in one direction: few companies are able succeed, and those that do, tend to be large companies able to mitigate the risks and deferred financial returns. The scale and scope of nuclear power plants required strategic organization of large firms, or in their absence, the formation of consortia. Initially, American multinationals exported turnkey projects, especially in countries lacking a mature industry capable of adapting to stringent requirements. When the engineering capabilities improved in host countries and safety fears assuaged, companies moved towards joint venture contracts, producing beneficial results for both the exporter and importer (De la Torre & Rubio-Varas, 2016). As a consequence of this, nuclear power is typified by a small number of suppliers; whilst companies from a dozen countries have successfully manufactured at least one commercial nuclear reactor, only five countries (US, Russia, France, Canada and Germany) have managed to become true exporters of the technology beyond FOAK projects (see Figure 3).[3]

Until the sudden halt to the United States nuclear industry just before Three Mile Island incident in 1979, the world's supply of nuclear reactors was dominated by two North American multinationals: Westinghouse or General Electric (or companies licensed by them) that built 80 percent of all reactors in the west. By the early 1980s, a dozen companies

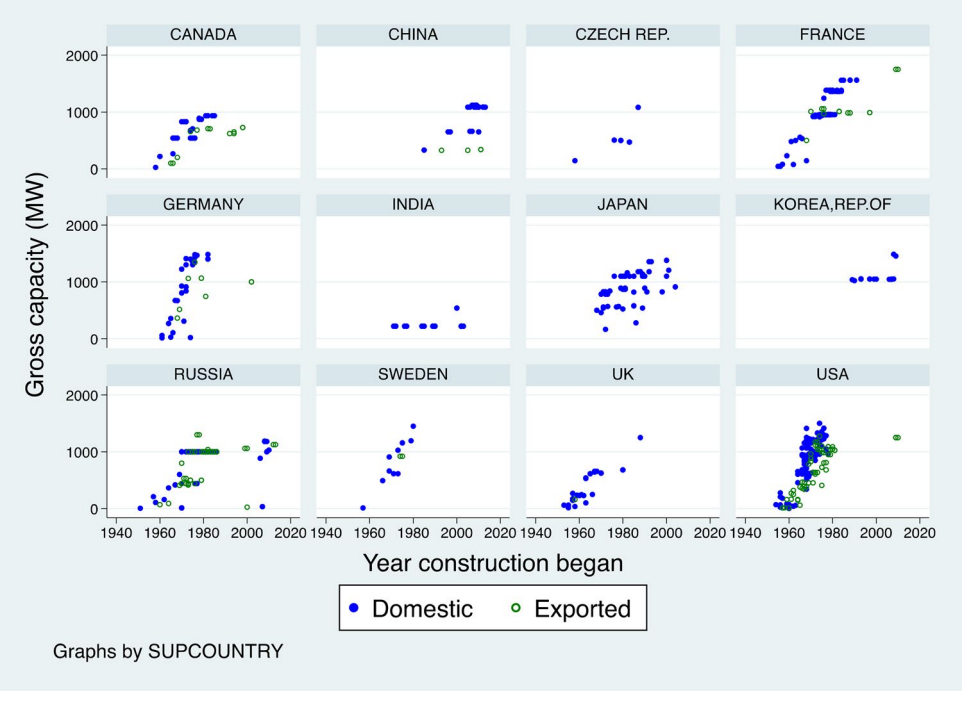

Figure 3. Supply side: reactors built by vendor's manufacturing country (1950s–2020).
Source: Own elaboration from the compilation of IAEA PRIS databases.

competed with the US multinationals supplying the core elements of the reactor such as generating sets, turbines, and control machinery. Few, however, could export entire nuclear projects beyond their own borders, and still fewer can do so today.

Successful international nuclear suppliers were limited to just two dominant business structures: either large integrated multinationals (e.g. Westinghouse, General Electric, KWU, Siemens) or state-owned national champions (e.g. Framatome, Atomenergoprom/Rosatom, AECL). The two largest, Westinghouse and General Electric, are good examples of the strategy employed by North American corporations when they became global firms using hierarchies and networks to manage complex processes to transfer knowledge to foreign affiliates, particularly in Europe (Jones, 2007). Whilst these processes were not free of difficulties, the role played by managers of engineering and consultancy firms was essential in mitigating risk (Taylor, 1994).

To understand why there were so few international companies undertaking civil nuclear projects, we have to look at the financial constraints inherent in large infrastructure projects; namely the capital intensive nature of nuclear power and the extended timeline for completion, loan repayments and profits. In this environment, financing by the supplier's government became more important to customers than the overall cost evaluation of the project (United States & Comptroller General's Report to the Congress, 1980, p.10). Until the early 1980s, US financial assistance, both directly through Eximbank loans, and indirectly by private loan guarantees to private loans, made it impossible for the European manufacturers to succeed in competition with the American nuclear manufacturers (De la Torre et al., 2020). The US policy changed after the election of Reagan in 1980, moving away from subsidies and ending cheap, preferential finance and opening the international market for alternative suppliers from Europe and Japan. With few exceptions, supplier nations provided cheap finance via public institutions to facilitate the export of nuclear power stations (Exim, 1970).

As this special issue demonstrates, the demand side of nuclear power is far more varied than the limited number of suppliers, with those acquiring reactors requiring specialist knowledge of the available alternatives. Companies acquiring civil nuclear technology required specialised knowledge on the alternatives available in the market. De la Torre et al. (2020) analyse the process of construction and connection to the electrical grid of four Spanish nuclear power plants with different financial and technological foreign partners. Three of them belong to the first generation of atomic plants and producing electricity from 1969 to 1972 and the fourth was connected twenty years later. These four examples allow us to observe how the learning curve and the acquisition of nuclear engineering skills by host companies evolved. In Spain, the industry developed the ability to fabricate and service reactor components able to compete internationally.

Even though the number of suppliers was limited, the technological choice had important implications for local industries and global nuclear non-proliferation. In the mid-1960s there were an array of possible designs for nuclear reactors, the basic differences depending on the fuel, the cooling and the moderating elements, and until the late 1960s there were no clear advantages to any of them. Eventually, three types of reactors were commercialized internationally (Fisher, 1997): (1) the light water nuclear power reactor, using low enriched uranium as its fuel and ordinary water as its coolant and moderator, built originally to a US design in Western countries and to a similar Soviet design in the USSR and Eastern European countries; (2) the gas graphite reactor using natural uranium as its fuel, moderated by graphite and cooled by carbon dioxide – a technological design favoured by Britain and France

(although abandoned by the latter in the 1970s in favour of the PWR). (3) Finally, Canada marketed a quite different nuclear power reactor using natural uranium as its fuel and heavy water as its coolant and moderator. Within each of these three main types there were to be further design categories. For instance, among the light water reactors, pressurized (PWR) and boiling water (BWR) reactors were developed in the West, while the Soviets built two types: the VVER series and the RBMK, the type made conspicuous by Chernobyl, which was closer to a MAGNOX in which moderation was undertaken by the use of a graphite core. Consequently, engineers and scientists were at the core of commercial negotiations and transactions involving the acquisition of civil nuclear technology, independently of whether the reactor was of domestic manufacture or an imported one (De la Torre et al., 2018).

The type and size of the chosen reactor determined the magnitude of the upfront investment, which in turn meant that not all utilities could undertake nuclear projects (Krautmann & Solow, 1988). Where the supply of electricity was fragmented among a number of private utilities (e.g. US, Spain), few utilities had large enough markets and deep enough pockets to undertake projects with more than two reactors at a single site (see Figure 4). Most underdeveloped countries still today have rather unconnected regional/local networks too small to accommodate the standard nuclear technology. Partially to overcome these issues, privately owned utilities in fragmented markets decided to create joint ventures and consortia for specific nuclear projects. In other countries, ownership expanded beyond the electricity sector, inviting co-ownership of the nuclear plant by other industries (different from electricity companies) and/or public bodies -municipalities partially own nuclear power plants in Sweden, Finland, the Netherlands and Germany, for instance (Rubio-Varas, 2021). This was never without conflict, as Jensen-Eriksen (2020) demonstrate in this Special Issue. In Finland the private companies have promoted their interests in the nuclear sector, where

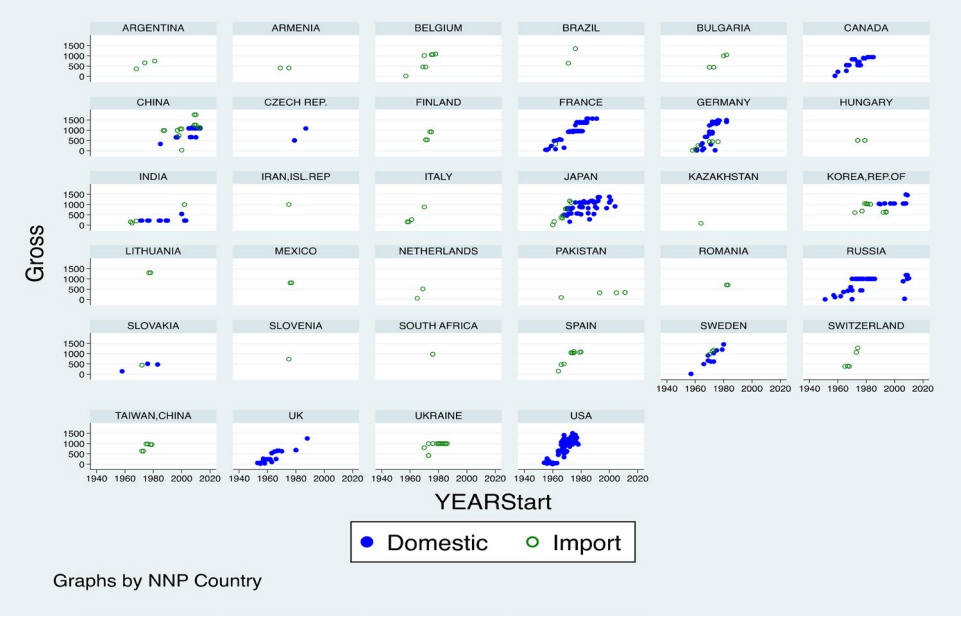

Figure 4. Demand side: nuclear reactors built by buying country (1950–2020).
Source: Own elaboration from the compilation of IAEA PRIS databases.

manufacturing industries have regarded cheap and abundant power as a key component of their business strategies. From the 1950s onwards, nuclear energy seemed a particularly attractive option. However, private firms faced opposition from a number of actors. They included the Soviets, who were eager to sell their reactors, while the Finns wanted to buy Western ones; centrist and left-wing politicians, who favoured state-controlled options; and finally, the environmental movement, which from the 1980s onwards opposed the construction of all new reactors.

In contrast, other nations where the electricity sector remained under the control of a single state-owned utility could accommodate larger reactors in groups of four or more (most notably France, but also the United Kingdom, the ex-Soviet Union, or the regional monopolies of Japan). Their electricity markets were largely integrated. As a consequence, standardization was more likely to occur in these countries as lesser agents took part on the decision over the reactor choice and repeated buys of the same type of reactor could be accommodated as shown in Figure 4.

Beyond the size/scale effect, the ownership structure has a crucial impact on the financial costs for those aspiring to buy civil nuclear technology. While for private companies profitability constitutes the primary decision criterion, a public investor may value other benefits for society (job creation, energy independence, industrial development, etc) above business profitability. Depending on the ownership and commercial structure chosen to develop a new nuclear project, the financing may come directly from the government (in other words, from taxpayers and public debt), or if undertaken by the private sector, from a combination of equity and (long-term) loans from national and international sources.

Crucially, capital costs differ according to the kind of promoter in question (public, private or mixed). On the one hand, state-owned companies have access to cheap capital when borrowing money. The interest rates on government bonds are usually relatively low compared to interest charged for financial loans taken up by private actors. For that reason, the financing of public projects is basically done though the issue of bonds, and this for 100 percent (D'haeseleer, 2013). This situation may apply to the largely state-owned companies such as Electricité de France (EdF) and Vattenfall (Sweden). On the other hand, private investors in liberalized markets operate in an uncertain environment, and their interest rates are the highest, depending on the rating of the company and the type of project. In the sense that of Rosenberg (2004) pointed out, the application of sophisticated managerial skills in order to exploit the vastly expanded capabilities of nuclear technology. The Finnish example with large customers acting as coinventors is an intermediate case that lowers the cost of capital for the investors (D'haeseleer, 2013, pp. 25–26).

In most parts of the world, many aspects of the nuclear ecosystem involve business decisions (Arora et al., 2019). For the most part the nuclear business applies the usual criteria of cost minimization and profit maximization within the boundaries of a non-perfectly competitive market no different from others of similar characteristics. In that sense, nuclear is a business like any other. Yet, in some countries, supply and demand of nuclear technology belongs to a single entity (e.g. EDF) or exists under a crossover of ownership between supplier and client (e.g. General Electric participation in utilities). From this perspective, Mascolo (2020) studies the construction of a nuclear power station in the South of Italy at the end of the 1950s, a joint study between the International Bank for Reconstruction and Development and the Italian government. It shows that Garigliano nuclear power plant is unique in terms of energy, politics and finance because it was intended to be an

international model, both in technology and operating procedures, for the construction of other nuclear power stations around the world. This case has to be contextualised in the complex scenario of the Italian nuclear policy of those years dominated by a clear split between the interests of the private and public spheres. Historically, the nuclear business decision making has been strongly marked by geopolitical strategy, a multi-layer-hyper-regulation and social opposition. All of which has contributed to also making nuclear a business like no other.

4. The 'state as entrepreneur'; varieties of capitalism as applied to the nuclear business

The state - private enterprise relationship varied between nations and across borders and individual nuclear industrial sectors varied depending upon the socio-economic and political context of the country. Therefore, the work of Hecht on nuclear exceptionalism has a relationship beyond Mazzucato's entrepreneurial state which is more closely aligned with the 'Varieties of Capitalism' view put forward by Hall and Soskice (2001). As a consequence, the nuclear exceptionalism Hecht alludes to had many forms depending on where the industry was operating. This goes beyond a socialist versus capitalist market economy argument as baring the Soviet Union, nations developing nuclear sectors in the 1950s were predominately based on a capitalist model, but one that had a role for the state acting as coordinator and facilitator, and in some cases, namely France, both customer and supplier. The relationship between the state and private enterprise depends on the initial purpose of a particular nuclear industry – in the case of Britain, France, USA and the USSR this was weapons – and the level at which state – business interactions took place. Consequently, in the United States for example, whilst the state was the facilitator of reactor research and development, it utilised private enterprise in the form of companies such as Westinghouse, General Electric and Du Pont (to name but three) as designer and vendor, whereas in the United Kingdom research and development was a government activity and in the form of the Central Electricity Generating Board was customer, but private enterprise built and delivered reactors of their own design but based upon the underlying government research (Chick, 2007). At the other extreme, the nuclear industry in France was completely government owned and run, and the state nuclear company acted as researcher, supplier, vendor and customer. Industries in nations such as Sweden and Switzerland started from a nuclear weapons perspective but soon coalesced around private vendors using Westinghouse PWR technology and, eventually private utility companies and, with varying levels of state participation. This is the prevailing model in the majority of nations utilising nuclear power but one further, final caveat has to be made: in some nations the origins of the industry were domestic and military, either overtly (Sweden), implicitly (Italy and Switzerland) or covertly (Spain, Argentina and Brazil) whilst in others (Finland and the Netherlands, for example) the industries were built upon imported technology for power generation purposes only [(Mallea et al. (2015), Rubio-Varas & De la Torre (2017), Jonter (2016), Evangelista (2011) and Foradori (2014)].

These phenomena are illustrated by Jensen-Eriksen (2020), where Finish private industry cooperated with the state to introduce nuclear power to feed local industry and yet due to the geopolitical considerations of 'Finlandization' had to utilise both Soviet (hybridised with western control systems and standards of safety) as well as Swedish reactors based upon

American designs, all operated by companies owed by both the state and private enterprise. Roitto et al. (2020) confirm this view of the Finish experience and that the demands of private enterprise were at the core, whilst also drawing comparators to the United Kingdom and Germany where the evidence suggests that, in the early post war period at least, private enterprise was wary of being involved in the nuclear industry, a state of affairs that changed in the following two decades to reflect two very different realities in Germany and Britain; in the former private utilities, designs and vendors and in the later, state utilities and designs delivered by private contractors. As De la Torre et al. (2020) and Mascolo (2020) also demonstrate, the Spanish experience formed by the Franco government of the 1960s and an Italian experience formed by a politically weak state that was a civil service led technocracy with delineated state – private sets of relationships that produced different local outcomes when interacting with the overseas financial institutions tasked with developing industrial development. Consequently, nation states which adopted nuclear power did so in a number of divergent ways that reflected local economic variations based on the socioeconomic and political context of place that affected technical and investment outcomes.

These local variations based upon social-economic and political factors specific to each nation in this period underline the view of Hall and Soskice (2001). But this is not without qualification; whilst Hall and Soskice advocate two polar opposites of capitalism, Liberal Market Economics (LME) and Coordinated Market Economies (CME) there are arguments within the varieties of capitalism literature that point to an eventual convergence of national economic strategies over time that tend towards the LME variety of capitalism (Gevurtz, 2011), and the prevailing nuclear orthodoxy of PWR reactors owned by private utilities (with some notable exceptions such as France, for example) supports this to an extent, even though it is apparent that significant aspects of the CME still exist (Donzé & Smith, 2018). Nevertheless, up until the 'big switch' towards light water reactors in the 1970s (France 1975, Britain 1978) the early years of nuclear energy was typified by distinct national business and technical strategies based on local conditions and from the perspective of the burgeoning varieties of capitalism literature in the field of business history, nuclear power provides an opportunity to study the role of state commercial relations during the post-war period that reflects the CME view of Hall and Soskice and the prevailing ordoliberal orthodoxy of that time [Thomas and Westerhuis (2014), Iversen and Soskice (2019), John and Phillips-Fein (2016), Kipping (2003), Hall and Gingerich (2009) and Kiran (2018)].

Despite the exceptionalism discourse it is difficult to identify business structures or strategies that are unique to the nuclear sector. We would like to argue that it shares features with some of the technologies of the second half of the 20th century (aerospace, aviation, telecommunication) with high capital requirements (human and financial), symbiotic relationships with the state (including a military side), and tight markets. Indeed, work by Edgerton underscores Mazzucato's view that the state had a pivotal role in guiding developments in the nuclear industry because the role of government was central to each high technology industry that evolved after 1945 (Edgerton, 2005). However, one aspect of this state role is the notion of the success or failure of a state led innovation strategy; as the article by MacKenzie, (2020) in this special issue demonstrates, the state led commercial nuclear industry in the United Kingdom was an expense failure comprised of plutonium producing designs that were the offspring of the British nuclear weapons programme (which could never be exported due to proliferation concerns), whereas the American industry based on non-proliferating power designs, whilst military in its inception and conception,

as demonstrated by Rubio-Varas & De la Torre (2017) was supported by cheap finance provided by the Atoms for Peace programme to generate exports.

5. Concluding remarks

The purpose of this special issue is to illustrate (and advocate for) the central role that nuclear power should play within the business history of the post Second World War period. In this introduction, with reference to the articles published within this Special Issue (De la Torre et al. (2020); Jensen-Eriksen (2020); Mascolo (2020); MacKenzie, (2020) and Roitto et al. (2020), we have also argued that the study of the nuclear industry is crucial in forming theoretical perspectives on the role of the state in the economy after the end of the Second World War and how different variants of capitalism evolved in Western economies during this period. Nuclear power is related to many inherent themes concerning the role of the state in industrial development and the rise of science and technology as a socio-political institution during a period of rapid socio-economic changes. This collection has demonstrated that whilst many countries had a superficially similar set out outcomes for local nuclear industries, the reality was one of a variety of approaches to implementing nuclear power generation that swung from a completely state owned, manufactured and managed industries to ones that were privately owned in their entirety but all were underpinned by state - business institutional arrangements without which, there would not be a nuclear industry operating today in any of the countries mentioned in this special issue. The business – political nexus was at the core of innovation in the sector and was integral to the creating the ecosystems that have supported the nuclear industry for more than half a century. By shedding light on this, we believe that we have demonstrated a new series of linkages between institutional views that support the endogenous theory of economic growth and the burgeoning varieties of capitalism literature in business history, whilst all the while added credence to Mazzucato's view of the state as the main entrepreneur in developing modern high technology industries. It is our hope that this study of the nuclear industry will provide a fertile breeding ground for additional work in other areas of study within business history that will shed light on the role of state – business relationships in the implementation of innovative technologies and methods that at times have irrevocably changed the prevailing economic zeitgeist and orthodoxies.

Notes

1. Studies of the French 'Colbertist' economic paradigm of state led capitalism, named after the 17th century French statesmen are sorely lacking from the economic and business history literature, with the last academic study of any kind occurring in 2007 (Cohen, 2007). With the rise in interest in the varieties of capitalism literature and the influence of Mazzucato's theories on concepts on innovation and industrial growth, we believe that the time may be ripe for a study of Colbertism and its influence on ordoliberal and mixed 'third way' economies.
2. The role of technology in exogenous and endogenous growth theories can be attributed to the work of Solow and Swan (1956) in the case of the former, and Kenneth Arrow (1962) in the case of the latter. Debates in the 1980s led by Romer (1986) and Lucas (1988) omitted technology per se in the endogenous growth model. Recent work by Bloom et al. (2020) has placed

technology back into the debate on economic growth and consequent draws attention to the role of the state and the nature of capitalist economies.

3. The remaining exporters were all FOAK projects. The British Nuclear Power Group (TNPG) built the Italian reactor at Latina. Sweden's ASEASTAL built the two reactors the Finish NPP at Olkiluoto; The Chinese four reactor exports to Pakistan could arguably be a repeated sale, but in our opinion does not make China a nuclear exported as yet.

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References

Álvaro, A. (2014). The Globalization of Knowldge-Based Services: Engineering Consulting in Spain, 1953-1975. *Business History Review*, *8*, 681–707.

Álvaro, A., Puig, N., & Torres, E. (2020). Managing foreign know-how and human local capital: Urquijo Group and the rise of Spanish Engineering firms. *Business History*, *62*(7), 1231–1223. https://doi.org/10.1080/00076791.2017.1413093

Armand, L., Etzel, F., Giordani, F. (1957). Un objectif pour Euratom, Rapport présenté par M. Louis Armand, M. Franz Etzel et M. Francesco Giordani sur la demande des gouvernements de la République fédérale d'Allemagne, de la Belgique, de la France, de l'Italie, du Luxemburg et des Pays-Bas. [s.l.]: 157. 117 p. 13–46. http://www.cvce.eu/obj/rapport_des_trois_sages_sur_euratom_4_mai_1957-fr-e72917a4-3c9d-48b1-b8cb-41307736731e.html

Arora, A., Belenzon, S., & Patacconi, A. (2019). A theory of the US innovations system: Evolution and the social value of diversity. *Industrial and Corporate Change*, *28*(2), 289–307. https://doi.org/10.1093/icc/dty067

Arrow, K. (1962). The economic implications of learning by doing. *The Review of Economic Studies*, *29*(3), 155–173. https://doi.org/10.2307/2295952

Balogh, B. (1991). Chain reaction: Expert debate and public participation in american commercial nuclear power, 1945–1975.

Bloom, N., Jones, C. I., Van Reenen, J., & Webb, M. (2020). Are ideas getting harder to find?*American Economic Review*, *110* (4), 1104–1144. https://doi.org/10.1257/aer.20180338

Buckley, P. J. (2009). Business history and international business. *Business History*, *51*(3), 307–333. https://doi.org/10.1080/00076790902871560

Chick, M. (2007). Electricity and Energy Policy in Britain, France and the United States since 1945.

Cohen, E. (2007). Industrial policies in France: The old and the new. *Journal of Industry, Competition & Trade*, *7*(3-4), 213–227.

D'haeseleer, W. D. (2013). *Synthesis on the economics of nuclear energy*. Study for the European Commission. Directorate General for Energy. Contract N° ENER/2012/NUCL/Si2.643067, https://www.mech.kuleuven.be/en/tme/research/energy_environment/Pdf/wpen2013-14.pdf

De la Torre, J., & Rubio-Varas, M. (2016). Nuclear power for a dictatorship: State and business involvement in the Spanish atomic program, 1950–85. *Journal of Contemporary History*, *51*(2), 385–411. https://doi.org/10.1177/0022009415599448

De la Torre, J., & Rubio-Varas, M. (2018). Learning by doing: The first Spanish Nuclear Plant. *Business History Review*, *92*(1), 29–55. https://doi.org/10.1017/S0007680518000053

De la Torre, J., Rubio-Varas, M., & Sanz-Lafuente, G. (2018). Engineers and scientist as commercial agents of the Spanish nuclear program. In D. Pretel & L. Camprubi (Eds.), *Technology and economic globalisation: Networks of experts in world history* (pp. 313–340). Palgrave Macmillan.

De la Torre, J., Rubio-Varas, M., Sánchez-Sánchez, M. E., & Sanz, G. (2020). Nuclear engineering and technology transfer: The Spanish strategies to deal with US, french and german nuclear manufacturers. *Business History*, 1955–1985. https://doi.org/10.1080/00076791.2020.1810239

Dimand, R. W., & Spencer, B. J. (2009). Trevor swan and the neoclassical growth model. *History of Political Economy*, *41*(Suppl 1), 107–126. https://doi.org/10.1215/00182702-2009-019

Donzé, P. Y. & Smith, A. (2018). Varieties of capitalism and the corporate use of history: the Japanese experience. *Management & Organizational History*, *13*(3), 1–22.

Drogan, M. (2016). The nuclear imperative: Atoms for peace and the development of U.S. policy on exporting nuclear power, 1953–1955. *Diplomatic History*, *40*(5), 948–974. https://doi.org/10.1093/dh/dhv049

Edgerton, D. (2005). *Warfare state: Britain 1920 to 1970*. Cambridge University Press.

Evangelista, M. (2011). Atomic ambivalence. Italy's evolving attitude toward nuclear weapons. In G. Giacomello and B. Verbeek, eds. *Italy's foreign policy in the twenty-first century: The new assertiveness of an aspiring middle power* (p. 115–134). Lexington Books.

Export Import Bank of the United States (EXIM). (1970). *Eximbank Programs in Support of Nuclear Power Projects*, (3. Box J11, Folder 2347. Ex-Im Bank Archives).

Federal Power Commission. (1971). *The 1970 National Power Survey.* US Government Printing Office.

Fisher, D. (1997). *History of the atomic energy agency: The first forty years*. The International Atomic Energy Agency.

Flyvbjerg, B. (2014). What you should know about megaprojects and why: An overview. *Project Management Journal*, *45*(2), 6–19. https://doi.org/10.1002/pmj.21409

Foradori, P. (2014). Reluctant disarmer: Italy's ambiguous attitude toward NATO's nuclear weapons policy. *European Security*, *23*(1), 31–44. https://doi.org/10.1080/09662839.2013.851674

Freeman, C. (1974). *The economics of industrial innovation*. Penguin.

Gevurtz, F. A. (2011). The globalization of corporate law: The end of history or a never-ending story? *Washington University Law Review*, *86*(3), 475– 521.

Hall, T. (1986). *Nuclear politics: The history of nuclear power in Britain*. Pelican.

Hall, P. A., & Soskice, D. (Eds.). (2001). *Varieties of capitalism: The institutional foundations of comparative advantage*. Oxford University Press.

Hall, P. A., & Gingerich, D. W. (2009). Varieties of capitalism and institutional complementarities in the political economy. *British Journal of Political Science*, *39*(3), 449–482. https://doi.org/10.1017/S0007123409000672

Hall, P. A., & Thelen, K. (2008). Institutional change in varieties of capitalism. *Socio-Economic Review*, *7*(1), 7–34. https://doi.org/10.1093/ser/mwn020

Hausman, W., Wilkins, M., & Hertner, P. (2008). Global electrification: Multinational enterprise and international finance in the history of light and power, 1878-2007.

Hausman, W., & Neufeld, J. L. (2011). How politics, economics, and institutions shaped electric utility regulation in the United States: 1879–2009. *Business History*, *53*(5), 723–746. https://doi.org/10.1080/00076791.2011.599589

Hecht, G. (1998). *The radiance of France: Nuclear power and national identity after world war II*. MIT Press.

Hecht, G. (2010). The power of nuclear things. *Technology and Culture*, *51*(1), 1–30.

Hewlett, R. G., & Holl, J. M. (1989). *Atoms for peace and war, 1953–1961. Einsenhower and the atomic energy commission*. University of California Press.

Iversen, T., & Soskice, D. (2019). *Democracy and prosperity: Reinventing capitalism through a turbulent century*. Princeton University Press.

Jensen-Eriksen, N. (2020). Looking for cheap and abundant power: Business, government and nuclear energy in Finland. *Business History*. https://doi.org/10.1080/00076791.2020.1772761

John, R. R., & Phillips-Fein, K. (eds). (2016). *Capital Gains: Business and Politics in Twentieth-Century America*. University of Pennsylvania Press.

Jones, G. (2007). Globalization. In Jones, G. & J. Zeitlin (Eds.), *The Oxford handbook of business history* (pp. 140–168). Oxford University Press.

Jones, G., & Khanna, T. (2006). Bringing history (back) into international business. *Journal of International Business Studies*, *37*(4), 453–468. https://doi.org/10.1057/palgrave.jibs.8400198

Jonter, T. (2016). *The key to nuclear restraint: The Swedish plans to acquire nuclear weapons*. Palgrave Macmillan.

Kipping, M. (2003). Business-government relations: Beyond performance issues. In Amatori F., and Jones G, (Eds.), *Business history around the world: Comparative perspectives in business history*. Cambridge University Press.
Kiran, J. (2018). Expanding the framework of the varieties of capitalism. Turkey as a hierarchical market economy. *Journal of Eurasian Studies*, *9*(1), 42– 51.
Krautmann, A. C., & Solow, J. L. (1988). Economies of scale in nuclear power generation economies of scale in nuclear power generation. *Southern Economic Journal*, *55*(1), 70–85. https://doi.org/10.2307/1058857
Lamoreaux, N., Raff, D. M. G., & Temin, P. (Eds). (1999). *Learning by doing in markets, firms and countries*. University of Chicago Press.
Lethonen, M. (2019). Ecological economics and opening up of megaproject appraisal: Lessons from megaproject scholarship and topics for a research programme. *Ecological Economics*, *159*(0), 148–156.
Lucas, R. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, *22*(1), 3–42. https://doi.org/10.1016/0304-3932(88)90168-7
MacKenzie. (2020). Fast Breeder Reactor Technology and the Entrepreneurial State in the UK. *Business History*.
Mallea, R., Spektor, M., & Wheeler, N. J. (Eds.), (2015). *The origins of nuclear cooperation: A critical oral history of Argentina and Brazil*. Woodrow Wilson International Center for Scholars.
Madureira, N. L. (2017). The confident forecaster. Lessons from the upscaling of the electricity industry in England and Wales. *Business History*, *59*(3), 408–430. https://doi.org/10.1080/00076791.2016.1201074
Mascolo, R. (2020). Tennessee valley in Southern Italy: How the ENSI project was the first and only World Bank loan for nuclear power. *Busines History*. https://doi.org/10.1080/00076791.2020.1819984
Maxwell, I. R., Mummery, P. W., & Sporn, P. (1959). *Progress in nuclear energy, the economics of nuclear power*. Pergamon Press.
Mazzucato, M. (2013a). Financing innovation: creative destruction vs. destructive creation. *Industrial and Corporate Change*, *22*(4), 851–867. https://doi.org/10.1093/icc/dtt025
Mazzucato, M. (2013b). *The entrepreneurial state: Debunking public vs. private sector myths*. Anthem Press.
McKinstry, S. (1997). The rise and progress of John Brown Engineering, 1966-97: US Technology, Scottish expertise and english capital. *Business History*, *39* (3), 105–134. https://doi.org/10.1080/00076799700000101
Meyer, K. E., Mudambi, R., & Narula, R. (2011). Multinational enterprises and local contexts: The opportunities and challenges of multiple embeddedness. *Journal of Management Studies*, *48* (2), 235–252. https://doi.org/10.1111/j.1467-6486.2010.00968.x
Millward, R. (2007). Business and the state. In Jones, G. & Zeitlin, J. (Eds.), *The Oxford handbook of business history* (pp. 529–557). Oxford University Press.
Müller, W. D. (2001). *Geschichte der Kernenergie in der DDR: Kernforschung und Kerntechnik im Schatten des Sozialismus*. Schäffer-Poeschel Verlag. ISBN 9783791017792
North, D. (1991). Institutions. *Journal of Economic Perspectives*, *5* (1), 97–112. https://doi.org/10.1257/jep.5.1.97
OEEC. (1959). European Nuclear Energy Agency, the industrial challenge of nuclear energy. Stresa Conference, Vol. III *Survey of European Programmes. Economics of Nuclear Power and Financing Programmes.* OEEC.
Penrose, E. (1959). *The theory of the growth of the firm*. Oxford University Press.
Pocock, R. F. (1977). *Nuclear power: Its development in the United Kingdom*. Gresham.
Pope, D. (2011). *Nuclear implosions: The rise and fall of the Washington Public Power Supply System*. Cambridge University Press.
Puig, N., & Alvaro, A. (2018). The long-term effects of foreign investment on local human capital: Four American companies in Spain, 1920s–1970s. *Business History Review*, *92*(3), 425–452. https://doi.org/10.1017/S0007680518000764
Radkau, J., & Lothar, H. (2013). *Aufstieg Und Fall der Deutschen Atomwirtschaft*. ISBN 978-3-86581-315-2
Roitto, M., Nevalainen, P., & Kaarkoski, M. (2020). Fuel for commercial politics: the nucleus of early commercial proliferation of atomic energy in three acts. *Business History*.
Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, *94* (5), 1002–1037. https://doi.org/10.1086/261420

Rosenberg, N. (2004). 'Innovation and economic growth' *in OCDE, Innovation and Growth in Tourism*, 43–52. OCDE.

Rubio-Varas, M., & De la Torre, J. (2017). *The economic history of nuclear energy in Spain: Governance, business and finance*. Palgrave Macmillan.

Rubio-Varas, M. (2021). The changing economic context influencing nuclear decisions. In Kaijser, A. (eds.) *Engaging the atom: The history of nuclear energy and society in Europe from the 1950s to the present* (pp. 70–110). West Virginia University Press.

Schmid, S. D. (2015). *Producing power: The pre-Chernobyl's history of the Soviet Nuclear industry*. MIT Press.

Schumpeter, J. A. (1942). *Capitalism, socialism and democracy*. Harper & Brothers.

Scurlock, J. (2007). A concise history of the nuclear industry worldwide. In Elliott, D. (Ed.), *Nuclear or not?: Does nuclear power have a place in a sustainable energy future?* (pp. 24–33). Palgrave Macmillan.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, *70*(1), 65–94. https://doi.org/10.2307/1884513

Smith, J. (1998). Patents, public policy and petrochemical processes in the post-world War II era. *Business and Economic History*, *27*(2), 413–419.

Swan, T. W. (1956). Economic growth and capital accumulation. *Economic Record*, *32*(2), 334–361. https://doi.org/10.1111/j.1475-4932.1956.tb00434.x

Taylor, G. D. (1994). Negotiating technology transfer within multinational enterprises: perspectives from Canadian history. *Business History*, *36*(1), 127–158. https://doi.org/10.1080/00076799400000006

Thomas, D., & Westerhuis, G. (2014). *The power of corporate networks: A comparative and historical perspective*. Routledge.

United States, Comptroller General's Report to the Congress. (1980). *U.S. Nuclear Non-Proliferation Policy: Impact on Exports* and Nuclear Industry Could Not Be Determined. Government Printing Office. https://www.gao.gov/assets/140/130475.pdf

Valentine, S. V., & Sovacool, B. K. (2010). The socio-political economy of nuclear power development in Japan and South Korea. *Energy Policy*, *38*(12), 7971–7979. https://doi.org/10.1016/j.enpol.2010.09.036

Verbeke, A., & Kano, L. (2015). The new internalization theory and multinational enterprises from emerging economies: A business history perspective. *Business History Review*, *89*(3), 415–445. https://doi.org/10.1017/S0007680515000689