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Bruno Tertrais
Senior Research Fellow, Fondation pour la recherche stratégique

FONDATION pour la RECHERCHE STRATÉGIQUE

Fallout: the defence, industrial and technological benefits of nuclear deterrence

Résumé

Il est légitime de s'interroger, en ces temps de restrictions budgétaires, sur le poids de la dépense nucléaire militaire. A l'examen, toutefois, la dissuasion nucléaire a de nombreux bénéfices militaires, industriels, et technologiques. Elle est, dans les faits, totalement imbriquée avec les autres éléments de notre système de défense.

Abstract

In the current climate of budgetary restrictions, it is fair to question the weight of military nuclear defence spending. Upon examination, however, nuclear deterrence has numerous military, industrial, and technological benefits. It is, in fact, totally intertwined with the other elements of our defence system.

It is reasonable to question the weight of military nuclear spending in France, particularly at a time when the defence budget is so severely constrained. How can it not be understood, for instance, that military personnel involved in operations using material that is often ageing and equipment that is sometimes obsolete question the relevance of this spending?

This debate needs to be approached objectively, namely by considering nuclear deterrence as an asset and not simply as a burden. The benefits or "fallout" of deterrence for defence as a whole, as well as for French industry, are often underestimated or poorly appreciated.

How much does deterrence cost?

In 2015, 2.9 billion € in Program Authorizations (PA) and 2.5 billion € Payment Credits (PC) in have been invested in deterrence in programme 146, "forces equipment".

Including programmes 144, 178, and 212, the total cost of deterrence today is 3.7 billion € in PC and 3.3 billion € in PA[1].

The total deterrence budget thus represents some 21-22% of spending on equipment, and 11-12% of the defence budget. Given that deterrence constitutes one of the five major "strategic functions" identified in the 2013 White Paper, its budgetary weighting is entirely in line with its role in the French defence and security make-up.

French nuclear spending more or less – comparisons are not easy, notably because the perimeters are not the same – corresponds to a tenth of that of the United States (using a maximalist estimate, $ 61.3 billion as compared with $ 6 billion in 2011)[2]. Evidently, there is no homothety between the arsenals and budgets: the number of weapons is not the principal determining factor of the budget, especially for more sizeable arsenals. In recent years, the total average amount of real spending (PC) on deterrence has been 3.5 billion € per year. This spending corresponds to less than 100 € per household (or 5 € per month for every French citizen). It is at a similar level to … the fiscal loss caused by the reduction of the rate of VAT for the restaurant industry (3.2 billion € per year according to Office of the Auditor General in 2010). France thus spends the equivalent of less than 0.2% of its national GDP to maintain the state of its nuclear deterrent.

A "ring-fenced" budget?

It is incorrect to contend that the deterrence budget is totally "ring-fenced".

Firstly, because the proportion of nuclear appropriations in the equipment budgets has fluctuated significantly over the years: in 1967, it accounted for more than 50%; at the end of the Cold War, 30%, before falling by half (to 15% in 1999) due to the drastic reduction of the arsenal during the 1990s, before rising again as a result of the modernisation of the nuclear forces in the 2000s, to 21-22% today. France allocated around 1% of its GDP to deterrence in 1967, and 0.4% on average until the end if the 1980s, (0.47% in 1990). Today, that figure stands at only 0.17%, which is almost an all-time low.

Next, at the risk of stating the obvious, since the budget has been reduced, even a constant share amounts to a reduction… The level of equipment appropriations allocated to deterrence has hardly varied over the last ten years. In real terms, the defence budget has dropped by more than 5% over the past decade.

Finally, because reductions, rebates, and postponements have been deliberately decided upon on several occasions over the last 15 years. In 1999, the "Programmes Review" led to the "Minos" programmes undertaken by the DGA, corresponding to a reduction of around 5% in the deterrence budget, through the optimisation of the timetables for commissioning the new generation of material in the sea-borne component. At the start of the present century, it was decided, on grounds of cost, not to make the M51 missile as accurate as possible. The timetable for the major simulation instruments (e.g. the Megajoule Laser) has been put back on several occasions. It was for essentially economic reasons that in 2010 the Franco-British Teutates project (the design, joint construction and shared use of a radiography facility) was launched.

In the framework of the preparation for the new Military Programming Law (MPL), savings were sought after. The credits and personnel of the CEA's Directorate for Military Applications (DAM) has undergone reductions (400 people, namely 9% of its workforce, between 2013 and 2016). The commissioning of the oceanic nuclear warhead (TNO) has been delayed by a year. The timetable of simulation experiments has been reviewed. The preparation of the future renewal of the sea-borne component now favours conservative – or low-cost – options. A 30% saving has been made on maintenance and operations credits for the M51 missile[3]. In total, almost two billion Euros have been saved compared to what was scheduled in 2008. As a result, across all of the current MPL, the cost of deterrence will not exceed 12% of the total.

Moreover, it is also important to recall that nuclear programmes are particularly well scrutinised and are much less subject to budgetary slippage than other programmes, to the extent that it has been affirmed that they

1. In 2014, nuclear deterrence constituted 20% of programme 146 "forces equipment": namely, 2.4 billion € in commitment authorisations (CA) and 1.9 billion € in payment appropriations (PA). The total cost of deterrence was 3.1 billion € in CA and 3.5 billion € in PA.

2. World Spending on Nuclear Weapons Surpasses 1 Trillion Per Decade, Global Zero, June 2011.

3. Audition de MM. Patrick Boissier (DCNS), Antoine Bouvier (MBDA) et Alain Charmeau (Airbus), sur la dissuasion nucléaire, Commission de la défense nationale et des forces armées, Assemblée nationale, 16 April 2014.

are "always in accordance with timetables, deadlines and costs"[4].

The impact of deterrence on our conventional capabilities

Deterrence is not a "constraint" for conventional military capabilities. On the contrary, it has a positive impact on them[5]. It has even been stated that deterrence "structures almost the entire French defence apparatus"[6].

Because deterrence is a political priority, its needs in terms of its environment and support have been protected. This point is fundamental and often ill known, even in defence circles. The format of "dual" capabilities such as intelligence satellites, nuclear attack submarines (inseparable from the constitution of the FOST), anti-submarine frigates, minehunters, helicopters, maritime patrol aircraft, and refuelling aircraft would certainly not have been conserved without the needs of deterrence. To take but a recent example, the electromagnetic CERES observation satellite would undoubtedly not have been conserved by the MPL if it had not been important for deterrence[7]. Moreover, the renewal of nuclear powered ballistic submarines (SSBNs) provided for the maintenance of a French capability in submarine design and construction. (Furthermore, showcasing this capability over time has ensured the preservation of know-how, something that is not the case for our British neighbours...)

Nuclear forces have, for some time, no longer been a "constraint" for aerial projection. And the replacement of the Mirage-2000N and Super-Etendard by the Rafale will culminate, from 2017-2018, in the "total duality" (nuclear/conventional) of aircraft carrying nuclear weapons. If our air force succeeded in carrying out their missions in Libya and Mali... it is also because it benefits from the particularly extensive training needed for nuclear missions[8]. For the air force, deterrence is one of the two major "structural missions" (along with air defence). In return, it could be argued that the very fact of using these capabilities in a "visibly" effective manner makes deterrence more credible.

The technological and economic advantages of investment in deterrence

In the field of defence, nuclear deterrence raises the quality of research and development. The "products" of deterrence are generally extremely complex. Deterrence, as has been said, is the "locomotive of performance" due to its technical demands including in terms of reliability, security, and safety.

As such, the defence industry has directly benefited from nuclear investment. In the maritime field, metallurgy of hulls and acoustic discretion, reactors, sonar, and combat information technology can be cited; in the air sector, ramjet, means of navigation, deep-strike capabilities with field monitoring, and terminal guidance. Precision targeting and electronic warfare (stealth, self-protection), which are key of any high intensity modern operation, have also indirectly benefited from deterrence. The same goes for means of command, control, and communication (C3): their strengthening, their resistance to cyber attacks, along with their autonomy (lack of dependency on GPS) are indirectly linked to deterrence efforts. Intelligence (collect and fusion) has also benefited from deterrence, from a very early stage (the digitisation of terrain placed at the disposal of the Strategic Air Forces in the 1970s). Finally, conventional explosives have also benefited (codes).

Many large companies contribute to deterrence, as primes (Airbus, AREVA-TA, DCNS, MBDA) or second tier companies (Air Liquide, Bull, CNIM, Jeumont, Mecachrome, Mittal, Safran/Herakles, Safran/SAGEM, Saint-Gobain, Schneider Electric, Thales, Thermodyn...). The industry surrounding the

4. Assemblée nationale, Avis au nom de la Commission des affaires étrangères sur le projet de loi, adopté par le Sénat (n° 1473), relatif à la programmation militaire pour les années 2014 à 2019 et portant diverses dispositions concernant la défense et la sécurité nationale, par Gwenegan Bui, rapporteur, n° 1540, 12 November 2013, p. 46.

5. The use of forces designated for deterrence for conventional missions is possible on the express decision of the President of the Republic.

6. Rapport d'information fait au nom de la Commission des affaires étrangères, de la défense et des forces armées par le groupe de travail sur l'avenir des forces nucléaires françaises, by Didier Boulaud et al., n° 668, 12 July 2012, p. 38.

7. Audition du général Denis Mercier, chef d'état-major de l'armée de l'Air, et du général Patrick Charaix, commandant des forces aériennes stratégiques, sur la dissuasion nucléaire, Commission de la défense nationale et des forces armées, Assemblée nationale, 15 April 2014.

8. The use of the air force in Syria was intended to employ 10 Rafale (each armed with a Scalp missile) against the backdrop of anti-air defence systems of Russian origin; here again, the training for nuclear missions would have proved extremely valuable.

M51 missile alone involves more than 450 companies[9]. For DCNS alone, deterrence represents almost 8 000 direct and indirect jobs[10].

Is there any need to recall it the fact that it is in part thanks to French nuclear military efforts that France was able to rapidly establish civilian nuclear power (theoretical research, technologies, and materials destined for the medical and commercial sectors, and of course the production of electricity)?

More broadly, in the civilian field, deterrence has an impact that is not negligible, whether in the guise of direct transfers, indirect consequences, or making instruments elaborated for deterrence available for research purposes. For the large companies working on deterrence, this is a source of robustness (expertise, finance flows).

A great deal of expertise in the field of aerodynamics (the mastery of supersonic flight), navigation (inertial guidance), piloting (fly-by-wire), thermal resistance to extreme environments (carbon-carbon composites), and electronics (silicon on insulator[11]), have stemmed from deterrence.

The launch of the M51.3 programme has allowed the French space industry to maintain its expertise without becoming totally dependent on European decisions on the future of the Ariane programme. 80% of techniques and know-how are common to ballistic missiles and space launchers.

Deterrence programmes also allow certain industries to finance research, technologies, and test centres that they would undoubtedly abandon without such demanding programmes that are guaranteed in the long term. The city of Brest has a "Technopole" … due to the presence of the Oceanic Strategic Force. The DAM transfers 70 to 80% of its budget to French companies and industry, more than 66% of which goes to high-tech industries[12]. Around 800 SMEs work on deterrence[13]. The number of indirect jobs generated by the DAM has been estimated as 10,000 to 22,000[14].

Questions are sometimes asked about the significant cost of the simulation programme, rendered indispensible by the definitive end to nuclear tests. But the CEA has ensured that it will also have scientific and economic effects that are not negligible.

The Megajoule Laser reportedly cost 3.3 billion € over fifteen years, but it also constitutes the most complex construction project that Bouygues has ever undertaken. The region of Aquitaine, which is in the immediate vicinity of this facility, has invested 100 million € in the development of a dedicated industrial pole: the "Aerospace Valley" whose upshot to date is 25 businesses created and 30 established, with 1500 direct and high skilled jobs created[15]. In addition more than 10,000 positions have been generated[16]. And the facilities themselves are open to civilian research (up to a limit of 10-20% for the Megajoule Laser (LMJ) itself, and 50% for the Laser Integration Line). The LMJ will soon welcome the PETAL (Petawatt Aquitaine Laser) Project, financed by the region and the Ministry of Research.

A great deal of the expertise developed by the DAM, notably in the fields of atmospheric re-entry and digital simulation has been integrated into the "Aerospace Valley" industrial pole.

The CEA calculation centres were opened up to civilian research in 2001. The Research and Technology Computing Centre (CCRT) began establishing partnerships with industry in 2003. A technopole ("Ter@tec") was created by the CEA and the local authorities. These facilities are used in fields as diverse as aeronautics (Snecma turbo-reactors), climatology, geology and hydrology (tsunami modelling), studying the behaviour of nuclear reactors (thermo-hydraulics, neutrons, materials), astrophysics, and public health. In the latter field, simulation is at the service of

9.. Audition de MM. Patrick Boissier (DCNS), Antoine Bouvier (MBDA) et Alain Charmeau (Airbus), sur la dissuasion nucléaire, Commission de la défense nationale et des forces armées, Assemblée nationale, 16 April 2014.

10. Audition de MM. Patrick Boissier (DCNS), Antoine Bouvier (MBDA) et Alain Charmeau (Airbus), sur la dissuasion nucléaire, Commission de la défense nationale et des forces armées, Assemblée nationale, 16 April 2014.

11. On this point see Boulaud et al., *op. cit.*, p. 43.

12. 70% : Rapport d'information fait au nom de la Commission des affaires étrangères, de la défense et des forces armées par le groupe de travail sur l'avenir des forces nucléaires françaises, by Didier Boulaud et al., n° 668, 12 July 2012, p. 42. 80% : Donguy, *op. cit.*, p. 55.

13. Intervention de M. Nicolas Dhuicq lors de l'audition du général Henri Bentegeat sur la dissuasion nucléaire, Commission de la défense et des forces armées, Assemblée nationale, 9 April 2014.

14. 10.000: Boulaud et al., *op. cit.*, p. 42. 22.000 according to Donguy, *op. cit.*, p. 55.

15. Pôle Route des Lasers, 2014.

16. Philippe Wodka-Gallien, "Le Laser mégajoule : bientôt opérationnel", *Défense*, n° 168, May 2014, p. 37.

epidemiology, and also of the study of living mechanisms at the molecular level (e.g. proteins). For instance, the Curie facility (commissioned in 2012 and which was ranked 15th in the world in 2013) has allowed chemists from Toulouse to simulate the complex molecular mechanics that cause Alzheimer's disease, using 80,000 Curie cores simultaneously[17]. At the end of 2013, Bull received 25 million € from R&T studies loans to support his efforts in the field of super calculators.

In total, it has been calculated that every Euro injected for the benefits of deterrence into the French industrial and technological fabric helps to generate 18 Euros of wealth[18].

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Nuclear deterrence is not a corpus separatum from the rest of the State apparatus. Moreover, the term "fallout" is not ideal: it would be better to refer to the "intertwining" of deterrence with the rest of the nuclear sphere, with the field of conventional defence, with the industrial fabric, and with civilian research and technology. The development of conventional SCALP cruise missiles and airborne ASMP-A missiles for deterrence are linked. In the submarine field (SSNs and SSBNs), both the technologies and command and training are closely linked. Space-launch vehicles have long benefited from the investment in ballistic missiles; today the reverse is largely true, but some of the fuel still remains in common (solid propellant developed by Herakles).

It is also important to evoke other benefits for our security and our diplomacy: France's contribution, in technical and intelligence terms, to the fight against nuclear proliferation and nuclear terrorism is of vital importance.

17. Sylvestre Huet, "Turing et Ada, unis par les liens du supercalcul", *Libération*, 14 December 2012.

18. Patrick Donguy, « Les retombées de la dissuasion au service de la compétitivité française », *Défense et Sécurité Internationale*, n° 79, March 2012, p. 54.

Some might contend that a large share of the aforementioned scientific and technological benefits could have been achieved without the nuclear dimension. This is perfectly possible, but such a contention neglects the strength of the psychological and political motivation – with their ramifications in terms of financing, expertise, etc. – that could only stem from an inspiring and unifying large strategic project.

The deterrence budget may need to rise, given that France is getting ready to begin a new cycle of modernisation. In the MPL, the cost of deterrence will rise to 12% on average (14% at the end of the period, an amount of 4.5 billion €, and more than 25% of the equipment appropriations)[19]. The cost of deterrence could account for 0.2% of GDP in 2025[20]. Over the duration of the MPL, almost a quarter (1.2 billion €) of the R&T defence budget (4.5 billion €) will be devoted to deterrence[21]. (Deterrence currently accounts for a third of the R&T study budget of programme 144, 250 million € out of a total of 750 million €). Between 2013 and 2023, France will spend 29 billion € per year on the modernisation of the FOST, and 2.6 billion € to modernise the FAS, amounting to 3 billion € a year[22].

This spending is significant and it will not be easy to maintain consensus on deterrence in the current and foreseeable budgetary climate. Yet, here once again, seeing it from an economic point of view only as a burden for defence and a strain on the State would be a grave mistake.

19. Audition du général Pierre de Villiers, chef d'état-major des armées, sur la dissuasion nucléaire, Commission de la défense nationale et des forces armées, Assemblée nationale, 6 May 2014.

20. Audition de. M. Laurent Collet-Billon, délégué général pour l'armement, sur la dissuasion nucléaire, Commission de la défense nationale et des forces armées, Assemblée nationale, 30 avril 2014.

21. Michel Cabirol, "Recherche amont : les quatre orientations majeures du ministère de la Défense", *La Tribune,* 5 March 2014.

22. Boulaud et al., *op. cit.*, p. 39.

Author

Bruno Tertrais, Senior Research Fellow at Fondation pour la recherche stratégique.

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