

Weapons and technology: the economics of Augustine weapons systems

Abstract

Augustine weapons systems are a new class of weapons which are high technology and costly with their unit costs rising between successive generations reflected in inter-generational cost escalation. They have potential for revolutionary change in a nation's armed forces and defence industries. In the same time frame, another new technology is emerging in the form of cheap drones replacing manned aircraft. Both of these new technologies are assessed in terms of their likely impact on military forces and defence industries. Augustine weapons systems are defined and their substitution effects are identified. There will be opposite effects on industry output, with costly Augustine systems bought in smaller quantities and cheap drones in larger volumes. Evidence is presented on cost escalation for a sample of UK fighter aircraft.

Keywords: weapons, technology, fighter aircraft

Volume 7 Issue 4 - 2023

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Received: October 20, 2023 | **Published:** November 02, 2023

Introduction

Weapons use technology and new technology results in new weapons and substitution effects. History is littered with examples. Swords and bows and arrows were replaced with guns, rifles and machine guns; cannons destroyed the traditional military advantage of castles; radios replaced the use of flags and pigeons; tanks replaced cavalry; helicopters are replacing tanks; steam power and then nuclear power replaced sail-powered warships; and nuclear weapons reduce the military advantage of large concentrations of conventional forces. Augustine weapons are a new class of weapons system with potential for revolutionary change in military forces and defence industries.

In the same time-frame as Augustine weapons, another new technology is emerging in the form of cheap drones, capable of attack and surveillance missions replacing manned aircraft. Both the Augustine and drone technologies will be reviewed. Three questions are asked. First, what is known about Augustine weapons; second what is not known; and third, what do we need to know for sensible debates about these new weapons? The simple answers to these questions are: little is known; there is a lot which is unknown; and much needs to be known. This article speculates about the future impacts of these new weapons technologies.

What are Augustine weapons systems?

Augustine weapons are a new class of weapons systems. They are costly high technology systems with costs rising substantially between generations of equipment. Historically, the unit cost of high-performance fighters has grown by a factor of four every ten years, with cost growth closely correlated with the passage of time.¹ "New technology opens vast new capability vistas which are then crammed into each new generation of a product".¹ The capability vistas are represented by electronics, computers and computer software.

Augustine weapons are presented as offering the prospect of battle field winning technologies. Increasingly, capital and technology will replace military personnel and personnel will become higher skilled. The emergence of remote warfare also raises ethical questions. The high and rising unit costs of Augustine weapons raise the future prospect that wars might become unaffordable. They also have implications for the armed forces and defence industries. These new weapons systems need to be subject to critical economic analysis

exploring the relationship between technology and weapons and their impacts on defence policy. In one sense, Augustine weapons are not new: like all weapons, they are lethal systems involving death and destruction, blood and ruins.²

Some economics

The central message of economics is that a society's resources are scarce and have numerous alternative uses. There is the classic 'guns versus butter' choice which affects all economies. More resources for defence means less for civil uses: military forces are not immune to this simple insight. It is an insight which military personnel ignore at their peril. Generals can have the latest all singing and dancing tanks; admirals can have the latest aircraft carriers and their jets; and air marshals can enjoy state of the art fighter jets, but none of these are costless. Something has to go: just as in any competitive economy, more expensive investments probably mean job losses. Certainly, high technology is not costless. Costly Augustine weapons come at a price. Being so costly, smaller quantities are bought with impacts on the size of armed forces and defence industries, forming the 'price' of Augustine weapons.

Military forces

At a higher and rising real unit cost, Augustine systems will be bought in smaller quantities (fewer are bought at a higher price). UAVs can be operated by ground-based crews, they have substantial range and endurance and can fly for longer periods of time compared with manned surveillance aircraft (e.g. maritime patrol aircraft). Simulators will replace actual operational flying so reducing the wear and tear of operational flying with a reduced demand for replacement aircraft. Overall, Augustine systems need greater skills inputs for their operation, maintenance and repair, so there will be a greater demand for more highly skilled military personnel.

Drones will impact the numerical strength of the armed forces. Augustine weapons mean smaller forces, but this effect will be offset by opportunities to purchase larger quantities of small cheap drones. There will be impacts on the training and support roles for military personnel. Simulators can be used for training so reducing the need for costly manned flights of expensive combat aircraft, with corresponding reductions in maintenance and repair bills.

Defence industries

Augustine weapons mean smaller volumes of costly systems for defence industries whilst drones mean the opposite, namely, larger quantities of cheap systems. Both types of weapons will mean defence industries becoming even more technology and R&D-intensive.

Industry structure could be affected with a continuation of the long-run trend towards a smaller number of larger firms. National domestic weapons markets are likely to become smaller as nations find it difficult to fund costly Augustine systems leading to incentives for international collaboration and a greater emergence of international firms.

The twin technologies of Augustine systems and drones might be combined in one firm or lead to the emergence of separate specialist defence companies, much depending on the transaction costs of the alternatives.

Evidence

There is considerable evidence in the UK and USA of inter-generational cost escalation, reflected in the rising unit costs between successive generations of weapons.³ Table 1 presents UK evidence on cost escalation from a sample of fighter aircraft.¹ The original and specific Augustine prediction was unit costs rising by a factor of four every 10 years. On this criterion, most aircraft in Table 1 did not appear to qualify in that their escalation factors were fewer than 2: only the Meteor and Javelin qualified as Augustine weapon systems.

Table 1 UK cost escalation

Aircraft	Date	Unit production cost (£s 1959 constant prices)	Escalation factor	Time gap (months)
Gauntlet	Jun-34	£4986	NA	NA
Gladiator	Nov-37	£5677	x1.1	41
Spitfire	Dec-39	£10852	x1.9	25
Meteor	Mar-46	£45591	x4.2	75
Hunter	Sep-55	£47143	x1.03	114
Javelin	Jan-57	£147051	x3.1	16
Lightning	Apr-59	£189168	x1.3	27

Note:

- i. The data set did not provide data for fighter aircraft prior to the Gauntlet.
- ii. Escalation factor is the difference between real unit production cost data for one generation of aircraft and its successor (e.g. Gladiator and Spitfire).
- iii. Time gap is time in months between each generation of aircraft: for example, time from Gladiator to Spitfire.

Source: DSTL (2010).⁴

¹The UK data were from military aircraft contracts for the period 1935 to 1965. Unit costs are for airframes only excluding other cost items such as engines, landing gear, radios and weapons.

Overall, between the Gauntlet and Lightning combat aircraft over the period 1934 to 1959 real unit production costs rose by a factor of almost 40-fold. There were substantial variations in cost escalation between each successive generation and none of the escalation factors conformed to the Augustine prediction of unit costs rising by a factor of four every 10 years. The Meteor came close with an escalation factor of 4.2 achieved in less than 10 years. To conclude, the data confirm inter-generational cost escalation but did not support the specific Augustine hypothesis of unit costs rising by a factor of four every 10 years.

Conclusion

Cheap drones are a challenge to Augustine weapons systems and could render them obsolescent. But a more likely result is that drones become technically more complex and lose their cheapness, joining the Augustine ranks of costly high technology weapons.

Much remains to be explored in developing an analytical framework for Augustine weapons. This exploratory article has reviewed what is known, what is not known and what we need to know to identify the causal factors leading to the development of Augustine weapons.

Acknowledgments

None.

Conflicts of interest

The author declares that there is no conflict of interest.

Funding

None.

References

1. Augustine NR. Augustine's laws. London: Penguin Books; 1987.
2. Overy R. Blood and ruins. London: Penguin Books; 2023.
3. Davies N, Eager A, Maier M, et al. Intergenerational equipment cost escalation. London: Ministry of Defence; 2011.
4. DSTL. Historical cost data of RAF aircraft 1935-65(using DSTL version). London: Ministry of Defence; 2010.