*Journal of Global History (2024), 1–19*
doi:10.1017/S1740022823000335

CAMBRIDGE UNIVERSITY PRESS

ARTICLE

# Contractor states and globalization of the market for naval artillery technology (1500–1750)

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**Abstract**

This article reflects on the dynamics that underlay the circulation of military technology during the early modern phase of globalization. The debate on the development and transfer of gunpowder weaponry has been dominated by a grid of analysis which implicitly puts value on sovereign production and direct state control over the resources used for war. Focusing on the transfer of naval artillery between Europe and Asia, the article argues for the need to expand the scope of analysis of the contractor state, so far centred on Europe, and study the potential world-scale of the market for naval resources and services in the period between 1500 and 1750. It also highlights the need to replace the reading of technological transfers centred on nation-states by a more fluid and transnational vision which articulates the demand stemming from both states and non-state actors and the rise of regional clusters specialized in providing naval technology with competitive levels of prices, in an age of increasingly interconnected maritime economies. Therefore, the article aims to show why naval artillery, despite being a protagonist of old imperialistic narratives, is still a relevant object of study for the agenda of global history.

**Keywords:** military technology; gunpowder weapons; contractor state; maritime economy; globalization; Europe and Asia

Since the middle of the twentieth century, the history of gunpowder technology has been dominated by Eurocentric narratives that have drawn a direct link of causality between the invention of firearms in the late Middle Ages and the rise of European hegemony in the world.[1] This literature has explained the superiority of European guns as a product of the intensive competition between western European states which would have stimulated military innovations. More recently, many studies of global military history have taken a critical stance towards this narrative by highlighting that neither firearms nor interstate competition were privileges of European societies and that, throughout the early modern period, the European presence in Africa and Asia was restrained to the sea and some coastal strongholds.[2] This new paradigm for the history of gunpowder technology has emphasized the world-wide circulation of weapons and

[1]Carlo M. Cipolla, *Guns, Sails and Empires: Technological Innovation and the Early Phases of European Expansion, 1400–1700* (New York: Minerva Press, 1965); Paul M. Kennedy, *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000* (London: Unwin Hyman, 1988); Geoffrey Parker, *The Military Revolution: Military Innovation and the Rise of the West, 1500–1800* (Cambridge: Cambridge University Press, 1988); Philip T. Hoffman, *Why Did Europe Conquer the World?* (Princeton: Princeton University Press, 2015).

[2]Some influential authors are Kenneth W. Chase, *Firearms: A Global History to 1700* (Cambridge: Cambridge University Press, 2003); J. C. Sharman, *Empires of the Weak: The Real Story of European Expansion and the Creation of the New World Order* (Princeton: Princeton University Press, 2019); Tonio Andrade, *The Gunpowder Age: China, Military Innovation, and the Rise of the West in World History* (Princeton: Princeton University Press, 2016).

experts during the early modern phase of globalization, and has discussed the capacities of various non-European states and societies to integrate, reproduce, reject, or generate gunpowder innovations following the spread of European-style firearms.

The purpose of this article is to widen the reflection on the circulation of military technology by discussing the idea that early modern states could rely on imported technological resources to carry out their wars. The old narrative on the role of guns in the rise of the West has been influenced by a long tradition of military history deeply rooted in national perspectives, which considered that states fought their wars with the technology they developed. In its project to undermine this narrative, the revisionist stream of global military history has somehow inherited an implicitly positive judgment on the military technology which was domestically produced by non-European states: what is regularly identified as a successful achievement is the capacity of China, Japan, or Mughal India to manufacture their own European-style muskets and artillery, while their limited attempt to compete with European naval technology at sea is often considered a weakness.[3] Nevertheless, studies on the contractor state have recently shed light on the fact that states, at least in Europe, were only rarely the producers of the military resources they mobilized for war.[4] This article argues that it is worth exploring how this vision of states as consumers capable of obtaining foreign technological resources from the private economic sphere can be applied outside of Europe. This new insight allows us to have a better grasp on the various ways military technology could circulate during the early stage of globalization in the period 1500–1750.

In this regard, naval artillery offers an interesting case study for several reasons. First, the burgeoning field of global military history has dedicated very little attention to this specific type of weaponry, which is too often studied within broader categories of analysis such as 'firearms', 'guns' or 'gunpowder technology'.[5] This work is motivated by the conviction that shooting heavy iron projectiles from the deck of a ship required a very different technological capacity than that of firing cannon towards a fortress or using a musket on a battlefield. Operating a distinction between various types of firearms opens interesting perspectives because, paradoxically, while many Asian states did manage to reproduce European-style gunpowder weapons, their naval armament often remained behind European standards. In other words, the sustained growth of direct exchanges between Europe and Asia had two opposite effects as it resulted in a technological convergence on land and a technological divergence at sea.

This article not only highlights these two opposite trends of technological transfer between Europe and Asia, but it also proposes an explanation inspired by the literature on the contractor state: large Asian states were able to negotiate access to European naval artillery especially by hiring the services of European ships which were often used to advance their own political agenda. The outsourcing of direct naval functions to efficient foreign ships can be considered a cost-effective solution that decreased the need for these states to develop expensive programmes of domestic production of naval armaments with all the necessary adaptations in shipbuilding, naval architecture, maintenance facilities, and training of crews. While it has been argued that the adoption or rejection of the new European-style guns by different societies had strong political and

[3]Chase, *Firearms: A Global History*, 130–33, 143, 174–5, 178; Andrade, *The Gunpowder Age*, 142, 196–207.

[4]Richard Harding and Sergio Solbes, eds., *The Contractor State and Its Implications, 1659–1815* (Las Palmas: Universidad de Las Palmas, 2012); Jeff Fynn-Paul, ed., *War, Entrepreneurs and the State in Europe and the Mediterranean, 1300–1800* (Leiden: Brill, 2014); David Parrott, *The Business of War: Military Enterprise and Military Revolution in Early Modern Europe* (Cambridge: Cambridge University Press, 2012); Roger Knight and Martin Wilcox, *Sustaining the Fleet, 1793–1815: War, the British Navy and the Contractor State* (Woodbridge: The Boydell Press, 2010); Rafael Torres Sánchez, *Military Entrepreneurs and the Spanish Contractor State in the Eighteenth Century* (Oxford: Oxford University Press, 2016); David Plouviez, *La Marine Française et Ses Réseaux Économiques au XVIII^e Siècle* (Paris: Les Indes Savantes, 2014).

[5]Chase, *Firearms: A Global History*; Andrade, *The Gunpowder Age*; Sharman, *Empires of the Weak*; Erica Charters, Marie Houllemare, and Peter H. Wilson, eds., *A Global History of Early Modern Violence* (Manchester: Manchester University Press, 2020).

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

cultural dimensions,[6] this study suggests that economic considerations should also be taken into account. The final proposition formulated here is that the technological leadership of western European ships might have been less the product of interstate competition than the result of an economic specialization caused by the spectacular boom in merchant shipping and the world-wide capacity to export naval services.

## Convergent forces: globalization of gunpowder technology

All the latest research agrees on the fact that gunpowder technology emerged in Asia. The first gunpowder weapons were fire lances and bombs invented in China in the twelfth and thirteenth centuries.[7] These incendiary and explosive weapons reached Europe through the Mongols in the early fourteenth century.[8] There, in a wide area between western Europe and the Ottoman Empire, the technology evolved towards metallic tubes, such as muskets and cannons, using the pressure of the gas resulting from the fast combustion of gunpowder in order to propel iron projectiles such as bullets and cannonballs.[9] By the time this technology reached back to China in the 1520s, it was already present in all continents. It is important to underline that this global circulation was more than a mere diffusion process as the object, gunpowder weaponry, was significantly altered in the process.[10] When the Chinese confronted Portuguese forces for the first time, in 1521, they acknowledged the superiority of European firepower, but they also quickly managed to acquire and copy these weapons.[11]

This new weaponry usually designated by the generic word 'gun' has long been considered a crucial element of the European expansion in the world. One of the most influential narratives of this historical process has been proposed by Geoffrey Parker with the concept of the 'military revolution'.[12] The development of this new type of gunpowder technology in Europe triggered a whole set of military innovations not only in terms of weaponry but also in infantry tactics, fortification, and naval architecture. Most importantly, the narrative explains how the West achieved world hegemony during the early modern period thanks to this advantage in warfare. The chronology and key innovations at the core of the military revolution have been debated.[13] The very existence of a military revolution has been questioned, insofar as the transformation spread over several centuries.[14] However, the idea of a connection between European overseas expansion and superior military technology is still defended by some historians. For instance Philipp Hoffman recently wrote about the many non-transferable 'clusters of complementary skills' which made early modern Europe the leading region in gunpowder technology, comparable to today's Silicon Valley.[15]

In the last two decades, many studies have moved away from this Eurocentric perspective on the history of gunpowder technology and have shown that, far from being a European monopoly

[6]Sharman, *Empires of the Weak,* 23; Sanjay Subrahmanyam and Geoffrey Parker, 'Arms and the Asian: Revisiting European Firearms and Their Place in Early Modern Asia', *Revista de Cultura* 26 (2008): 12–42.

[7]Chase, *Firearms: A Global History*, 1; Andrade, *The Gunpowder Age*, 16, 40–41.

[8]Andrade, *The Gunpowder Age*, 76.

[9]Parker, *The Military Revolution*; Rogers, *The Military Revolution Debate*; Gábor Agoston, *Guns for the Sultan: Military Power and the Weapons Industry in the Ottoman Empire* (Cambridge: Cambridge University Press, 2005).

[10]See the remarks of Gänger about the abusive use of the word 'circulation' in global history: Stefanie Gänger, 'Circulation: Reflections on Circularity, Entity, and Liquidity in the Language of Global History', *Journal of Global History* 12 (2017): 303–18.

[11]Tonio Andrade, 'Cannibals with Cannons: The Sino-Portuguese Clashes of 1521–1522 and the Early Chinese Adoption of Western Guns', *Journal of Early Modern History* 19 (2015): 311–35.

[12]Parker, *The Military Revolution*.

[13]Clifford J. Rogers, ed., *The Military Revolution Debate: Readings on the Military Transformation of Early Modern Europe* (Boulder: Westview Press, 1995).

[14]Jeremy Black, *A Military Revolution? Military Change and European Society 1550–1800* (Basingstoke: Macmillan Education, 1991).

[15]Hoffman, *Why Did Europe Conquer the World?*, 163.

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

in the early modern period, firearms became meaningful instruments in many societies across the world. European guns became a staple of the Atlantic slave trade with Africa, where an enslaved person could be purchased in exchange for about twenty to thirty muskets in the early eighteenth century.[16] Access to massive amounts of firearms enabled some more centralized and militarized states, such as the Kingdom of Dahomey in the Gulf of Guinea, to expand and conquer smaller and weaker neighbours, thus feeding the Atlantic trade with more slaves.[17] In America, European firearms also spread among the indigenous population. In the seventeenth century, the Guarani living in the River Plate basin managed to obtain muskets with the complicity of local Jesuits and smugglers involved in the Atlantic trade. These weapons allowed the Guarani to negotiate political and military status with the Spanish colonial authorities in exchange for the defence of this remote borderland.[18] In North America, indigenous communities became a very serious threat for the colonies of New England after they started to receive regular supplies of muskets from French, Dutch, and English traders in the 1640s.[19] All these examples show that licit and illicit trade permitted gunpowder technology to circulate through transnational networks and bypass the national boundaries which have long constituted the basic unit of analysis in military history.

Early modern Asian societies went one step beyond the mere acquisition of European guns through trade as they properly integrated this new weaponry into state military structures, including domestic production facilities. Robust evidence shows that the Ottomans already used guns in the 1380s, only half a century after their first appearance in western Europe.[20] During the fifteenth century, they developed a whole network of cannon manufactures while their troops, especially the Janissaries under the direct command of the Sultan, gradually increased their proportion of handguns. For this reason, Agoston even claims that 'the Ottomans preceded their European adversaries in establishing centralized and permanent troops specialized in the manufacturing and handling of firearms'.[21] Their Persian rivals created their own artillery corps in the late fifteenth century and started to manufacture cannons and muskets in the early sixteenth century.[22] When the Portuguese explored the coast of India in the 1500s, they came upon vast numbers of guns in all port cities.[23] After the capture of Goa in 1510, they discovered an arsenal with many gunpowder experts and they even sent back home an Indian gunsmith to teach his skills in Portugal.[24] In 1525, Babur invaded India with a powerful train of artillery and muskets which became a core element of the Mughal army in the following decades.[25] With its long acquaintance to gunpowder technology and its well-developed arms industry, Ming China was particularly fast in integrating the new type of firearms: copies of Portuguese swivel guns called *folangji*, 'Frankish cannons', were already produced in Beijing in 1523, barely two years after the first Chinese clash with Portuguese forces.[26] A couple of decades later, Japanese blacksmiths replicated the first Portuguese muskets which reached the archipelago and soon became renowned experts in the manufacturing of firearms. In the 1570s, muskets played a decisive role in the wars

[16]David Northrup, *Africa's Discovery of Europe, 1450–1850* (Oxford: Oxford University Press, 2002), 90.

[17]Richard J. Reid, *Warfare in African History* (Cambridge: Cambridge University Press, 2012), 81–3; John K. Thornton, *Warfare in Atlantic Africa, 1500–1800* (London: UCL Press, 1999).

[18]Pedro Omar Svriz Wucherer, *Resistencia y negociación: Milicias guaraníes, jesuitas y cambios socioeconómicos en la frontera del imperio global hispánico (ss. XVII–XVIII)* (Rosario: Prohistoria ediciones, 2019).

[19]Geoffrey Parker, 'Europe and the Wider World, 1500–1750: The Military Balance', in *The Political Economy of Merchant Empires: State Power and World Trade, 1350–1750*, ed. James D. Tracy (Cambridge: Cambridge University Press, 1997): 161–95, 166.

[20]Agoston, *Guns for the Sultan*, 17.

[21]Agoston, *Guns for the Sultan*, 192.

[22]Chase, *Firearms: A Global History*, 114, 117.

[23]Chase, *Firearms: A Global History*, 131.

[24]Richard Eaton and Philip B. Wagoner, 'Warfare on the Deccan Plateau, 1450–1600: A Military Revolution in Early Modern India?', *Journal of World History* 25, no. 1 (2014): 5–50, 16.

[25]Chase, *Firearms: A Global History*, 131–3.

[26]Andrade, *The Gunpowder Age*, 142.

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

for the unification of Japan.[27] By the time of the Great East Asian War (1592–1598), China, Korea, and Japan fought each other with thousands of musketeers.[28]

The adoption of European gunpowder technology by Asian powers also highlights the complex patterns of technological transfers and the important agency of Asian expertise. European experts undeniably exported their skills to attractive foreign patrons: for instance, in the 1540s, several sources mention the presence of many German, French, Venetian, Genoese, Spanish, and Sicilian technicians in the cannon foundry of Istanbul. Nevertheless, at that time, the majority of craftsmen in this production centre were Muslims, which is why Agoston rather speaks of a technological dialogue happening at what was actually a crossroad between metallurgy techniques from the East and the West.[29] It is also interesting to mention that Ottoman gunpowder experts were major vectors for the transfer of firearm technology towards North Africa, Central Asia (Turkistan), India (Gujarat, Mughal Empire), Southeast Asia (Aceh), and even China, as they became diplomatic tools of the Ottoman foreign policy to support allies and limit Portuguese expansion in the Indian Ocean.[30] Furthermore, the hiring of foreign experts was also practised by European powers in their colonies: for instance in 1623, Portuguese authorities made a contract with two Chinese masters for the production of cast-iron artillery in Macao.[31] Such Chinese craftsmen with work experiences in the cannon foundries of Portuguese Macao and Spanish Manila were particularly sought after by the Chinese government who sometimes managed to attract them under its own patronage.[32]

Asian societies so deeply appropriated the gunpowder technology coming from Europe that they sometimes generated their own innovations. For example, in the sixteenth-century Deccan plateau, the sultanate of Bijapur borrowed some features of the Portuguese cannons such as trunnions and swivel forks in order to produce a new type of defensive artillery with more lateral and vertical movement than any European equivalent.[33] Quite interestingly, some scholars have also argued that the musketry volley fire – a military tactic which has been identified as an element of the military revolution – was successfully applied by the famous unifier of Japan, Nobunaga, a few years before it was implemented in Europe, by the Dutch, in the 1590s.[34] All these examples clearly show that Europeans were not the only source of expertise on gunpowder technology in the early modern period.

In the end, the general impression might be that the implementation of sustained direct connections between the different parts of the world which was triggered by the Iberian expansion launched a process of global technological convergence in the field of gunpowder weaponry. Nevertheless, the process was not homogeneous: some areas were only receptive to certain aspects of the new firearms while others became more deeply acquainted with most parts of the gun technology brought by the European intruders. Subrahmanyam and Parker have even evoked the suspicion and, sometimes, the revulsion that European gunpowder technology provoked in some societies, especially those with strong warrior cultures.[35] Another issue which has been granted

[27]Chase, *Firearms: A Global History*, 178.

[28]Kenneth M. Swope, *A Dragon's Head and a Serpent's Tail: Ming China and the First Great East Asian War, 1592–1598* (Norman: University of Oklahoma Press, 2009).

[29]Agoston, *Guns for the Sultan,* 44–8.

[30]Giancarlo Casale, *The Ottoman Age of Exploration* (Oxford: Oxford University Press, 2010); Nicola Di Cosmo, 'European Technology and Manchu Power: Reflections on the "Military Revolution" in Seventeenth-Century China', in *Making Sense of Global History: The 19th International Congress of the Historical Sciences*, ed. Sølvi Sogner (Oslo: Oslo University Press, 2001), 119–39.

[31]Vitor L. G. Rodrigues, 'Mestres-Fundidores Portugueses Na China', in *Portugal – China: 500 Anos*, ed. Miguel Castelo Branco (Lisbon: Babel, 2014), 158–63.

[32]Andrade, *The Gunpowder Age*, 198.

[33]Eaton and Wagoner, 'Warfare on the Deccan Plateau, 1450–1600', 25–6.

[34]Andrade, *The Gunpowder Age*, 166; Hoffman, *Why Did Europe Conquer the World?*, 82; Chase, *Firearms: A Global History*, 179–82.

[35]Subrahmanyam and Parker, 'Arms and the Asian'.

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

very little analysis is the rather limited integration of European-style ordnance on board non-European ships.

## Divergent forces: the exception of naval artillery

A certain episode of Chinese history studied by Tonio Andrade reveals some interesting limits to the Asian appropriation of European gunpowder technology at sea.[36] In 1663, the Qing emperor launched an important naval operation to seize Amoy, the main coastal base of the Zheng, a powerful family of merchant warlords who had remained loyal to the former Ming dynasty. The confrontation that followed opposed hundreds of junks on both sides and it first clearly turned to the advantage of the Zheng over the imperial forces. Nevertheless, the Qing fleet was helped by a squadron of fifteen ships belonging to the Dutch VOC which proved to be enough to completely reverse the balance of power. Andrade notes that the Zheng commanders 'recognized Dutch naval superiority immediately' and clearly expressed their fear in their correspondence. When the Dutch ships were able to properly use their firepower on the second day of battle, they managed to disband the Zheng and forced them to flee. As quoted by Andrade, the Dutch admiral, an Italian observer, and the Qing commander all agreed that the small Dutch squadron, on its own, was capable of facing the whole Zheng fleet numbering several hundreds of Fujianese junks.

This striking outcome, confirmed by various testimonies, raises important issues for historians of military technology interested in global comparative perspectives. The first element that needs to be emphasized is that the Dutch squadron achieved what the vast war fleet of a giant state like Qing China could not. It is worth noting that this squadron was not even composed of specialized warships. In all military operations of the period, the VOC rather used large and medium-size yachts, usually equipped with up to forty cannons, which Parthesius describes as 'armed merchant vessels'.[37] Second, it should be highlighted that these fifteen ships were a rather small force in comparison with what could be found in European waters at that time. For instance, in June 1665, the Dutch state sent 103 ships, numbering 4,869 cannons at the battle of Lowesoft, and yet, this fleet was severely defeated by superior British firepower.[38] In other words, the technological gap in naval warfare between the western and eastern edges of the Eurasian landmass might have been such that a very small sample of western ships could play a major role in the largest naval battles between eastern fleets. The point is not that technology gave an almighty power to Europeans in Asian waters: Andrade describes other battles in which the Zheng actually got the edge over the VOC thanks to good leadership, clever tactics, and bigger numbers.[39] However, it seems quite legitimate to wonder how Dutch ships could enjoy such an overwhelming advantage in firepower over all Qing and Zheng ships while China had already embraced the new type of European firearm technology for more than a century.[40]

This question highlights the need to operate a distinction between various groups of gunpowder weapons when analysing their appropriation by non-European societies. By the early seventeenth century, the Chinese army had become a master in the technology of muskets through the implementation of domestic production, drill, and new infantry tactics.[41] In the 1520s, the Ming started to copy Portuguese swivel guns and launched the production of *folangji*, 'Frankish

[36]Tonio Andrade, 'Was the European Sailing Ship a Key Technology of European Expansion? Evidence from East Asia', *International Journal of Maritime History* 23, no. 2 (2011): 17–40.

[37]Robert Parthesius, *Dutch Ships in Tropical Waters: The Development of the Dutch East India Company (VOC) Shipping Network in Asia, 1595–1660* (Amsterdam: Amsterdam University Press, 2010), 75, 159, 167.

[38]Jonathan I. Israel, *The Dutch Republic: Its Rise, Greatness, and Fall, 1477–1806* (Oxford: Oxford University Press, 1995), 768.

[39]Andrade, 'Was the European Sailing Ship a Key Technology of European Expansion?'.

[40]Andrade, *The Gunpowder Age*; Andrade, 'Cannibals with Cannons'.

[41]Andrade, *The Gunpowder Age*, 144–87.

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

guns', which became one of the most common ordnance used in China. This was a type of very light artillery shooting cannonballs of less than 1 lb (0.45kg).[42] The production and use of heavier artillery developed later, in particular during the wars of the Manchu invasion. The Ming obtained cannons and artillerists from Portuguese Macao in the 1620s and then hired the Jesuit Adam Schall to manufacture heavy artillery in Peking in the 1640s, whereas their rivals, the Qing, managed to cast large European-style cannons called *hongyo dapao* (redcoat cannon) in the 1630s.[43]

Nevertheless, the outcome of the naval confrontation between the Qing and the Zheng in 1663, and the spectacular role played by Dutch cannons, clearly shows that such heavy artillery had not yet been mounted on board Chinese junks. This is not to say that Chinese ships were not equipped with gunpowder weapons. Swope has shown that the Ming ships of the Great East Asian War (1592–98) carried some artillery, but their largest guns were *folangji*.[44] Arming warships with heavier weapons required major transformations in naval architecture. Thus, a Chinese military treatise from the 1560s explained that *fagong*, a type of Chinese artillery shooting cannonballs of about 5 lbs (2.4 kg), could not be fired from warjunks without ripping them open and sinking them.[45] As a result, Chinese naval ordnance was completely outclassed, in terms of both range and impact, by the kind of cannons which were commonly used on board European ships at that time, generally shooting cannonballs of at least a few pounds and up to more than 30 lbs (14 kg.).[46] In other words, the new gunpowder technology coming from Europe was clearly less integrated into the Chinese navy than into the land army.

To what extent was this feature shared by other Asian states? Several examples show the danger of any generalization on this topic. In the sixteenth century, the sultanate of Aceh managed to recapture part of the Portuguese maritime spice trade with the support of Ottoman expertise in artillery and galley warfare.[47] Later, the ships of the sultan of Oman in the seventeenth century or the ones of Maratha privateer Kanhoji Angria in the early eighteenth century had enough heavy artillery to threaten most European vessels.[48] Yet, the historiography based on European and Asian primary sources has depicted the Europeans as the 'lords' or the 'masters of the sea', as the Portuguese already claimed to be in the sixteenth century.[49] The idea of a gradual dominance of European ships in Asian waters throughout the period spreading from 1500 to 1800 has been shared by most of the historiography on maritime Asia.[50] Even some authors who have been critical of Parker's narrative on the military revolution and the rise of the West acknowledge a certain European advantage with respect to violence at sea.[51]

[42]Andrade, *The Gunpowder Age*, 143; Barend Noordam, 'Military Innovation and Intrastate Warfare: Portuguese Artillery and Sieges during the Wokou Raids of the Mid-Sixteenth Century', in *The First World Empire: Portugal, War and Military Revolution*, ed. Hélder Carvalhal, André Murteira, and Roger Lee de Jesus (London: Routledge, 2021), 206–22.

[43]Di Cosmo, 'European Technology and Manchu Power', 127–9.

[44]Swope, *A Dragon's Head and a Serpent's Tail*, 78.

[45]Noordam, 'Military Innovation and Intrastate Warfare', 210.

[46]John F. Guilmartin, 'Guns and Gunnery', in *Cogs, Caravels, and Galleons: The Sailing Ship, 1000–1650*, ed. Robert Gardiner and Richard W. Unger (London: Conway Maritime Press, 1994), 139–50; Jan Glete, *Navies and Nations: Warships, Navies, and State Building in Europe and America, 1500–1860* (Stockholm: Almqvist & Wiksell International, 1993).

[47]Casale, *The Ottoman Age of Exploration*, 123–9, 145–7; Sanjay Subrahmanyam, *The Portuguese Empire in Asia, 1500–1700: A Political and Economic History* (Harlow: Longman, 1993), 134.

[48]Kirti Chaudhuri, *Trade and Civilisation in the Indian Ocean: An Economic History from the Rise of Islam to 1750* (Cambridge: Cambridge University Press, 1985), 156; Sharman, *Empires of the Weak*, 42, 60.

[49]Sharman, *Empires of the Weak*, 5, 35; Michael N. Pearson, *The Indian Ocean* (New York: Routledge, 2003), 116; Jorge Flores, *Unwanted Neighbours. The Mughals, the Portuguese, and Their Frontier Zones* (New Delhi: Oxford University Press, 2018), xi.

[50]Pearson, *The Indian Ocean*, 139, 153, 183; Ashin Das Gupta, *Indian Merchants and the Decline of Surat, c.1700–1750* (Wiesbaden: Franz Steiner Verlage, 1979); James D. Tracy, ed., *The Rise of Merchant Empires: Long Distance Trade in the Early Modern World 1350–1750* (Cambridge: Cambridge University Press, 1993), 10; Michael Charney, *Southeast Asian Warfare, 1300–1900* (Leiden: Brill, 2004), 121, 130; Chaudhuri, *Trade and Civilisation in the Indian Ocean*, 157.

[51]Sharman, *Empires of the Weak*, 5, 35; Andrade, *The Gunpowder Age*, 5, 196.

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

The problem is that this gap in naval artillery has often been analysed exclusively from the perspective of interstate competition. First, the intensity of interstate competition has been held as the principal cause for the European advantage: the main narrative is based on the idea that military innovations were more stimulated in Europe because of political fragmentation and incessant warfare.[52] Nevertheless, as Hoffman has pointed out, this factor cannot explain, on its own, any gap in gunpowder technology between Europe and other regions which also experienced long periods of intense warfare, such as India.[53] Other scholars have argued that the development of gunpowder technology followed different paths in western Europe and Asia because states were confronted with different types of threat. In this perspective, Chase has argued that the main foes of the Chinese state have been nomads against whom heavy artillery was useless.[54] In a more general note about Asia, Subrahmanyam and Parker have highlighted that confrontations between Europeans and Asians before the eighteenth century were a marginal phenomenon in a geopolitical landscape dominated by interstate competition between Asian rivals which obeyed their own cultural and political codes and in which the introduction of gunpowder technology did not produce massive transformations in a similar way to what happened in Europe.[55]

At the core of these views lay the problematic assumption that states developed internally the technological innovations they deployed on the battlefield. Such a vision, which might better correspond to late-nineteenth-century nation states, fails to capture the transnational nature of the military resources mobilized by early modern states. The recent works of the contractor state group have shown that European states resorted massively to the international market of private entrepreneurs in order to access key military resources and technology.[56] In this sense, the episode of the battle near Amoy in 1663 can have two readings: it might indeed show a technological gap between Dutch and Chinese warships, but it also highlights the capacity of the Chinese state to resort to European technology in order to advance its own geopolitical agenda; after all, the Dutch fought for the Qing emperor against the Zheng dissidents. In a period that some historians have considered an 'age of partnership',[57] Asian rulers sometimes managed to obtain access to European naval technology by hiring the services of European ships. It was not a political capitulation to European overwhelming technological dominance but rather an economic deal whose consequences need to be analysed more in depth. It is therefore essential to reconsider the mobilization of military technology by states as operating inside a market which, in the case of naval technology, was becoming globalized because of the presence of European ships in all the waters of the world.

## Contractor states and the access to European naval technology

Although the fiscal systems of early modern states have been the object of a global comparative study,[58] it is still necessary to understand the other side of the coin and compare also how states spent their money and mobilized resources for war. Focused on western Europe, the recent research on the contractor state has proposed to consider early modern states not so much as

[52]Kennedy, *The Rise and Fall of the Great Powers*; Parker, *The Military Revolution*.

[53]Hoffman, *Why Did Europe Conquer the World?*, 5.

[54]Chase, *Firearms: A Global History*.

[55]Subrahmanyam and Parker, 'Arms and the Asian'.

[56]Harding and Solbes, eds., *The Contractor State and Its Implications, 1659–1815*; Fynn-Paul, ed., *War, Entrepreneurs and the State*; Parrott, *The Business of War*; Knight and Wilcox, *Sustaining the Fleet, 1793–1815*; Torres Sánchez, *Military Entrepreneurs and the Spanish Contractor State in the Eighteenth Century*; Plouviez, *La Marine Française et Ses Réseaux Économiques au XVIII^e Siècle*.

[57]Blair B. Kling and Michael N. Pearson, eds., *The Age of Partnership: Europeans in Asia before Dominion* (Honolulu: The University Press of Hawai'i, 1979).

[58]Bartolomé Yun Casalilla and Patrick O'Brien, eds., *The Rise of Fiscal States: A Global History 1500–1914* (Cambridge: Cambridge University Press, 2012).

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producers but rather as purchasers and consumers of military resources.[59] Although state demand for military technology stimulated the development of some state-ruled industrial complexes such as arsenals, large parts of the military supplies were outsourced to private businessmen and their transnational networks.[60] These studies have also reassessed the role of military entrepreneurs who had long been considered minor actors of the military bureaucracy, often associated with ideas of corruption and decadence of public service, and who are now presented as 'the most efficient option for any state to pursue, given the limitations of government at the time'.[61] This new approach invites historians to move away from the classic institutional views on military forces centred on nation states, in order to understand the mobilization of military resources as an international 'market'.[62] In this perspective, the on-going research of Wilson and Klerk is proposing the interesting idea of 'fiscal military hubs', defined as international clusters able to supply specialized military resources and expertise to states, semi-state and non-state actors.[63]

So far, this literature on the contractor state has insisted on the European dimension of the fiscal-military entrepreneurs' activities, but there is evidence that Asia started to be connected to these networks as well. Direct channels for the sale of heavy armament were established between Europe and Asia: for instance, in the first half of the seventeenth century supplying heavy ordnance to the sultan was a requirement for every European ship willing to trade in Makassar. As a consequence, Portuguese, English, and Danish cannons were not only common on the walls of this preponderant Southeast Asian port, but they were also sold in the open market to local shippers who struggled to defend their trade in spices with the Moluccas.[64] In India, the European chartered companies developed a profitable side business in naval guns for local merchants and ship owners, at least until this trade started to be more regulated in the 1720s.[65] The importance of the trade in artillery can be grasped from an inventory made in 1799, when the British conquered Seringapatam, the capital city of the kingdom of Mysore: they found about 1,500 pieces of ordnance, most of them manufactured in Britain, France, Spain, and Holland, which had either been supplied by European private merchant ships or smuggled by agents of the chartered companies.[66] It is tempting to see in these imports the dependence of Asian states on the military technology produced in Europe. However, it is worth noticing that this dependence was not absolute, as both Makassar and Mysore also had local state-ruled cannon manufactures. Furthermore, the situation in these two Asian states was not much different from that of some European states such as Spain, which imported cannons for its armadas from British and French

[59]Richard Harding and Sergio Solbes, 'Introduction' in *The Contractor State and Its Implications, 1659–1815*, eds. Richard Harding and Sergio Solbes (Las Palmas: Universidad de Las Palmas, 2012); 7–16, 9.

[60]Fynn-Paul, ed., *War, Entrepreneurs and the State*; Parrott, *The Business of War*; Knight and Wilcox, *Sustaining the Fleet, 1793–1815*; Torres Sánchez, *Military Entrepreneurs and the Spanish Contractor State in the Eighteenth Century;* H. V. Bowen, 'The Contractor State, c.1650–1815', *International Journal of Maritime History* 25, no. 1 (2013): 239–74. Harding and Solbes, eds., *The Contractor State and Its Implications*.

[61]Jeff Fynn-Paul, Marjolein 't Hart and Griet Vermeesch, 'Introduction: Entrepreneurs, Military Supply, and State Formation in the Late Medieval and Early Modern Periods: New Directions', in *War, Entrepreneurs and the State in Europe and the Mediterranean, 1300–1800*, ed. Jeff Fynn-Paul, (Leiden: Brill, 2014), 1–12, 10.

[62]Fynn-Paul, 't Hart and Vermeesch, 'Introduction', 11.

[63]Peter H. Wilson and Marianne Klerk, 'The Business of War Untangled: Cities as Fiscal-Military Hubs in Europe (1530s–1860s)', *War in History* 29, no. 1 (2022): 80–103.

[64]Tristan Mostert, 'Suppliers, Knowledge Brokers, and Brothers in Arms. Portuguese Aspects of Military Innovation in Makassar' in *The First World Empire. Portugal, War and Military Revolution*, ed. Hélder Carvalhal, André Murteira, and Roger Lee de Jesus (London: Routledge, 2021), 186–205, at 194.

[65]Kirti N. Chaudhuri, *The Trading World of Asia and the English East India Company 1660–1760* (New Delhi: SChand & Co, 1978), 202–3.

[66]H. V. Bowen, 'Trading with the Enemy. British Private Trade and the Supply of Arms to India, c.1750–1820', in *The Contractor State and Its Implications, 1659–1815*, ed. Richard Harding and Sergio Solbes (Las Palmas: Universidad de Las Palmas, 2012), 32–53, 40.

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firms.[67] In the end, importing cannons was, for any state, a choice based on economic and technical criteria, but its main consequence was the burgeoning, in Europe, of some clusters specialized in the production of heavy weaponry with increasingly competitive levels of quality and prices.

States could import military technology either by working with the market or by subverting it with the use of coercion. For instance, in 1537, the Ottomans seized all Venetian merchant vessels in Egypt and forced their crews of gunners, pilots, and skilled craftsmen to join the powerful fleet they were assembling in Suez to attack the Portuguese in India.[68] Orientalist views would have interpreted this episode as an example of Asian despotism and a clear evidence of European technological leadership, but a fairer comparison should highlight some striking similarities with what was practised by states in western Europe. Thus, more than half of the ships which composed the famous Spanish armada of 1588 were merchant vessels from Spain, Italy, the Netherlands, the Hanseatic League, and England which had been requisitioned by royal officials – with a negotiated compensation for their owners.[69] Even in the squadrons of Spanish state-owned warships, the overwhelming presence of Hanseatic, Flemish, Italian, and Dutch gunners proved that the Spanish monarchy relied heavily on foreign merchant vessels to obtain qualified military technicians for its armadas.[70] The Spanish navy was not the exception but rather the rule throughout Europe: according to Glete, European states massively resorted to armed merchantmen to fight their wars at sea until the late seventeenth century.[71] In the following century, privateers acting under state license remained essential elements in the confrontations between naval powers at sea.[72] Once again, the conclusion is that the naval technology deployed by states was not the mere result of nationalized domestic production but a complex mix of resources that states could produce, buy, or obtain by force from the wider maritime economy.

The type of agreement binding together Qing China and the VOC in 1663 was another interesting form of mobilization of military resources and technology. The literature tends to present it essentially from a political perspective, as an 'alliance' between two powers.[73] After all, the VOC was a chartered company enjoying diplomatic and political authority as a sort of extension of the Dutch state in Asia.[74] Nevertheless, although the agreement certainly had a political dimension – the Dutch were also seeking revenge from the Zheng for the recent loss of Taiwan – we should not forget that the main purpose which drove the actions of this company was economic profit. The involvement of the VOC on the side of Qing China was largely motivated by the prospect of obtaining legal access to the Chinese trade in the general context of a maritime ban of all foreign traders.[75] Was not this a form of payment for military services? By leaving the door opened to such a concession, the Chinese authorities gained temporary access not just to European weaponry but to a full package of European naval technology ready to be employed: large and sturdy ships armed with

[67]Agustín González Enciso, 'Buying Cannons Outside: When, Why, How Many? The Supplying of Foreign Iron Cannons for the Spanish Navy in the Eighteenth Century', in *The Contractor State and Its Implications, 1659–1815*, ed. Richard Harding and Sergio Solbes (Las Palmas: Universidad de Las Palmas, 2012), 130–52.

[68]Casale, *The Ottoman Age of Exploration*, 59.

[69]Colin Martin and Geoffrey Parker, *The Spanish Armada: Revised Edition* (Manchester: Manchester University Press, 1999).

[70]Brice Cossart, *Les Artilleurs et La Monarchie Hispanique (1560–1610): Guerre, Savoirs Techniques, État* (Paris: Classiques Garnier, 2021), 263–4, 273–5.

[71]Jan Glete, *Warfare at Sea, 1500–1650: Maritime Conflicts and the Transformation of Europe* (London: Routledge, 2000), 24, 31.

[72]Jacques Péret, *Les Corsaires de L´Atlantique: De Louis XIV à Napoléon* (La Crèche: Geste Édition, 2012). David J. Starkey, *British Privateering Enterprise in the Eighteenth Century* (Exeter: University of Exeter Press, 1990).

[73]Andrade, 'Was the European Sailing Ship a Key Technology of European Expansion?', 36.

[74]Markus P. M. Vink, 'Between Profit and Power: The Dutch East India Company and Institutional Early Modernities in the "Age of Mercantilism"', in *Between the Middle Ages and Modernity: Individual and Community in the Early Modern World*, ed. Charles H. Parker and Jerry H. Bentley (Lanham: Rowman & Littlefield, 2006), 285–306.

[75]Wei-chung Cheng, *War, Trade and Piracy in the China Seas (1622–1683)* (Leiden: Brill, 2013), 205–6.

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heavy cannons and manned by an experienced and skilled crew – in other words a whole technological set which would have been long and costly for the Qing state to generate on its own. Therefore, the participation of the Dutch squadron in that Chinese naval battle can be interpreted as a form of mercenary activity which is, again, not dissimilar to what happened in Europe, where, for example, the Venetian Republic hired Dutch mercenary merchantmen to reinforce its navy for some campaigns in those very same years.[76]

It seems that large Asian states were regularly in a favourable position to negotiate this type of services from the Europeans. In China more than a century earlier, the Ming government authorized the Portuguese to settle and trade in Macao in exchange for their help to fight against pirates.[77] Pearson presents the absence of an imperial navy in Mughal India as a 'cost-effective decision' by a state which had little interest in sea matters.[78] Its main price was to leave the Mughals at the mercy of European blackmailing through naval firepower, but this threat was limited because western chartered companies mainly sought to secure trade agreements and economic concessions. On the other side, by accepting the kind of protection racket imposed by the Europeans through the *cartaz* system and the sale of protection passes to local ships, the Mughals gained access to mercenary naval services upon demand without bearing the expenses of building and maintaining an entire navy. Therefore, when the pressure of Anglo-American pirates sharply rose around the Red Sea in the late seventeenth century, the Dutch, English, and French East India companies were compelled to fulfil their protection duties and escort Indian merchant ships from Surat.[79] Similarly, Tokugawa Japan obtained naval support from the VOC in the seventeenth century, and Nader Shah of Persia from the English East India Company (EIC) in the eighteenth century.[80] As Peter Good has noted, the study of how Asian states hired naval services from the Europeans remains quite neglected by the historiography, although Van Meersbergen perceives that these various cases clearly fit a 'larger pattern'.[81]

Naval assistance was often discussed as part of trade agreements between states and European companies. For instance, the terms of the agreement reached in 1624 between the Mughal Empire and the East India Company specified that the English had to offer their assistance to all ships belonging to Surat.[82] In Persia, Nader Shah successfully negotiated the support of the English EIC for naval operations and diplomatic escort after he had first cancelled all previous trade agreements with the Europeans in 1732.[83] He also took advantage of the competition between the English and Dutch companies to improve his bargaining power and, when faced with their reluctance to provide assistance, he could still obtain ships from private European merchants.[84] In some contexts, provincial authorities could also play a decisive role in negotiating such services.

[76]Louis Sicking, 'Selling and Buying Protection: Dutch War Fleets at the Service of Venice (1617–1667)', *Studi Veneziani* 67 (2013): 89–106.

[77]Harriet Zurndorfer, 'Oceans of History, Seas of Change: Recent Revisionist Writing in Western Languages about China and East Asian Maritime History during the Period 1500–1630', *International Journal of Asian Studies* 13, no. 1 (2016): 61–94, 77.

[78]Michael. N. Pearson, 'Merchants and States', in *The Political Economy of Merchant Empires: State Power and World Trade, 1350–1750*, ed. James D. Tracy (Cambridge: Cambridge University Press, 1997): 41–116, at 112.

[79]Guido van Meersbergen, *Ethnography and Encounter: The Dutch and English in Seventeenth-Century South Asia* (Leiden: Brill, 2022), 127; Chaudhuri, *The Trading World of the East India Company*, 122.

[80]Adam Clulow, *The Company and the Shogun: The Dutch Encounter with Tokugawa Japan* (New York: Columbia University Press, 2013); Peter Good, 'The East India Company and the Foundation of Persian Naval Power in the Gulf under Nader Shah, 1734–47', in *The Dutch and English East India Companies: Diplomacy, Trade and Violence in Early Modern Asia*, ed. Adam Clulow and Tristan Mostert (Amsterdam: Amsterdam University Press, 2018), 211–36.

[81]Good, 'The East India Company and the Foundation of Persian Naval Power', 233; Guido van Meersbergen, 'Diplomacy in a Provincial Setting: The East India Companies in Seventeenth-Century Bengal and Orissa', in *The Dutch and English East India Companies. Diplomacy, Trade and Violence in Early Modern Asia*, ed. Adam Clulow and Tristan Mostert (Amsterdam: Amsterdam University Press, 2018), 55–78, at 67.

[82]Van Meersbergen, *Ethnography and Encounter*, 126.

[83]Good, 'The East India Company and the Foundation of Persian Naval Power', 215.

[84]Good, 'The East India Company and the Foundation of Persian Naval Power', 220, 224, 226.

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Therefore, in Bengal, it was not the Mughal emperor but rather his local representative, the *subahdar*, who from time to time exploited European naval strength to further Mughal geopolitical ends, as in 1666 when Shaista Khan solicited the support of two VOC ships to aid his invasion of Arakan.[85]

## Exports of European naval services to Asia

Such mechanisms might explain why Asian states integrated much more the European technology of firearms in their land armies than at sea. The practice of outsourcing direct military functions to private actors also occurred in Europe, as Parrott has shown through the famous cases of Albrecht von Wallenstein and Ernst von Mansfeldt during the Thirty Years War (1618–1648).[86] But obviously, hiring the massive armies of military entrepreneurs such as Wallenstein or Mansfeldt was not an option for Asian states. Transporting and victualling large amounts of infantry troops all the way from Europe to Asia would have been far too long, expensive, and difficult to implement, without even mentioning the risk of hosting hordes of foreign fighters. In Asia, there was a market for infantry mercenaries coming from Europe, but their numbers remained extremely small in comparison with the troops China, Mughal India, or even smaller Asian states could muster locally.[87] In this sense, it seems quite reasonable to infer that, on land, Asian states had a certain incentive to develop their own domestic capabilities because European exports of military services remained limited to small, specialized corps.

In contrast, at sea, the exports of military services from Europe were more fluid for the simple reason that squadrons of European ships, well-armed with cannons but eager to trade, came to the Asian shores on their own initiative. Although these newcomers sometimes represented a threat, especially for small and weak states, they could also be used by other states to strengthen temporarily their maritime policy. Their impact was often so decisive that the states who could hire their services might simply not have been in need to make huge investments in domestic naval innovations. This does not mean that Asian states did not try to integrate European naval technology into their own apparatus. For instance, in the seventeenth century, Mughal emperor Aurangzeb recruited European experts to work on the design of new ships with stronger firepower.[88] The same Zheng family who was defeated by the Dutch VOC near Amoy in 1663 had previously managed to build a European-style squadron armed with cannons in the 1630s, when their leader, Zhilong, served the Ming emperor. However, the experiment was short-lived as the Dutch organized a surprise attack and burnt all these ships at anchor before they could do them any harm.[89] After this loss, the Zheng made no further attempts because no threat justified the very high expenses of building such ships.[90] When faced with the 'make or buy' dilemma, only those Asian states who could not hire the services of European ships did make sustained efforts to transform their own navy: the clearest example is the sultanate of Oman, whose powerful fleet of western-style ships was feared by the Europeans in the seventeenth and eighteenth centuries.[91]

[85]Van Meersbergen, 'Diplomacy in a Provincial Setting', 66.

[86]David Parrott, 'The Military Enterpriser in the Thirty Years′ War', in *War, Entrepreneurs and the State in Europe and the Mediterranean, 1300–1800*, ed. Jeff Fynn-Paul, (Leiden: Brill, 2014), 63–86.

[87]Subrahmanyam, *The Portuguese Empire in Asia*, 256–61; Geoffrey Parker, 'The Artillery Fortress as an Engine of European Overseas Expansion, 1480–1750', in *City Walls: The Urban Enceinte in Global Perspective*, ed. James D. Tracy (Cambridge: Cambridge University Press, 2000), 386–416, 408.

[88]Chaudhuri, *Trade and Civilisation in the Indian Ocean*, 156.

[89]Andrade, 'Was the European Sailing Ship a Key Technology of European Expansion?', 22–3.

[90]Andrade, *The Gunpowder Age*, 207.

[91]Sharman, *Empires of the Weak*, 54, 59; Chaudhuri, *Trade and Civilisation in the Indian Ocean*, 156; Good, 'The East India Company and the Foundation of Persian Naval Power', 214.

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In other words, the market for naval services reached a global scale faster than the market for military services on land. Flynn and Giráldez have argued that the main economic engine for early modern globalization was the Asian demand for American silver which took different routes, either passing by Europe and the Atlantic Ocean or directly through the Pacific Ocean.[92] Yet Pearson, building on the figures proposed by Steensgaard, presents a slightly different picture in which bullion would have only represented about 30 per cent of European exports to Asia, while 60 per cent of those exports would have been constituted by services, essentially in the sphere of navigation, transportation, and violence at sea.[93] These estimates should be taken with caution as the value of services is difficult to quantify, but they are an invitation not to underestimate the economic significance of the Asian market for European naval services. Military historians tend to reduce the circulation of war technology to flows of weapons and experts in their making but, in the maritime context, it is quite likely that European technology actually travelled to Asia mostly in the shape of services performed by European ships.

Another crucial point is that states were not the only consumers of naval services. Maritime freight, meaning the service of transporting commercial goods by sea, probably represented a far larger market than that of naval services to states, and in that market too, cannons played a decisive role. It seems that better naval ordnance gave European ships an advantage over local competitors in terms of protection which helped them to convince local shippers to resort to their services.[94] In addition, firepower was often used by the European chartered companies as a strategic deterrent in order to obtain concessions from local rulers which translated into economic advantage over local ships.[95] For these reasons, the economic historian Habib concluded his comparative study of Indian and European mercantile communities by emphasizing the major difference in terms of guns and men-of-war rather than commercial organization and size of capital.[96] Although this progressive shift has been often depicted as a sort of conquest, it resembles less of a clash between states and more of a long-term economic struggle in which technology gave a competitive advantage to those economic agents who developed a form of regional specialization in an increasingly globalized world.

A sense of this economic specialization can be grasped from the choice made by the VOC to rely essentially on European naval supplies in order to provide for the upkeep of its vast fleet in Asia in the seventeenth century. Military considerations played a decisive role, especially because the VOC believed in the superior military capacities of European shipbuilding.[97] Nevertheless, economic considerations were as important. For the maintenance of its ships in Batavia, most of the ropes, nails for sheathing, tar and even masts were sent from the Netherlands because the VOC officers were rarely satisfied with the quality and price of the naval material they could find on Asian markets.[98] Following the same logic, the VOC directors calculated that building ships in Batavia was more expensive than sending them from the Netherlands.[99] Even for its crews, the VOC had a marked preference for European sailors who were sent to Asia in very high numbers in order to compensate for their high mortality rate in the tropical climate.[100] In other words, this company which was settled at both edges of the Eurasian landmass had come to the conclusion

[92]David O. Flynn and Arturo Giráldez, 'Born with a "Silver Spoon": The Origin of World Trade in 1571', *Journal of World History* 6, no. 2 (1995): 201–21; David O. Flynn and Arturo Giráldez, 'Born Again: Globalization's Sixteenth Century Origins', *Pacific Economic Review* 13 (2008): 359–87.

[93]Pearson, 'Merchants and States', 108.

[94]Pearson, *The Indian Ocean*, 201.

[95]Chaudhuri, *Trade and Civilisation in the Indian Ocean*, 87.

[96]Irfan Habib, 'Merchant Communities in Precolonial India', in *The Rise of Merchant Empires: Long Distance Trade in the Early Modern World 1350–1750*, ed. James D. Tracy (Cambridge: Cambridge University Press, 1993), 371–99, at 399.

[97]Parthesius, *Dutch Ships in Tropical Waters*, 169.

[98]Parthesius, *Dutch Ships in Tropical Waters*, 106–7.

[99]Parthesius, *Dutch Ships in Tropical Waters*, 170.

[100]Parthesius, *Dutch Ships in Tropical Waters*, 109.

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that reproducing European naval technology in Asia was more costly than importing fully functional ships from the Netherlands. The same reasoning probably encouraged many Asian political and economic actors – rulers and merchants alike – to hire the services of European ships because they might have considered these were economically and militarily more competitive than what could be put at sea with local resources.

Nevertheless, the capacity of Asian societies to engage with European naval technology should not be ignored. For instance, increasing numbers of 'lascars', a generic term referring to Asian seamen, were hired by the English EIC and the Dutch VOC to crew ships especially for intra-Asian trade.[101] Besides, the resilience of Asian shipping should also be emphasized. A clear example is the Ottoman reaction to the Portuguese penetration of the spice trade in the sixteenth century: not only did the Ottoman state promote predatory corsair attacks on Portuguese shipping, but it also protected its own merchant shipping through the implementation of convoy systems in the Red Sea and the Indian Ocean. With the help of the Mappila corsairs from Calicut, Muslim merchants under the protection of Ottoman mercenaries opened a new maritime route connecting Aceh to the Red Sea through the Maldives. These developments allowed the Ottomans to experience a commercial ascendancy in the Indian Ocean in the 1540s.[102]

Despite these Asian adaptations, the desirability of European naval technology remained very strong among Asian rulers. Therefore, when, in the 1730s, Nader Shah of Persia decided to increase his sea power, he looked for the 'most powerful naval technology in the region', namely the one provided by the English EIC.[103] Not only did he hire the services of English ships, but he also bought several ships built by the EIC in order to create his own independent navy. However, he then experienced the kind of difficulties other Asian states might have faced in their attempts to duplicate western-style navies: finding reliable and skilled crews to man these ships proved particularly challenging.[104] In 1735, this new Persian navy was defeated by the Ottomans near Basra thanks to the superior firepower of two EIC ships which had been requisitioned by force with their crews.[105] In 1740, the Arab crews of the Persian fleet massively mutinied and even killed the admiral, thus hindering the rise of Persian sea power in the Gulf region. For these reasons, Nader Shah continued to hire the services of European ships, a fact which shows once more how relevant it could be for Asian rulers to have access to fully operational naval solutions provided by Europeans instead of relying only upon local naval resources.[106] The efficiency of a technology as complex as the sailing ship armed with cannons was the result of a fruitful interaction between a very wide array of skills in shipbuilding, cannon-making, rope-making, ship maintenance, sailing, piloting, gunnery, management of crews, etc. Generating the whole set of skills in Asia was certainly far more difficult than hiring the services of European ships and crews which already mastered them. As the next section argues, these naval skills experienced a faster development in western Europe because of the sharp rise in commercial shipping which stimulated the emergence of some technological clusters specialized in naval technology.

## Technological clusters and dynamics of regional specialization

Although military historians have so far emphasized the role of interstate competition as the main explanation for the gap in naval technology between the two edges of the Eurasian continent, more attention should be paid to the formidable impulse that the world-wide growth

[101]Matthias Van Rossum, 'A "Moorish World" within the Company: The VOC, Maritime Logistics and Subaltern Networks of Asian Sailors', *Itinerario* 36, no. 3 (2012): 39–60.

[102]Casale, *The Ottoman Age of Exploration,* 8, 45, 58, 74.

[103]Good, 'The East India Company and the Foundation of Persian Naval Power', 211.

[104]Good, 'The East India Company and the Foundation of Persian Naval Power', 228.

[105]Good, 'The East India Company and the Foundation of Persian Naval Power', 225.

[106]Good, 'The East India Company and the Foundation of Persian Naval Power', 231.

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

of European commercial shipping might have represented for the constitution of specialized technological clusters within western Europe. According to Unger, the total tonnage of the European fleet was multiplied by four or five during the sixteenth century, and by an impressive factor of seventeen over the period between 1500 and 1780.[107] Thus, maritime transportation became a leading sector of the world economy and made a critical contribution to economic growth in early modern Europe.[108]

It is important to note that most of this rise in shipping was external to the Indian Ocean and maritime Asia. In 1670, the Dutch arguably had the best shipping network of all Europeans in Asia, but the volume of ships dedicated to this East Indies trade barely represented 12 per cent of their total merchant tonnage.[109] The construction of a maritime economy bridging the two sides of the Atlantic Ocean contributed more decisively to the increase in the size of the European merchant fleet. For instance, the transatlantic convoys of the *carrera de Indias* represented about 20 to 30 per cent of Spanish merchant tonnage in the late sixteenth century.[110] In the English case, the growth of the shipping tonnage during the seventeenth century was primarily prompted by the development of sugar and tobacco plantations on the other side of the Atlantic Ocean.[111] Yet regional trade articulating various areas of Europe still represented the bulk of European shipping: in 1670, more than 50 per cent of the Dutch merchant tonnage was dedicated to freight with Norway, France, England, Portugal, and the Baltic Sea.[112] This regional shipping within Europe was surely strengthened by the increasing transcontinental trade with America and Asia insofar as exotic commodities arriving in a few key harbours had to be redistributed towards many other consumption areas.

It is quite likely that this boom in maritime trade which occurred mainly within European seas and in the Atlantic Ocean drastically accelerated the accumulation of technological capital and innovation in some key western European clusters. The typical example of military innovation driven by private shipping is that of cast-iron ordnance. This new type of artillery was successfully produced for the first time in England in the 1540s.[113] As its raw material, iron, was much cheaper than copper, the final price of such cannons was three to four times lower than their bronze counterparts. Nevertheless, this economic advantage came along with a series of limitations. First, cast-iron guns were significantly heavier than bronze ones. This issue of weight disqualified them from land service where transportation costs and manoeuvrability were crucial. Although this weakness was less critical at sea, European state navies remained reluctant to adopt them for many decades. It seems that sixteenth-century cast-iron cannons suffered from the reputation of being less reliable and more prone to overheat and burst in case of intensive use.[114] In this precise example, states' demand clearly fails to explain the fast expansion of facilities producing cast-iron ordnance. While, in 1546, there was only one gun-founder who manufactured cast-iron artillery in the Weald (Southeast England), by the 1570s their number had risen to about ten masters managing nineteen blast furnaces.[115] In 1575, the total production of cast-iron artillery in England

[107]Richard. W. Unger, 'The Tonnage of Europe's Merchant Fleets 1300–1800', *The American Neptune*, 52 (1992): 250–61; Jan Lucassen and Richard W. Unger, 'Shipping, Productivity and Economic Growth' in *Shipping and Economic Growth, 1350–1850*, ed. Richard W. Unger (Leiden: Brill, 2011): 3–44, at 5.

[108]Lucassen and Unger, 'Shipping, Productivity and Economic Growth'.

[109]C. O. Cederlund, 'The Ships of Scandinavia and the Baltic', in *The Heyday of Sail: The Merchant Sailing Ship 1650–1830*, ed. Robert Gardiner (Edison, NJ: Book Sales, 2000), 55–76, at 57.

[110]Huguette Chaunu and Pierre Chaunu, *Séville et l'Atlantique, 1504–1650* (Paris: A. Colin, 1955); Regina Grafe, 'The Strange Tale of the Decline of Spanish Shipping', in *Shipping and Economic Growth, 1350–1850*, ed. Richard W. Unger (Leiden: Brill, 2011), 81–115.

[111]Nuala Zahedieh 'Productivity in English Atlantic Shipping in the Seventeenth Century: Evidence from the Navigation Acts', in *Shipping and Economic Growth, 1350–1850*, ed. Richard W. Unger (Leiden: Brill, 2011), 117–34, at 118.

[112]Cederlund, 'The Ships of Scandinavia and the Baltic', 57.

[113]Edmund B. Teesdale, *Gunfounding in the Weald in the Sixteenth Century* (London: Royal Armouries, 1991), 13.

[114]Glete, *Warfare at Sea, 1500–1650*, 23. Guilmartin, 'Guns and Gunnery', 149. Cipolla, *Guns, Sails and Empires*, 41.

[115]Teesdale, *Gunfounding in the Weald in the Sixteenth Century*, 38.

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reached 500 tonnes per year, a figure which doubled by the end of the sixteenth century.[116] Around that time, cast-iron cannons were also produced in large numbers in the Low Countries, especially around Liège.[117] How to explain such an industrial boom if states were not interested in purchasing these weapons?

The answer has already been formulated by Jan Glete, who identified Northern European merchantmen as the main market for such ordnance.[118] The risk of overheating was limited for commercial vessels as they were supposed to have less intensive use of artillery than warships, whereas the cheapness of cast-iron cannons certainly decreased the protection costs and therefore gave an economic advantage to their owners. This hypothesis is confirmed by archaeological research: in the late sixteenth century, cast-iron cannons produced in England were the most common pieces of artillery, not only on the decks of English merchant ships but also among their Dutch and Hanseatic competitors.[119] Data from the trading routes connecting Northern and Southern Europe confirms this situation. When, in 1585, a total of forty-seven commercial ships from the Low Countries, England, France, and Hamburg were seized in Andalusian ports following a general embargo imposed by King Philipp II, Spanish officials carefully inventoried the artillery that they carried for protection during their trading activity: they found an impressive amount of 422 pieces of ordnance, of which more than 90 per cent were cast-iron cannons.[120]

Evidence from the Iberian Peninsula suggests that the market for English and Walloon cast-iron ordnance expanded much further than the North Sea. In 1582, the Spanish authorities registered the artillery equipping nineteen commercial vessels before refitting them for battle.[121] Interestingly, the inventory separated the artillery provided by the King from the private artillery belonging to the ship as a protection for its day-to-day business. Whereas the first category (the King's) totalled 65 cannons all made of bronze, the second one amounted to 248 cannons of which 80 were cast-iron. Figures from the fleets of New Spain (year 1586) and *Tierra Firme* (year 1589) highlight the rising preponderance of this technology among Spanish transatlantic convoys in those years.[122] While the state's disdain for cast-iron artillery is illustrated by the fact that the two escort galleons (under the King´s flag) only had bronze cannons, the commercial ships carried about 45 per cent to 60 per cent of cast-iron guns. The success of cast-iron ordnance among transatlantic convoys kept on increasing in the following decades: in 1600 and 1601, the officer in charge of testing the artillery embarked by the fleets claimed that he had checked a total of 439 cast-iron cannons and only 103 bronze ones.[123] When the Spanish monarchy promulgated new laws in 1605 to compel transatlantic merchantmen to carry at least 2 bronze pieces of artillery, the merchants and ship-owners of Seville all complained about the extra cost and advocated for cheaper cast-iron ordnance.[124] Pereira's research has recently shown that the Portuguese authorities also passed some contracts with English merchants to obtain supplies of cast-iron ordnance for the carracks connecting Lisbon to the Portuguese *Estado da India*.[125] All this information indicates that the spectacular growth in English and Walloon production of cast-iron artillery in the late sixteenth and early seventeenth century was not only stimulated by local

[116]Keith Krause, *Arms and the State: Patterns of Military Production and Trade* (Cambridge: Cambridge University Press, 1992), 41.

[117]Krause, *Arms and the State*, 39.

[118]Glete, *Warfare at Sea, 1500–1650*, 23 and 110.

[119]Delia Ní Chíobháin, 'The Arming of Late Sixteenth Century Merchantmen' (Master's thesis, University of Southern Denmark, 2011).

[120]Archivo General de Simancas (AGS), Guerra Y Marina (GYM), leg. 177/17 and 114.

[121]AGS GYM leg. 128/310.

[122]Archivo General de Indias (AGI), Contratación (CT), leg. 1082, 1083 and 2945.

[123]AGI, Indiferente General (IG) leg. 2007.

[124]AGI IG leg. 2008. For the law from year 1605, see *Recopilación de leyes de los reinos de las Indias* (Madrid: Julian de Paredes, 1681) libro IX, Titulo XXX, Ley XXXIII.

[125]Edgar Pereira, 'A Contractor Empire. Public-Private Partnership and Overseas Expansion in Habsburg Portugal (1580–1640)' (PhD diss., Leiden University, 2020), 79.

shipping demand but more broadly by European and transoceanic commercial vessels eager to decrease their protection costs.

Quite interestingly, in the seventeenth century, state navies gradually grew fonder of these cast-iron guns. In the 1620s, the King of Sweden hired an expert from Liège, Louis de Geer, to develop a domestic industry of cast-iron ordnance and his kingdom soon became the main exporter of such weaponry until the end of the early modern period.[126] In the following decades, Spain, Russia, and France all engaged technicians from the Low Countries to develop their own manufactories of cast-iron cannons.[127] This type of artillery became more common aboard warships from the mid-seventeenth century onwards.[128] First, it only replaced small and medium bronze pieces because, for some time, navies were confronted with the difficulty to produce large cast-iron ordnance, as happened in France where cast-iron cannons of 24 and 36 lbs were not successfully produced before the 1690s.[129] However, by the end of the eighteenth century, bronze artillery had almost disappeared from the decks of European warships: among the nearly 10,000 pieces of artillery of the Spanish navy in 1793, all but 25 were made of cast-iron.[130] In the words of a famous specialist of naval history, this military technology was 'perhaps most important in global repercussions' insofar as 'iron's cheapness made it possible to arm ships on an unprecedented scale and the nations which could cast and purchase iron ordnance in quantity enjoyed a steadily increasing advantage in the struggle to control the commerce of the world's oceans'.[131] What is often omitted, though, is that it was commerce, not warfare, which sustained and ripened this technology in the first place.

The main argument here is that the dynamics of military innovations and regional specialization in naval artillery were not only ruled by state demand but also by private shipping. In the case of naval cast-iron ordnance, the rise of trans-regional maritime trade within Europe and the growth of the transatlantic economy stimulated the emergence of technological clusters producing new and cheaper weaponry which could also be used to improve the competitiveness of European ships in Asian waters. As a result, it is possible to formulate an hypothesis which ought to be explored more in depth through further research: the naval technology introduced by European ships in Asia, especially in the form of services, was maybe more immaterial than the silver from Potosi, but it was certainly as global in the sense that its price and the quality of its performance were the fruits of the rising interactions between the different parts of the world.

## Conclusion

Although gunpowder technology has been a core protagonist in the narratives of military history and, more recently, global military history, studies have rarely focused on naval artillery. This article has highlighted that the dynamics underlying the circulation of portable firearms, cannons for sieges, and artillery for ships, followed very different paths over the period 1500–1750. It has shown that large Asian states integrated European-style gunpowder technology into their land armies more broadly and intensively than into their navies. This situation was illustrated by the example of the battle of Amoy in 1663, in which the cannons of a small Dutch squadron had a major impact on a confrontation which involved hundreds of Chinese imperial war-junks against a comparable fleet of powerful regional leaders. Although the outcome of this event is revealing of

[126]Krause, *Arms and the State*, 42.

[127]Krause, *Arms and the State*, 45–7; José Alcalá Zamora y Queipo de Llano, *Historia de Una Empresa Siderúrgica Española: Los Altos Hornos de Liérganes y La Cavada, 1622–1834* (Santander: Institución Cultural de Cantabria, Centro de Estudios Montañeses, 1974).

[128]Glete, *Warfare at Sea, 1500–1650*, 23.

[129]Olivier Chaline, *La Mer et La France: Quand Les Bourbons Voulaient Dominer Les Océans* (Paris: Flammarion, 2016), 246.

[130]Francisco Javier López Martín, 'El Artillado de Las Naves: El Diseño de Las Piezas, Su Ubicación En Los Barcos y Los Centros de Producción Durante Los Siglos XVI y XVII', *Antropología* 100 (2015): 67–104.

[131]Guilmartin, 'Guns and Gunnery', 149.

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

the technological gap which existed between the naval ordnance used by Dutch and Chinese ships in the seventeenth century, it also sheds light on how the Chinese state was able to gain temporary access to Dutch naval technology in order to achieve its own political goals and defeat its opponents. While the issue of the access to key military technology has long been framed in terms of domestic state-owned production, this particular case shows that Asian states did not necessarily need to generate their own western-style navies, especially when they could resort to European ships for temporary services in exchange for trade concessions and other economic deals.

This possibility to outsource direct naval functions to private foreign actors can explain why gunpowder technology was often less integrated into Asian navies than into Asian land armies. On land, for logistical and economic reasons, European exports of military services remained limited to small, specialized corps and, therefore, Asian states invested more efforts in developing their own domestic capabilities. At sea, in contrast, exports of military services from Europe were more accessible to Asian states because squadrons of European ships, well-armed with cannons but eager to trade, came to Asian shores on their own initiative. Historians have often circumscribed the circulation of technology to flows of commodities or experts in their production. Undoubtedly, European cannons were sold in Asia and European gun-founders were hired by Asian states, but this article suggests that the European technology of naval ordnance was mainly exported in the form of services performed by European ships. Although further research is necessary to quantify this activity, it is worth reminding that, according to some economic historians of the Indian Ocean, European naval services – shipping, privateering, and fighting for Asian states and non-state actors – might have far exceeded the value of all other European exports to Asia over the period between 1500 and 1750.[132]

The resort to foreign military technology provided by private economic actors should not be considered *per se* a weakness of Asian states insofar as it was a common practice they shared with many European states of the time. As the literature on the contractor state has shown, renouncing the development of domestic state-owned production capacities was often a cost-saving solution in the early modern period. Nevertheless, in an increasingly globalized economy, cost-driven choices contributed to the shaping of a specific geography of innovations by reinforcing some regional specializations, a fact which was particularly true for naval technology because of the high mobility of ships. A good example in this regard is provided by cast-iron ordnance, a new type of artillery cheaper than bronze, which was invented in England in the 1540s and quickly made its way onto the decks of commercial vessels. The sharp increase of European and intercontinental shipping stimulated the growth of a few technological clusters specialized in the manufacturing of such armament in South England, around Liège in the Low Countries, and later in Sweden. The capacity of European ships to export protection and military services to Asian waters at competitive prices was certainly owing to the multiplication of this cheap heavy weaponry. This particular example also shows that interstate competition cannot be considered the only driving force of military innovation insofar as cast-iron ordnance started to be integrated into state-owned warships only many decades after it had become common among private commercial vessels.

The interdependence between states and naval technology became more preponderant in the eighteenth and nineteenth centuries. European warships gradually became more specialized while commercial vessels progressively decreased their armament until completely abandoning artillery in the nineteenth century.[133] Meanwhile, partly as a result of interstate competition, the fiscal capacities of western European states drastically increased in comparison with their Asian counterparts.[134] In parallel, these states also improved national control over military resources.[135]

[132]Pearson, 'Merchants and States', 108. Pearson´s estimations are based on Steensgaard's studies.

[133]Christopher French, 'Merchant shipping of the British Empire', in *The Heyday of Sail: The Merchant Sailing Ship, 1650–1830*, ed. Robert Gardiner (London: Conway Maritime, 1995), 10–33, 29; Chaline, *La Mer et La France*, 214, 235.

[134]Yun Casalilla and O'Brien, eds., *The Rise of Fiscal States*.

[135]Wilson and Klerk, 'The Business of War Untangled', 93.

https://doi.org/10.1017/S1740022823000335 Published online by Cambridge University Press

In the nineteenth century, France and Great Britain were more directly involved in naval warfare with Asian states and got the upper hand thanks to their specialized navies backed by greater financial means. The point of this article is not to deny the relationship between states and military technology which became particularly strong during the nineteenth century, but rather to point out its historicity and reflect on the earlier forms of connections which past societies developed with military and naval technologies. In the long run, contracting the services of European ships over the period 1500–1750 might have been an efficient cost-saving decision for some Asian states, although it came at a price: it did not foster the rise of local technological clusters but rather contributed to the boom of naval technologies at the other edge of the Eurasian landmass. By the end of the early modern period, increasingly powerful western European states strengthened their grasp over these very same technologies which had matured thanks to centuries of investments by private economic agents. In other words, understanding how the relationship between states and military technology evolved over the past five centuries requires adopting transnational perspectives which take into account economic dynamics and the role of private economic networks in supplying technological resources and services to states and non-state actors with potentially a world-wide reach.

**Acknowledgements.** The author would like to thank Professor Bartolomé Yun Casalilla for his numerous comments and suggestions.

**Funding statement.** This article has been written in the framework of the project GLOBALGUNS which has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 845675. Funding for open access publishing: Universidad Pablo de Olavide.

**Competing interests.** The author(s) declare none.

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Cite this article: Cossart B. 2024. Contractor states and globalization of the market for naval artillery technology (1500–1750). *Journal of Global History*, doi:10.1017/S1740022823000335