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**Total Factor Productivity for the Royal  
Navy from Victory at Texal (1653) to  
Triumph at Trafalgar (1805)**

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# Total Factor Productivity for the Royal Navy from Victory at Texal (1653) to Triumph at Trafalgar (1805)\*

*Patrick Karl O'Brien FBA and Xavier Duran*

“It is upon the Navy under the providence of God that the safety, honour and welfare of this realm do chiefly depend”  
*Preamble to articles for the first Anglo-Dutch war, 1652-54*

## **Abstract**

The size and strength of the Royal Navy experienced a punctuated evolution into the largest and most powerful Navy in the world by 1815.

Most historians tend to represent its superiority in conflicts at sea as an indication of several factors that would be conceptualized by economists as residuals in a production function, namely: better technologies, efficient seamanship, bravery in battle, the Nelson factor, strong logistical support on shore and latterly well designed systems of economic incentives. But are these factors anywhere near sufficient to explain the Royal Navy's relative prowess over rival fleets? This paper argues that the fiscal and financial institutions based upon a political consensus for a sustained uplift in state expenditures on the largest standing fleet of warships in Europe was created during an interregnum of Republican rule, carried forward by the Stuarts and exploited to reach its full potential between the Glorious Revolution (1688) and the Congress of Vienna (1815). The Royal Navy's protection promoted development and consolidation of the realm's extensive maritime sector that, in turn, sustained the largest fleet of battleships on call for defense and aggression in Europe and across the oceans of the world economy.

One of the major unsolved (perhaps insoluble problems) in European history is concerned with the design of a narrative, concluding with a story that might explain the rise of the Royal Navy to a position of

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\* To be published in R. Unger (ed) *Shipping, Efficiency and Economic Growth, 1350-1800* forthcoming Brill 2010. Not to be cited without permission from Patrick O'Brien (p.o'brien@lse.ac.uk)

hegemony over all other rival navies. That evolution and outcome occurred between the first Anglo-Dutch War (1652-54) and final victory at Trafalgar and Waterloo over the course of a Second Hundred Years War with France from 1689-1815.<sup>1</sup> Thereafter, from the Congress of Vienna in 1815 to the entry of the United States into the Second World War, which paradoxically flowed from the destruction of an American fleet at Pearl Harbour by Japanese sea and airpower in 1941, Britain's Royal Navy held indisputable command over the oceans of the world.<sup>2</sup>

There are two possible explanations for the Navy's climb to that position of hegemony. First (and with the recent publication of fiscal and other scattered European-wide data recording and indicating expenditures on navies), few modern naval historians would be prepared to deny that a "very high" measure of significance must be accorded in the narrative to the scale, scope and persistence of investment by the British state in fleets of warships and their onshore infrastructure of ports, docks, shipyards, bureaucratic organizations, specialized manpower, and other inputs required for sea power.<sup>3</sup> Furthermore, that strategy pursued for the national defence of an island realm, combined effectively with private investment in the ships, weapons and on shore facilities of a national merchant marine for commerce, but also for piracy, privateering and other forms of predation upon foreign competitors to create a very

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<sup>1</sup> F. Crouzet, 'The Second Hundred Years War with France. Some Reflexions?' *French History*, 10 (1996) pp. 432-50

<sup>2</sup> P.K. O'Brien and A. Clesse (eds.), *Two Hegemonies. Britain 1846-1914 and the United States, 1941-2001* (Aldershot, 2002)

<sup>3</sup> Nicholas Rodger writes: "British sea power benefitted essentially from a breadth and depth of public support which had no equivalent in any other naval power", N.A.M. Rodger, 'Queen Elizabeth and the Myth of Sea Power in English History', *Transactions of the Royal Historical Society*, 14 (2004), pp. 153-174. Although the concluding chapter of his seminal work on the history of the Royal Navy (N.A.M. Rodger, *The Command of the Ocean. A Naval History of Britain. Vol. 2, 1649-1815*, (London 2004) pp. 575-83) supports the general points made in this paper, our emphases differ. Rodger's text contains many references to the Royal Navy's superior efficiency over the navies of rivals, particularly France, that may or may not turn out to be both valid and significant.'

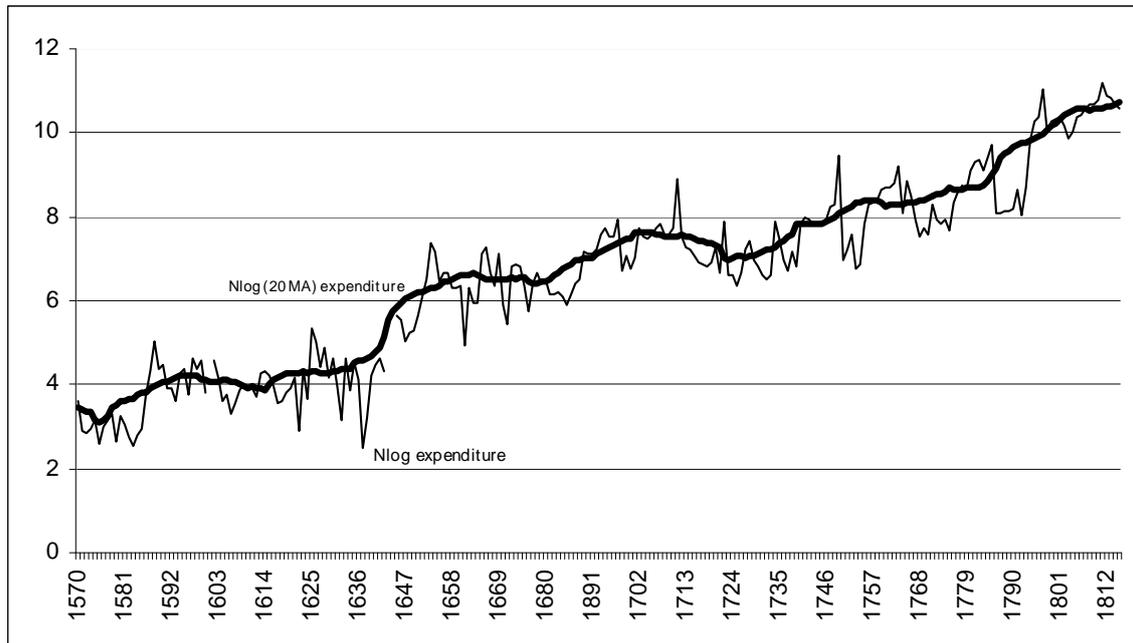
large scale European and global multinational shipping industry for the kingdom. Private investment in a mercantile marine clearly supplemented both the defensive and offensive operations of the Royal Navy. Throughout the period from the Navigation Act of 1651 to victory at Trafalgar, flows of resources, information and nautical knowledge between the two sectors operated symbiotically. This connexion must form the core of any history of British naval success from Cromwell to Nelson, as well as a significant component of any rounded explanation for the kingdom's precocious industrialization.<sup>4</sup>

The graphs set out below demonstrate that quantified representations of the United Kingdom's consistently high and rising levels of public expenditures on the Royal Navy can: now be constructed (Figure 1), compared with expenditures upon military force (Figure 2), and albeit within an altogether less acceptable level of accuracy, juxtaposed alongside outlays on gross domestic fixed capital formation by the private sector for the growth of the economy. (Figure 3)

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<sup>4</sup> The argument is outlined in P.K. O'Brien. 'Fiscal and Financial Preconditions for the Rise of British Naval Hegemony 1485-1815', in J. Backhaus and N. Rodger (eds.), *Navies and State Formation* (forthcoming 2009). It will be elaborated in book form by the authors of this paper, *The Royal Navy and the First Industrial Revolution* (forthcoming 2010)

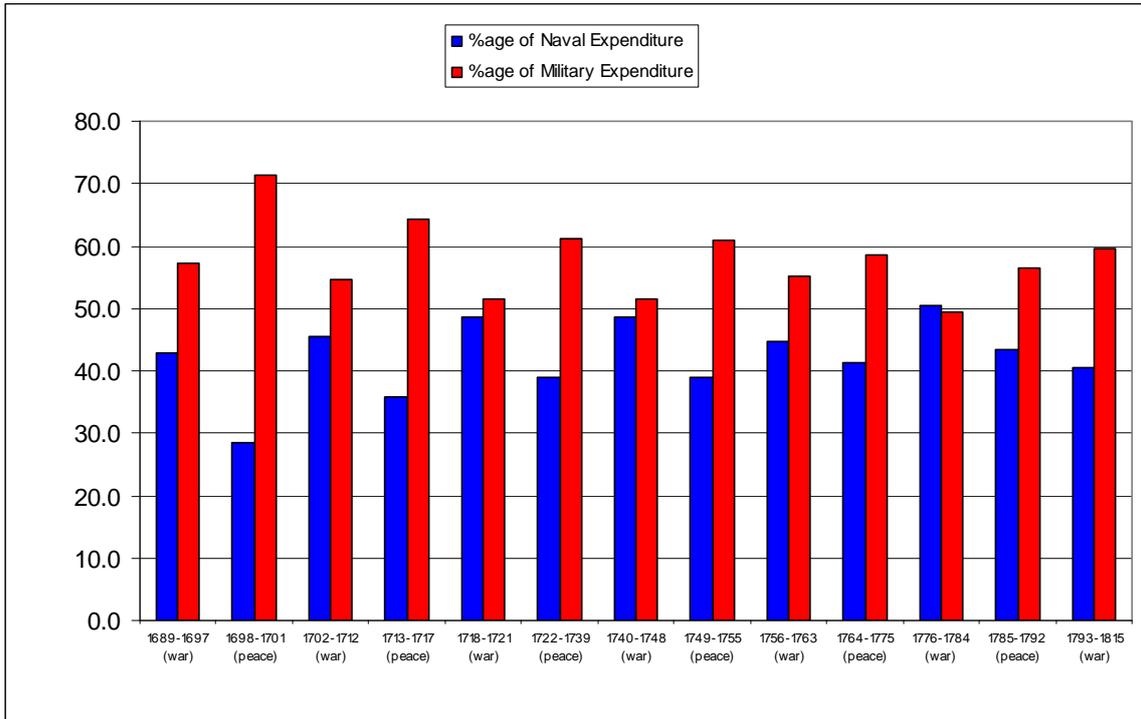
**Figure 1: Trends in Expenditures on the Royal Navy 1569-1815 (Natural Log of Real Expenditure in £000 in Constant Prices of 1660)**



**Sources:** The database has been constructed by the authors from Official and Secondary sources is available on request and will be included and referenced in their book *The Royal Navy and the Industrial Revolution* (forthcoming 2010)

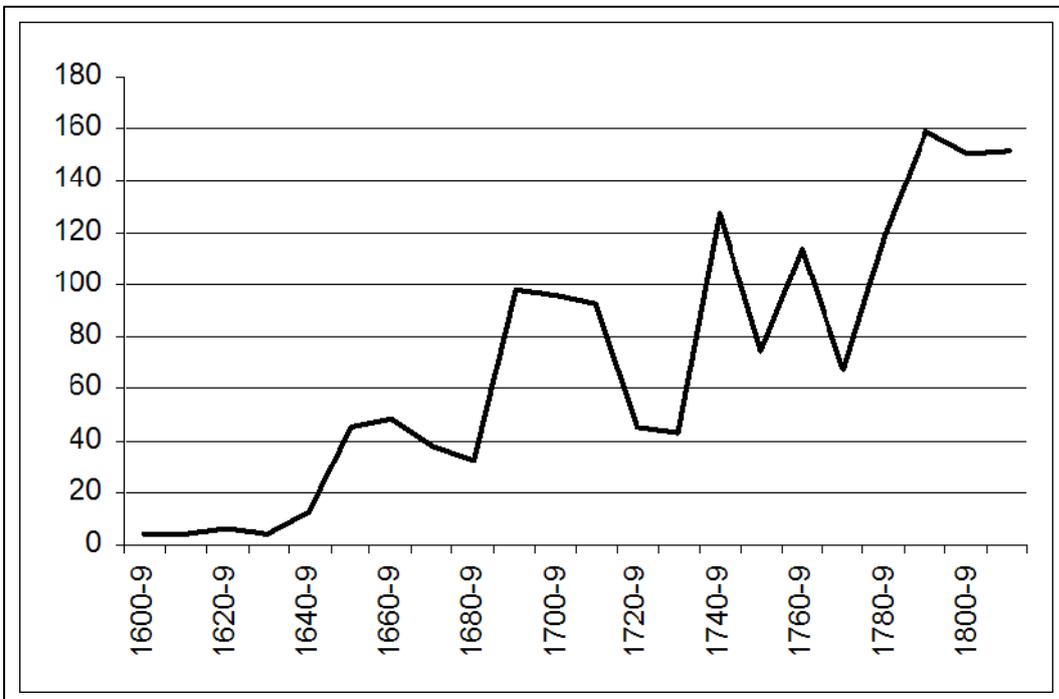
**Notes:** Nlog Expenditure: Natural logarithm of Royal Navy Expenditure in real 1660 pounds; Nlog 20 MA Expenditure: Natural logarithm of 20 year centred moving average of Royal Navy Expenditure in real 1660 pounds

**Figure 2. Proportions of Expenditures on Armed Forces Allocated to the Army and Navy, 1689-1815**



**Sources:** See figure 1 and Parliamentary Paper 1868-69 (XXXV)

**Figure 3. Expenditures on the Royal Navy Compared to Conjectures for GDFCF, 1600-1815**



**\*Sources:** See Figure 1

Figures of comparable scope and quality have neither been published nor collected, let alone calibrated into formats required for systematic and reciprocal comparisons across a relevant sample of rival states with serious commitments to naval power. Although recently constructed estimates for expenditures undertaken by the Netherlands and Spain, together with some un-quantified suggestions for France support the view that between 1714-1800 both Bourbon monarchies allocated far higher proportions of their revenues to armies than to navies and that the *absolute* levels of expenditures on warships and onshore infrastructural support for naval operations at sea but all three rival powers not only fluctuated more sharply, decade after decade, but they fell well below allocations made for the support of Britain's Navy.<sup>5</sup>

Furthermore, Martin Korner's statistics for expenditures by European states does not include any data to suggest that outlays by any other rival power even begins to match British allocations for the realms' Royal Navy.<sup>6</sup> While Jan Glete's complementary research designed to measure the displacement tonnage of all types of warships owned and controlled by the English, French, Spanish, Dutch and other maritime states between 1650 and 1815, clinches poorly quantified impressions derived from fiscal data that the scale of the Island kingdom's fleet of

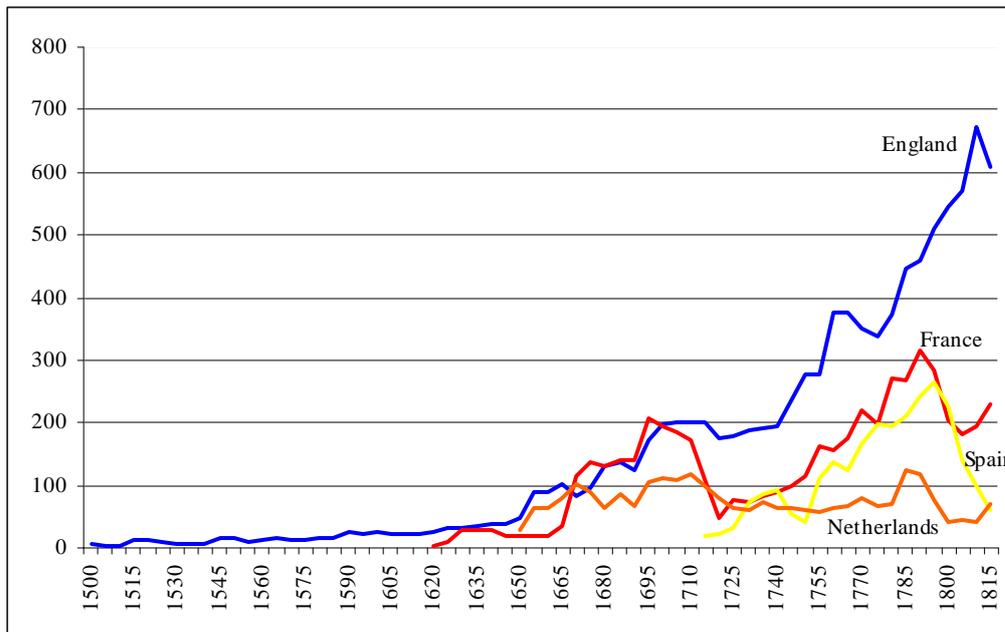
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<sup>5</sup> For Spain, vide José Jurado Sanchez, 'Military Spending, Spending Capacity and Budget Constraints in Eighteenth Century Britain and Spain', in *Revista de Historia Económica* (2009) pp 141-74 and R. Torres Sanchez, 'Possibilities and Limits: Testing the Fiscal Military State in the Anglo-Spanish War of 1779-83', in R. Torres Sanchez (ed.), *War, State and Development. Fiscal Military States in the Eighteenth Century* (Navarra, 2007), pp. 437-460. For France I relied upon H. Goherel, *Les tresoiries generaux de la Marine* (Paris, 1965); M. Marion, *Histoire Financière de la France depuis 1715* (5 vols: Paris, 1927-18), and J. Riley, *The Seven Years War and the old Regime in France* (Princeton, 1986). For the Netherlands we are grateful to Professor Wantje Fritschy of the Free University of Amsterdam for allowing me to see her unpublished estimates of naval expenditures 1701-94. For France, we are grateful for the advice of Professors Joel Felix of Reading University and Daniel Baugh of Cornell University.

<sup>6</sup> M. Korner, 'Expenditure', in R. Bonney (ed.), *Economic Systems and State Finance* (Oxford, 1995), pp. 393-404

battleships armed, specialized and maintained in a state of readiness for warfare at sea first converged and then pulled sharply away from navies maintained by rivals on the mainland as well as the great agrarian empires of Asia.<sup>7</sup>

**Figure 4: Scale of Royal and other State Navies (displacement tonnage 000s)**



**Source:** Glete, J. (1993) Appendix 2. Data corresponds to “Naval strength”. England 1500-1815, Netherlands 1650-1815, France 1620-1815 and Spain 1715-1815.

Figures for the numbers and tons of armed merchant vessels, corsairs and privateers preying upon enemy (and neutral) merchant marines in wartime have not been published.<sup>8</sup> Nevertheless histories of British, French, Dutch, Iberian and other European trades, which include odd references to data on exports and imports by country, suggest Britain began to move to the top of European league tables for trade combined with shipping after 1660. Unverifiable estimates for the tonnage of ships

<sup>7</sup>J. Glete, *Navies and Nations: Warships, Navies and State Building in Europe and America 1500-1860* (2 vols. Stockholm, 1993), appx 2.

<sup>8</sup>J.S. Bromley, *Corsairs and Navies* (London, 1987) and J. Thompson, *Mercenaries, Pirates and Sovereignty* (Princeton, 1994)

included in European mercantile navies, all suggest that the scale and scope of the merchant ships accumulating under British ownership and management also exceeded the capacities for seaborne transportation available to any of its mainland rivals, including eventually the Netherlands by large and ever diverging margins.<sup>9</sup>

Figure 5. Tonnage of Ships and Number of Sailors Employed in the Maritime sectors (Navy + Merchant Marine) of England and the Netherlands 1575-1825

	Tonnage		Seamen	
	English	Dutch	English	Dutch
1575	68,433		16,000	
1600		240,000		33,000
1625	210,000	400,000		
1650				46,000
1675	350,000	900,000		50,000
1700			55,000	
1725		500,000		50,000
1750	500,000		70,000	
1775	700,000	397,000	70,000	45,000
1800	1,856,000		95,000	
1825	2,202,000	130,792		24,000

**Source:** English tonnage and seamen and Dutch tonnage (Lucassen & Unger (2000)) and Dutch seamen (Davids (1997))

Finally disparate and unverifiable references to the numbers of vessels owned or leased by “hostile” powers that were destroyed and captured in times of war do not suggest that the kingdom’s geopolitical rivals and commercial competitors compensated for markedly lower investments in warships by calling upon larger fleets of privateers or well

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<sup>9</sup> It is difficult to construct a European-wide table of the tonnage of ships available by country for private seaborne commerce and transportation because data for several countries are not available. Furthermore definitions of mercantile marines vary by country and over time, and measures used to report tonnage are not consistent across countries or time. Vide, J. McCusker, *Essays in the Economic History of the Atlantic World* (London, 1997)

armed merchant marines.<sup>10</sup> All the evidence suggests a long term and growing divergence in the size of the navies and mercantile marines of the United Kingdom compared to its rivals and competitors from the mainland of Europe and the Ottoman, Mughal and Qing empires of Asia as well.<sup>11</sup>

Economists will point to the probabilities that high, consistent and complementary investments by the public and private sectors in the ships, infra-structural capital and manpower required to keep naval and merchant marines “ship shape” for both warfare and commerce, would, in theory, generate several kinds of positive inter-connexions, all rigorously specified and labelled under such enticing taxonomies as agglomeration effects, network externalities and general purpose technologies.<sup>12</sup>

Historians will only agree that modern theories seem plausible, provide some graphic vocabulary, as well as a few examples, although they could not actually measure the increasing returns that undoubtedly accompanied and added to flows of benefits from Britain’s sustained commitment to a maritime strategy (1651-1805) for the combined defence and development of the Island kingdom. Nevertheless that strategy must be accorded a place of a real significance in explanations for the realm’s precocious transition, first to a commercialized and then to an industrial economy. Capital formation undertaken by the state, working in close cooperation with the private sector, in sailing ships, ports, docks, cannon, skilled manpower, the navigational knowledge and commercial

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<sup>10</sup> J. Levy, *Wars in the Modern Great Power System, 1495-1975* (Lexington, 1983)

<sup>11</sup> L. Harper, *The English Navigation Laws* (New York, 1939) and G. Modelski and W. Thompson, *Seapower in Global Politics* (Seattle, 1993)

<sup>12</sup> M. Fujita, P. Krugman and A. Venables (MIT Press, Cambridge., 2000); H. Helpman (ed.), *General Purpose technologies* (MIT Press, Cambridge, 1998); J. Triole, *The Theory of Industrial Organization* (MIT Press, Cambridge, 2000)

organization required for international trade, combined symbiotically with national defence and mercantilist warfare at sea.<sup>13</sup>

Yet there has also been a clear and persistent strand of, let us call it patriotic writing about the Navy, well supported by references to bellicose politicians as well as xenophobic Britons of the day. That history has been consolidated by into an all too rarely controverted national myth that continues to represent the manifest successes of the Royal Navy over a long sequence of some ten major wars (1652-1802-15) as a record of superior efficiency and organization over the fleets of the Netherlands, Spain, France, Denmark, Russia, the United States and other rivals in conflicts at sea. Too many historians continue to offer such under-specified and under-quantified explanations for success that downgrade the significance of resources.

Unfortunately the Royal Navy's relative efficiency could never be validated or invalidated by fitting anything approximating to production functions to the achievements of a sample of rival European navies. In theory production functions measure *relative levels of success* in converting inputs of capital, labour and other resources into variegated "outputs" of "public goods" such as external security, protection for the mercantile marine, colonization, the transportation of troops, victories in battles at seas, successful diplomatic threats and other elements of an interrelated set of multiple objectives serving national interests.<sup>14</sup>

Another potential but less rigorous, demanding and inconclusive approach to the problem of British naval efficiency is to proceed by way of systematic and reciprocal comparisons to at least clarify the precise

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<sup>13</sup> P.K. O'Brien, 'Provincializing the First Industrial Revolution', Department of Economic History, London School of Economics GEHN Working Paper 23/06 (2006)

<sup>14</sup> This was appreciated by N.A.M. Rodger, 'Form and Function in European Navies, 1660-1815' in L. Akveld et al (eds.), in *In het kielzog: Maritiem-historische Studies* (Amsterdam, 2003) pp. 85-97 and N.A.M. Rodger, 'Sea Power and Empire', in P. Marshall (ed.), *The Oxford History of the British Empire*, vol.2 (Oxford, 1998), p. 169-183

location and possible significance of particular examples of the relative prowess embodied in rival navies. Such comparisons rarely appear, however, in the voluminous and scholarly bibliography for European naval history, because that library has been largely constructed upon a country by country basis, often without adequate reference to the volume, value and quality of resources placed at the disposal of all national navies for the various missions that they undertook to achieve the multiple objectives defined by monarchs, oligarchies and their advisers.<sup>15</sup>

Simply to expose an under-exploited potential for comparative history, to assist a growing group of European naval historians who are providing research into the relative logistical efficiencies of national navies, and as a challenge to scholars who are bunkered in national archives, two “outsiders” from economic history propose to formulate a provisional and contestable argument, based largely upon English secondary sources, that the extant and largely *a priori* case made for the ostensibly *superior efficiency* of the British navy is at present unproven. Furthermore, it appears to them that its margins of efficiency over rival navies from 1653-1805 were in all probability rather small. If this turns out to be correct, it implies that Britain’s rise to a position of geopolitical hegemony was the product of access to a higher volume of fiscal and financial resources, allocated to build up an almighty navy.<sup>16</sup>

Effective naval power emanated as the outcomes of “systems” established, funded and maintained by states for the mobilization, combination and coordination of several analytically separable inputs required for a range of different national objectives, for example, the

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<sup>15</sup> M. Acerra et al (eds.) *Les marines de guerre européennes XVII-XVIII<sup>e</sup> siècles* (Paris, 1998) and L. Sondhaus, *Naval Warfare 1815-1914* (London, 2001)

<sup>16</sup> Europe’s naval historians have latterly become more engaged with comparative history. M. Acerra and A. Zysberg, *L’essor des marines de guerre européennes vers 1680-vers 1790* (Paris, 1997) and R. Knight, ‘The Fleets of Trafalgar: The Margin of Superiority’, in D. Cannadine (ed.), *Trafalgar in History* (New York, 2006) pp. 61-78

Royal Navy's absolute priority was to preclude invasion of the Isles by sea. Its secondary missions included protection for the realm's international commerce, extensive fishing industry and coastal trades; predation upon enemy and other potentially hostile commerce in wartime; offshore support for allies and colonies; the transportation of troops, the bombardment of enemy bases, coastal fortification and maritime cities; the containment of smuggling and backing for gunboat diplomacy.<sup>17</sup>

Clearly the scale and scope of the principal capital goods in the form of national armed sailing fleets evolved gradually to include a mix of capabilities required to perform several and specialized tasks. Heavily armed cruisers could not be expected to pursue and intercept the cutters used by smugglers to deliver cargoes of illegal merchandise to the home market. Thus, the mix of capabilities embodied in warships constructed and/or commissioned for service by the Royal Navy, and for that matter all other European navies must be related for purposes of comparison to their evolving and differentiated missions on behalf of states.

By the end of the Napoleonic Wars, the tonnage of faster and lighter frigates, sloops, brigs and cutters at the disposal of the Royal Navy as a proportion of the total tonnage, had risen sharply from around 15% in 1710 to 43% a century later.<sup>18</sup> These ratios indicate that the security of the realm provided by larger scale, heavily armed ships of the line, strategically positioned off shore probably absorbed a diminishing but still cost effective proportion of total expenditures on the Navy. Given the high probability of increasing returns to combined public and private investment in capital goods for maritime operations, an island power could, over time, maintain external security by allocating reduced shares

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<sup>17</sup> D. Baugh, 'Great Britain's Blue Water Policy, 1689-1815', in *International History Review*, X (1988), pp. 33-58

<sup>18</sup> R.W. Unger, 'Warships, cargo ships and Adam Smith: trade and government in the eighteenth century', *The Mariner's Mirror*, 92, 1 (2006). 41-59 and R. Harding, *The Evolution of the Sailing Navy, 1509-1815* (Basingstoke, 1995)

of the fiscal and financial resources available to its armed forces for that key purpose and reallocate a rising proportion to other more profitable mercantilist objectives, as well as that other all important public good – the maintenance of internal order. (Vide Figure 2)

At present historians of the British navy have offered little by way of hard evidence to suggest that the mix of warships available to rival fleets of France, Spain and other powers were sub-optimal for the strategic objectives pursued by their rulers.<sup>19</sup> They have not, moreover, been able to demonstrate that warships built in the Hanoverian states own or in private yards for service in the Royal Navy were either of consistently superior designs for comparable purposes, included more effective energy systems, that is sails, masts, rigging, rudders and pumps for the harnessing of wind and water power, or deployed more technologically advanced ordnance than rival warships charged with similar missions.<sup>20</sup> Although no other state relied anywhere nearly as much as Britain upon its navy for external security or sought as consistently and tenaciously to secure command of the seas, the limited range of modern secondary sources for European-wide comparisons do not demonstrate that British built warships and their guns enjoyed protracted periods of technological advantage over ships built and cannon cast in yards and foundries from other parts of the continent.<sup>21</sup>

On the contrary, it has not been difficult for historians of the Royal Navy to cite a long list of complaints and anxieties which refer to the

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<sup>19</sup> N.A.M. Rodger, *The Command of the Ocean, a Naval History of Britain*, vol. 2, 1649-1815 (London, 2004)

<sup>20</sup> B. Lavery, *Ships of the Line. The Development of the Battlefleet 1650-1850* (London, 1983), and B. Lavery, *The Arming and Fitting of English Ships of War 1660-1815* (London, 1987)

<sup>21</sup> B. Lavery, *Nelson's Navy. The Ships, the Men and Organization 1793-1815* (London, 1989) and N.A.M. Rodger, *The Command of the Ocean. A Naval History of Britain*, vol. 2, 1649-1815 (London, 2004) and L.D. Ferreiro, *Ships and Science. The Birth of Naval Architecture* (Cambridge, Mass, 2006)

qualities of warships built in French and Spanish yards.<sup>22</sup> Contemporaries who made such invidious comparisons did not, however, consistently compare like with like or consider the trade-offs involved in the construction of ships for speed, which was a French preoccupation, for convoy duties across the Atlantic which was a Spanish priority, and for the durability required to remain for long periods at sea in all weathers and to engage enemies at close quarters in duels of strength and endurance, which were the essential prerequisites for both the strategy and the formalist line ahead tactics for the battles the Royal Navy endeavoured, in principle, to pursue between 1689 and 1815.<sup>23</sup>

All European warships embodied variations in their capacities for speed, manoeuvrability, endurance, firepower and for facilities accommodating large crews in confined and unhealthy spaces to sail ships and fire cannon. As floating fortresses European warships increased in scale and capabilities to carry one to three decks of 32 to over 100 guns, to remain stable on the waves and to withstand the concentrated impact of heavy cannon balls weighing 9lbs to 42lbs. Shipwrights tried to maintain balances between the weight of cannon, the height and complexities of rigging and the size and shape of hulls. Big warships took several years to build and could remain on active duty for up to and, in some cases (with refits) for more than 20 years. To remain

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<sup>22</sup> C. Wilkinson, *The British Navy and the State in the Eighteenth Century* (London, 2004) ; D.H. Roberts (ed.), *Eighteenth Century Shipbuilding. Remarks on the Navies of the English and the Dutch* (Rotherfield, 1992) and J. Meyer and M. Acerra, *Histoire de la Marine Francaise des Origines a nos Jours* (Rennes, 1994)

<sup>23</sup> D. Baugh, 'The Eighteenth Century Navy as a National Institution in J. Hill (ed.), *Oxford Illustrated History of the Royal Navy* (Oxford, 1995); J. Boudriot and H. Berti, *L'art llerie de mer: marine francaise 1650-1850I* (Paris, 199) and ; D. Goodman, *Spanish Naval Power 1589-1665* (Cambridge, 1996)

at sea ships required regular triennial servicing in dockyards ashore and complete refits at least every 4-5 years.<sup>24</sup>

Throughout the age of sailing fleets the design and construction of warships and their ordnance occurred within the framework of two competitive multinational industries: shipbuilding and armaments. Both seem to have been marked by slow incremental rates of technical innovation and compared to other sectors of manufacturing industry, a relatively rapid diffusion of available knowledge, skills and techniques. Those features moved both state and mercantile marines to broadly similar levels of technological efficiency.<sup>25</sup> Diffusion occurred through purchase and hire, but often by way of the capture of foreign models as well as the migration of shipwrights, seamen and gun founders across frontiers.<sup>26</sup> Evidence suggests that the British navy derived some temporary competitive advantages from a relatively rapid deployment of copper sheathing and from investment in dry docks that preserved ships timbers and speeded up completion and turnabout times for the building, repair, cleaning and maintenance of hulls.<sup>27</sup> Some proportion of the guns mounted on ships of the Royal Navy on service during the wars from

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<sup>24</sup> O. Warner, *Fighting Sail: Three Hundred Years of Warfare at Sea* (London, 1979) and B. Lavery, *Ships of the Line. The Development of the Battlefleet 1650-1850* (London, 1983)

<sup>25</sup> D. Lyon, *The Sailing Navy. All the Ships of the Royal Navy. Built, Purchased and Captured* (Conway, 1993) and

B. Lavery, *The Arming and Fitting of English Ships of War 1660-1815* (London, 1987)

<sup>26</sup> B. Lavery (ed.), *The Ships of the Line* (2 vols, London 1983-84); J. Glete, *Navies and Nations: Warships, Navies and State Building* (Stockholm, 1993) and R. Unger, *Dutch Shipbuilding before 1800* (Amsterdam, 1978)

<sup>27</sup> D. Baugh, 'Naval power. What gave the British Navy Superiority?' in L. Prados De La Escosura (ed.), *Exceptionalism and Industrialization. Britain and its European Rivals 1688-1815* (Cambridge, 2004), pp. 235-57; R. Knight, 'The Introduction of Copper Sheathing into the Royal Navy, 1779-86', in *Mariners Mirror*, 59 (1973) pp, 299-309 and R. Knight, 'The Building and Maintenance of the British Fleet during the Anglo-French Wars 1688-1815', in M. Acerra et al (eds.), *Les Marines de Guerre Européennes. XVII-XVIII<sup>e</sup> siècles* (Paris, 1985), pp. 35-50

1776 to 1815 may have been superior to enemy cannon.<sup>28</sup> In general, and given the multinational nature of Europe's shipbuilding, shipping and armaments industries, the modern secondary literature dealing with early modern warships and naval artillery does not *prima facie* support a case for sustained and cumulative technological leadership enjoyed by Britain either in the construction of warships or in the design, manufacture and mounting of cannon for more accurate delivery of destructive energy at safer distances, over the period it took for the Royal Navy to achieve command of the oceans.<sup>29</sup>

At the very least, while its significance remains an open question for research and debate, technological retardation appears to be something of a short chapter in conceivable explanations for the failures of Britain's rivals to contain the long run success of the Royal Navy as the instrument of what many European statesmen and commentators of the age regarded as "maritime despotism".<sup>30</sup> An alternative explanation is that more of the Royal Navy's triumphs at sea could be attributed, as many naval historians are disposed to argue, to the superior skills of British seamen, the leadership and managerial qualities of their officers and to features of organization aboard the floating fortresses that might be represented as "British" and virtually particular to the operation of warships by the Royal Navy.<sup>31</sup>

Before investigating the potential quality of British seamen, something quantitative and familiar should be repeated about Europe's

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<sup>28</sup> B. Lavery, *Nelson's Navy, the Ships, Men and Organization 1793-1815* (London, 1989) and N.A.M. Rodger, *Command of the Oceans*, pp. 420-422.

<sup>29</sup> My generalization is based on the fine scholarship of Brian Lavery, Dan Baugh, Nicholas Rodger and a collection of articles edited by R.D. Smith, *British Naval Armaments* (London, 1989) plus J. Boudriot and H. Berti, *L'artillerie de mer. Marine Franchise 1650-1850* (Paris, 1992)

<sup>30</sup> A. Harvey, *A Collision of Empires. Britain in Three World Wars, 1793-1945* (London, 1992)

<sup>31</sup> B. Lavery (ed.), *Shipboard Life and Organization 1731-1815* (Aldershot, 1998). Dan Baugh in a letter to me in ??? to this view

evolving stocks and supply curves for this scarce category of labour. Once again it is unfortunate that statistics for the changing size and occupational distribution of seamen available to Venice, Portugal, Holland, Spain, France, Sweden, Denmark, Prussia, Russia, the Ottoman Empire and other states with ambitions to acquire naval power cannot be tabulated here. Nevertheless, any review of published, but again, largely descriptive, studies of Europe's early modern trade overseas suggests that the "pools" of seamen engaged directly and indirectly with all forms of waterborne transportation could already have been larger for England and its colonies than from anywhere on the mainland, even before the promulgation of the First Navigation Act by the Republic in 1651.

Thereafter, British supplies of manpower and other resources linked to all forms of economic and geopolitical activities at sea increased in line with the growth of the kingdom's exports, imports, re-exports, coastal, riverine and fishing trades, as well as warfare at sea. For the manning and control of warships, the Royal Navy could draw upon an ever increasing stock of human capital embodied in seamen and officers from the realm's and the empire's expanding merchant marine which increased in scale from an estimated 340,000 tons of ships in 1686 to 1,200,000 tons in 1790.<sup>32</sup>

With the possible exception of the Dutch navy, which used higher wages to recruit sailors from the maritime regions of Germany, Scandinavia and Russia, as well as the Netherlands, supplies of seamen potentially available to all navies seem to have been an omnipresent and widespread problem.<sup>33</sup> Nevertheless, for Britain the supply remained elastic enough to man larger and larger fleets with seamen from the

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<sup>32</sup> J. Lucassen and R. Unger. "Labour Productivity in Ocean Shipping 1500-1850", *International Journal of Maritime History*, XII, 2 (2000), 127-141, and the manpower data cited in several articles in P.C. van Royen, J.R. Bruijn and J. Lucassen, eds., *Those Emblems of Hell 1580-1870. Sailors and the Maritime Labour Market* (St Johns, 1997)

<sup>33</sup> D. Baugh, "The Eighteenth Century Navy as a National Institution", in J. Hill (ed.), *Oxford Illustrated History of the Royal Navy* (Oxford, 1995), pp. 120-60

realm's merchant marine who were readily re-employed by the private sector at the end of conflicts.<sup>34</sup> This well recognized allocation and reallocation of manpower between the merchant and Royal Navy carried advantages for both the security of the kingdom and growth of its economy.<sup>35</sup> Seamen, both officers and men, remained at sea in times of war and peace over long stretches of their working lives, acquiring skills and accumulating relevant experience. Between the navy and the merchant marine connexions remained virtually continuous, which certainly promoted flows of tacit but *useful* and productive knowledge. Across the board the public services and private enterprise shared the costs of training able seamen, gunners, navigators, masters and commanders. Furthermore, the redeployment of the king's sailors obviated those familiar problems of disorder and crime associated with the demobilization of troops embodying redundant skills and expertise in violence at the end of the wars.<sup>36</sup>

Unsurprisingly the historiography concerned with the crews of warships continues to be inordinately concerned with officers, particularly admirals. Only a handful of books contains research into the relative skills, pay, experience and motivation of able, ordinary and other seamen who often served in several European, including the British navies and merchant marines over this period.<sup>37</sup>

*A priori* economic theory it is true is designed for the analysis of modern free labour markets. Nevertheless, that theory should certainly not lead historians to any expectation that methods favoured by the British Admiralty for recruitment and payment of sailors, methods which remained virtually unreformed throughout decades of victories at sea,

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<sup>34</sup> R. Davis, *The Rise of the English Shipping Industry in the 17<sup>th</sup> and 18<sup>th</sup> Centuries* (Newton Abbot, 1972) and R. Hope, *A New History of British Shipping* (London, 1990)

<sup>35</sup> G. Scammel, *Seafaring, Sailors and Trade 1450-1750* (Aldershot, 2003) Chs 4 and 5

<sup>36</sup> C. Emsley, *Crime and Society in England 1750-1900* (Basingstoke, 1987)

<sup>37</sup> P. Earle, *Sailors. English Merchant Seamen 1650-1775* (London, 1998)

could be represented as “superior” for the employment, commitment, training and efficiency of the workforces that manned warships in the service of the Royal Navy, that is compared to jobs in the merchant marine or other European navies and merchant marines.<sup>38</sup>

On the contrary, published evidence on wages and conditions of employment offered to British crews of warships suggest that few men with the experience and skills required for work at sea could have been attracted on economic grounds to serve the Crown in times of peace and fewer still during periods of war when differentials in pay and conditions of employment on merchant ships engaged in trade, and still more employed in armed vessels active in privateering, looked far better than anything on offer from the Royal Navy.<sup>39</sup>

For example, and at the outbreak of every war, wages of seamen in the merchant marine rose sharply to reflect uplifts in the risks and costs in transporting merchandise by sea as well as the impact of intensified demands from the Royal Navy for the thousands of extra seamen required to man the fleet commissioned for immediate active service and in anticipation of future demands from warships under accelerated construction.<sup>40</sup> Until the mutinies of 1797 Parliament maintained the real wage rates of ordinary and able seamen, which included food, medical treatment, deferred pay, with no provision for clothing, at levels fixed in 1652 though revised in detail in 1686. Over time the regulated diets of fresh food, cleaner spaces and safety available on the king’s warships compared favourably with conditions provided by smaller, more vulnerable and perhaps less healthy ships of the merchant navy.

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<sup>38</sup> The secondary sources are far from adequate. But vide: J.S. Bromley (ed.), *The Manning of the Royal Navy*

1693-1873 (London, 1974) and J. Glete, *Navies and Nations*

<sup>39</sup> S. Gradish, *The Manning of the British Navy during the Seven Years War* (London, 1980) and D. Baugh, ‘The Eighteenth Century Navy as a National Institution’, pp. 120-160.

<sup>40</sup> P. Earle, *Sailors, English Merchant Seamen 1650-1775*

Nevertheless, mariners who continued to work in the private sector could not be subjected to the same discipline, including harsh penalties such as mandatory death for eight crimes, optional for another eleven and commonplace floggings for a variety of offences; far longer periods of confinement aboard ships; out in all seasons and often on unhealthy stations in tropical waters or even in home ports where leave ashore occurred at the discretion of captains.<sup>41</sup>

Although conditions improved over time and a pay rise of 23% which followed the mutinies of 1797 and a further 16% came on stream a year after Trafalgar, no economist comparing wage differentials and conditions for employment across the two marines, could be surprised that a majority of the workforce who defended the realm, its property, religion, freedoms and system of parliamentary governance from French and other “despotisms” on the mainland consisted of a majority of seamen who had, by one means or another, been impressed, that is coerced, into serving their king and country and were only released for leave during or at the end of conflicts at the discretion of the Royal Navy. Tom Paine and other radicals of the time pointed to the anomaly, but mariners were by no means the only occupation or social group among Britain’s eighteenth century workforce, burdened by loss of autonomy and the maintenance of strict controls over labour.<sup>42</sup>

Parliaments grumbled, but refused that is before passing quota acts in 1795, to emulate French policies of registration and systematic conscription, let alone countenance Dutch systems of paying market wages. Ministers recognized that the inefficiencies associated with impressment operated as a self-reinforcing institution that at one and the

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<sup>41</sup> C. Lloyd, *The British Seaman: A Social Survey* (London, 1968) and N. Eder, *Crime and Punishment in the Royal Navy of the Seven Years War 1755-1763* (Aldershot, 2004)

<sup>42</sup> M. Lewis, *A Social History of the Navy 1793-1815* (London, 1960)

same time forced up wages for the mercantile marine and reduced incentives for the Royal Navy to save scarce labour. Nevertheless, Parliament legislated only to circumscribe the operations of this attack on free labour in ways that mediated between the increasing and urgent needs of the navy with the competitive, but economically, pressing demands of overseas and internal trade upon which the tax revenues of the state also depended. For example, the law limited liability for impressments to mariners who, except at critical moments of “embargoes on trade”, as in 1717 and 1779, could not be forcibly removed from employment on *outbound* merchant ships, fishing vessels, colliers, ferries, boats servicing naval demands for food and raw materials or only with difficulty from colonial shipping.<sup>43</sup> Sensibly, apprehended smugglers were sent to sea, but the Admiralty retained antipathies towards criminals and other “misfits” that the poor law and other local authorities offered for service. The Navy did recruit and train a considerable number of boys from the lower classes and transformed an unknown number of landmen taken by press gangs into seamen. It also increased supplies of trained labour available to the maritime sector of the economy as ordinary or even as able seamen, over spells of intensive training for those men and boys, 3-6 months, in a “boarding” school which was a warship at sea that it took to produce a competent mariner.

The skills required to operate the energy systems of warships, that is their top and mainsails, took far more training and experience to acquire. So did the technical know-how of carpenters, coopers, caulkers, rope makers, bakers, cooks, coxswains, boatswains, armourers, other artisans and, above all, lead gunners found among the recognized and differentially remunerated hierarchy of skills employed abroad all

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<sup>43</sup> C. Wilkinson, *The British Navy and the State in the Eighteenth Century* (London, 2006)

European warships. Over the long run impressments worked out because the number of seamen in service rose from 48,000 in 1713 to 327,000 a century later and the ratio of foreigners aboard ships of the Royal Navy, still around 15% at that time, had fallen sharply from the years of King William's war in the 1690s.<sup>44</sup> Nevertheless, manning the fleet remained as the key problem confronting the Admiralty throughout the period of Britain's rise to hegemony at sea. To cope with periodic but sudden demands for large numbers of extra men, the Navy supplemented impressments with incentives, including: bounties to all who "volunteered", promoting able seamen to petty officer levels, allowing seamen derisory shares in prize money and opportunities to serve under captains of their choice, in order to attract labour of the required calibre to "volunteer" and to remain on duty with the King's fleet. Yet on any ex post inspection the incentives offered to seafarers and other men under threat of impressments do not look enticing.<sup>45</sup> The bounties paid to "volunteers" who "enlisted" amounted to around one third of a year's wages for an able seaman, 22% for an ordinary seaman and 11% for a landsman. There was also a possibility of receiving , along with the rest of a fortunate crew, a personal share of the meagre 12.5% of the total imputed value of enemy ships, guns and cargoes allocated to seamen aboard warships lucky enough to capture prizes. For example, the men who fought at Trafalgar took home about £10 each. The incentives offered to the workforce as a whole do not appear to be anything like as attractive as rewards offered to officers. Although seamen could, and did, compete to be promoted to warrant officers and become eligible for an enhanced share of the prize money allocated for the destruction, or better still, the capture of enemy warships or merchant vessels at sea. They also look

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<sup>44</sup> D. Baugh, 'The Eighteenth Century Navy', pp. 120-160

<sup>45</sup> C. Prendergast, 'The provision of incentives in firms', in *Journal of Economic Literature*, 37 (1999), pp. 7-63

much less attractive than either the booty that privateers could expect to expropriate on risky voyages of predation or the higher wages, softer discipline and guaranteed spells ashore for seamen who avoided press gangs and remained with the merchant marine.<sup>46</sup>

Incentives helped, but the regime for impressments coupled with severe punishments for desertion remained vital for manning the fleets of warships and their increasing complement of cannon, maintained in commission and at sea for ever longer spells throughout the eight wars fought by the kingdom between 1689 and 1815. Jobs and service with the Royal Navy promoted some accumulation of human capital, including skills and self-discipline, utilized for the development of an interdependent maritime, urban and industrial economy. But for this age of mercantilism and warfare it was the effective defence of the homeland, victories at sea and a succession of favourable peace treaties that provided most of the essential geopolitical and institutional preconditions for the continued expansion of the country's exports, imports and re-exports which promoted a cumulative process of expansion for Britain's shipping and shipbuilding industries. By the Seven Years War, if not before, the capital and manpower employed in this sector had already matured into the largest scale industry for maritime enterprise in Europe. Symbiotic connexions of the merchant marine with the Royal Navy and to national defence allowed for allocations and reallocations of manpower between the services with increasing facility and on a scale that could not be matched by rival powers and economies from the mainland.

Perhaps as many naval historians and recently an American economist assert, the crews aboard British warships might have been more skilful and better motivated in the performance of their "duties" than

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<sup>46</sup> D. Benjamin and C. Thornberg, 'Organization and Incentives in the Age of Sail', in *Explorations in Economic History*, 2 (2007), pp. 317-41, and D.J. Starkey, *British Privateering Enterprise in the Eighteenth Century* (Exeter, 1990)

French, Spanish, Dutch and other sailors. Nevertheless, any survey of pay, including prize money, prospects for promotion and other conditions of employment for a workforce recruited and run by the British state under a regime of coercion and servitude transfers the onus of proof to those who make such theoretically implausible assertions and often without reference to the marine sectors of rival countries.<sup>47</sup>

At present few comparative histories concerned with the motivation and skills of seamen are available.<sup>48</sup> Meanwhile contrasts are more readily documented by referencing published historical research into the officer corps of the Royal and other navies. Officers were responsible for maintaining and improving organizational structures and established practices for the management of warships, for ordnance and for their crews of young potentially insubordinate men with ostensibly strong incentives to shirk, free ride, play for safety and to risk desertion.

Unless male bonding, pride, loyalty and patriotism and other touted propensities of jack tars are recognized as significant for the efficiency of crews working and living together in the highly regimented confines of British warships, the “weight” of incentives designed by the Admiralty to elicit high standards of performance at sea seem to have been concentrated to an overwhelming degree upon a hierarchy of professional officers.<sup>49</sup> Most of these young men were from gentry or middling orders of society and, increasingly as time passed, a rising proportion came from “naval families”. Some, but not many and usually from up the social scale entered the service after three years education at the Royal Naval Academy established in 1737. The majority aspiring to be upwardly

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<sup>47</sup> P.C. Van Royen et al (eds.), *Those Emblems of Hell European Sailors in the Maritime Labour market 1570-1870*

<sup>48</sup> K. Davids, ‘Maritime Labour in the Netherlands’ and S. Palmer and D. Williams, ‘British Sailors 1775-1870’ in Van Royen et al (eds.), *Those Emblems of Hell*.

<sup>49</sup> D. Syrett and P.M. Di Nardo, *The Commissioned Sea. Officers of the Royal Navy* (London, 1994)

mobile enlisted as midshipmen at ages between 12 and 15 and without payment of premia normally demanded for training in other professions. Over a period of six to seven years English, Scottish, Irish and Welsh youths acquired the knowledge and became experienced and qualified enough in navigation, the handling of sails and rigging, gunnery, seamanship and leadership to sit the examination for promotion to the rank of lieutenant and to become “eligible” to command a warship. The acquisition of the range of skills required to sail, navigate and enter battles which involved the coordination of complex structures, sailing on choppy waters, using unpredictable energy systems, superintending ships loaded with ordnance and enclosed with crews of hundreds of “un-free” seamen aboard floating fortresses of different “rates”, that is of varied types, sizes and capacities – must have been no small managerial achievement.<sup>50</sup>

To display competence in an examination became a necessary, but hardly a sufficient condition for promotion. Strong recommendations from the candidates’ captains and confirmation from the Admiralty were also required, before young men around the age of 20 received certification to run their own ships. Thereafter, calls to command only came to the minority who secured patronage and preferment, primarily from their professional peers within the Navy, but for an unmeasured but possibly non-trivial number of cases also through the influence of aristocrats and politicians of the day.<sup>51</sup> Although only a tiny percentage of officers ever climbed from the ranks to commissioned officers, within the constraints of this *ancien regime* the Royal Navy seems to have moved further up the ladder towards meritocracy than the army and most other agencies of

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<sup>50</sup> N.A.M. Rodger, *The Wooden World. An Anatomy of the Georgian Navy* (New York, 1986)

<sup>51</sup> M. Palmer, ‘The Sails Right Hand: Command and Control in the Age of Fighting Sail, 1652-1827’, in *Journal of Military History*, 61 (1997) pp. 679-765 and D. Baugh, *The Eighteenth Century Navy*, pp. 120-160.

state, that is except for the department of Excise. According to several authorities, the hierarchy in charge of running the Navy remained less inclined to select management teams in charge of expensive warships on grounds of birth and resisted or manipulated politicised and aristocratic systems of preferment, more effectively and consistently than the admiralties of Spain, Venice, Portugal, Denmark and France but only before the Revolution, but not Holland or the United States.<sup>52</sup> Their views are not, however, based on the range of and depth of comparative historical research to be anything more than conjectures.

Whether the Admiralty in London had designed and maintained an incentive system and contracts for its officers, that, on *a priori* grounds could be represented as superior to the systems of rival navies also remains to be investigated, perhaps in the vocabularies of tournament and other incentive theories displayed in the mathematical forms discussed by economists.<sup>53</sup>

Meanwhile the efforts of the Lords of the Admiralty to recruit and retain talented and ambitious young men received support from the high and rising status that society accorded to posts in the Navy. For good reasons “Britons” rejoiced in their floating fortresses and the public certainly conferred approbation on the officers and seamen for defending the realm, protecting commerce and for the delivery of value for the money that they surrendered as taxes.<sup>54</sup> An increasingly xenophobic

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<sup>52</sup> R. Lavery, *Nelson's Navy* and A. Guimera, ‘Some Notes on the Superiority of the Royal Navy in the Eighteenth Century’ (unpublished letter of 29 January 2009)

<sup>53</sup> E. Jenkins, *A History of the French navy* (London, 1973); J. Glete, *Navies and Nations*; D. Goodman, *Spanish Naval Power*, (Cambridge, 1996), J. Bruijn, *The Dutch Navy of the Seventeenth and Eighteenth Centuries* (New York, 1993) and C. Menard and M. Shirley (eds.), *Handbook for New Institutional Economics* (Boston, 2005). I am indebted to conversations with two outstanding naval historians, Dan Baugh and Augustin Guimera on this point.

<sup>54</sup> P. O'Brien, ‘Fiscal Exceptionalism: Great Britain and its European Rivals from Civil War to Triumph at Trafalgar and Waterloo’, in D. Winch and P. O'Brien (eds.), *The Political Economy of British Historical Experience 1658-1914* (Oxford, 2002)

nation became entranced with the power of their navy to inflict a long series of humiliating defeats on Catholic enemies and economic competitors. Almost nobody inside or outside Parliament questioned the need to spend ever increasing sums of money to construct, man and maintain warships that, as records of victories at sea and balance sheets of ships lost, destroyed and captured show, remained decade after decade superior to the achievements of rival navies.<sup>55</sup> Monarchs, ministers, Parliament, clergy, the press, poets, novelists, playwrights and the public at large displayed nothing but pride in the officers and seamen who defended their liberties, religion, properties and interests overseas. Tropes, images, medals, paintings, fictional heroes celebrating Britannia's "rule of the waves" its "ship of state", "gallant officers" and "jolly jack tars" proliferated across the classes and testify to a patriotic consensus of social approbation for a dominant, ostensibly well managed and victorious navy, long before Nelson appeared on the scene to provide more than a century of security for Britain and its empire that followed from "final" victory at Trafalgar.<sup>56</sup>

That popularity did not translate either into the repeal of impressment, higher wages for seamen, or to generous salaries for a gallant corps of officers. As apprentices, midshipmen who, along with all other officers, purchased their own food and clothing, existed for years on virtually the same "real wage" as an able seaman. That was somewhere between 30 and 45 shillings a month and roughly equivalent to levels of remuneration in money and kind, paid to agricultural labourers. Before revisions in pay in 1797 and 1806, lieutenants received 112 to 140 shillings a month and captains 168 to 560 shillings, depending on the

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<sup>55</sup> D. Hepper, *British Warship Losses in the Age of Sail 1650-1859* (East Sussex, 1994)

<sup>56</sup> M. Lincoln, *Representing the Royal Navy. British Sea Power, 1750-1815* (Aldershot, 2002)

scale of armaments that the ships they commanded carried. Only commissioned officers received half pay when they were “on call” on shore.<sup>57</sup>

Apart from acquiring status as “warriors” and aspiring “gentry” in the service of their king and country, the most widely publicized incentive for young men already born some way up the social scale to pursue careers in the Royal Navy was the prospect of making fortunes from the capture and sale of “prizes” particularly rival warships, but also, with considerably less risk, enemy merchant vessels with their cargoes as well as helpless neutrals suspected of running “contraband” to Britain’s enemies in wartime. Given that the scale of rewards that could accrue from the capture of hostile ships and their cargoes, were carefully calibrated by rank and that failures to engage with enemy warships could be severely punished as cowardice, it seems that the Admiralties of the day maintained in place a clear progression of material incentives that *prima facie* provided “significant encouragement” for midshipmen to endure six or seven years on low pay to make it to lieutenant and for an elastic supply of commissioned lieutenants to compete for preferment and patronage from their professional peers in order to receive the call to take command of warships, preferably frigates, of the scale and/or speed likely to capture valuable prizes, and for captains to impress admirals and the Admiralty with loyalty, and above all, with personal records of victories and captures to suggest that they might be entrusted to move to the apex of the pyramid and command entire squadrons and even fleets of warships.<sup>58</sup>

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<sup>57</sup> N. Rodger, *Command of the Ocean and Baugh, Eighteenth Century Navy* (London, 2004)

<sup>58</sup> R. Hill, *Prizes of War: Prize Law and the Royal Navy in the Napoleonic Wars 1793-1815* (London, 1999) and R. Morris, *Naval Power and British Culture. Public Trust and government Ideology* (Aldershot, 2004)

Although scales for incentives changed over time the principles maintained are captured by “modal” percentages that indicate that around half of all prize money flowing as rewards for naval successes at sea accrued to admirals and captains, a further 25% to other commissioned officers, 12.5% to warrant officers and the rest to the crews of victorious ships. Thus the distribution of rewards looks redolent of incentive and bonus systems maintained by modern Anglo-American business corporations, and reified until recently by some economists from those cultures as optimal for efficiency. Whether the Royal Navy’s prize or tournament system playing on the decisions of its officers can be represented as a peculiarly “British” institution that made some appreciable difference to the efficient delivery of violence at sea or varied in significant and ostensibly positive ways from comparable systems maintained by French, Spanish, Dutch and other rival navies, has not yet been clarified.<sup>59</sup>

British naval historians are inclined to assert that among the officer classes who managed European fleets, service with the Royal Navy tended to confer higher rewards, status and job satisfaction at lower levels of risk from disease and violent death in action than service with rival navies. Many have also represented naval warfare as a process where repeated victories at sea cumulated into a “culture” of aggressive and successful risk taking of the “entrepreneurial” style displayed by Nelson and his captains at Trafalgar.<sup>60</sup> Perhaps such “cultures” of success breeding more success are not given the weight they warrant in

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<sup>59</sup> D. Benjamin and A. Tifrea, ‘Learning by Dying: Combat Performance in the Age of Sail’, in *Journal of Economic History*, 67 (2007) pp. 968-1001; M. Verge-Franchesci, *Les officiers generaux de la marine royale, 1715-74* (Paris, 1990); J. Bruijn, *Dutch Navy* and D.C. Goodman, *Spanish naval power, 1589-1665; reconstruction and defeat* (Cambridge, 1997); *Augustin Guimera thinks it was compared to Spain*

<sup>60</sup> T. Wareham, *The Star Captains Frigate Command in the Napoleonic Wars* (Annapolis, 2001)

economic models for behaviour based upon material incentives.<sup>61</sup> In recent years more naval historians, led by Nicholas Rodger, have, however, moved on to debate a wider view of navies and one more congenial to economic historians which hypothesizes that at the top of any list of competitive advantages enjoyed by the Royal Navy over rival fleets was the extent and depth of the realm's domestic resources and organizational capabilities mobilized and coordinated by the state, to construct, arm, man and maintain an increasingly large fleet of warships at sea for protracted periods of time.<sup>62</sup>

Clear and persistently higher levels of combined public and private investment in an infra-structure of buildings, docks, cranes, scaffolding, stores, tools, inventories of raw materials and efficiently managed shipyards, employing elastic supplies of labour skilled in the arts of designing, building, repairing and maintaining *all kinds* of ships (including warships for the Royal Navy) surely cumulated between 1651 and 1815 into a significant comparative advantage for British trade and the British economy.<sup>63</sup>

Effective maritime power presupposed that navies could call upon elastic and lower cost supplies of the fixed capital, knowledge, technologies, raw materials, weapons, victuals, seamen, marines and all other inputs required to keep fleets of warships at/or ready for engagements with enemies at sea. In Britain naval demands declined, but never fell back to previous levels, even in interludes of peace, when breaks in connexions and learning curves could well have reduced productivity, particularly for those all important turnabout times for repairs

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<sup>61</sup> B. Tunstall and N. Tracy (eds.), *Naval Warfare in the Age of Sail. The Evolution of Fighting Tactics, 1650-1815 Annapolis, 1990* and A. Mahon, *Types of Naval Officers Drawn from the History of the British Navy* (Boston, 1904). This is Dan Baugh's view

<sup>62</sup> J. Keegan, *The Price of Admiralty: War at Sea from Man of War to Submarine* (London, 1988) and Rodger, *Command of the Ocean*

<sup>63</sup> P.K. O'Brien and X.Duran, *The Royal Navy and the Industrial Revolution*

and refurbishment , which became vital in wartime when the pressures to keep warships constantly at sea intensified.<sup>64</sup>

Nevertheless, the hypothesis under review here is not the relative scales and scope of on-shore logistical support systems and organizations embedded in the societies, economies and political systems of Europe's *ancien regimes*, but their relative efficiencies. Across Europe, maritime powers maintained complex public organizations, ministries, admiralties, boards, directorates, commissions and other agencies of state, at the centre of a process, to turn to economics jargon, of transforming inputs into outputs in order to fulfil missions at sea.<sup>65</sup>

In command of capital owned and workforces employed by the state, or more commonly, operating as bureaucratically organized coordinators working with private firms, the naval agencies of European states were charged by royal rulers, advised by aristocratic oligarchies or Parliaments of notables, with responsibilities for building, hiring, repairing and maintaining warships, for procuring their cannon, ammunition and small arms, for supplying victuals, stores, tools, spare parts and other inputs necessary to maintain fleets at sea. Logistical support systems required for Europe's national navies aspired, notwithstanding the case of the Netherlands and its five admiralties, to become competent, specialized and efficient parts of a centralized command system, embodying various types of organization producing naval power in combined public and public ownership and exemplifying very different rules and practices for the coordination and collaboration required

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<sup>64</sup> M. Duffy (ed.), *Parameters of British Naval Power* (Exeter, 1992)

<sup>65</sup> J. Wilson, *Bureaucracy. What Government Agencies Do and Why They Do It* (New York, 1989)

between governments and private enterprise in order to supply and service national navies.<sup>66</sup>

Every European navy can be represented as a more or less efficient partnership between a national state and a network of domestic private enterprises. Although states like Britain and the Dutch Republic with larger maritime sectors enjoyed a greater range of competitive options for collaboration, it will be difficult, even when the vast bibliography of historical literatures dealing with the operations of European ministries, admiralties, boards, commissions and other agencies established by states to mobilize and sustain navies is laid side by side, to reach valid conclusions about their relative levels of efficiency that are more than informed and negotiable judgments.<sup>67</sup>

Since properly designed exercises in productivity measurement are out of the questions, the view that navies of the Netherlands and Britain which were based upon large and increasing maritime sectors enjoyed lower cost services from their infrastructures on shore are again plausible only as conjectures.<sup>68</sup> At present two provisional hypotheses, based upon a perusal of recent histories of the ministries, bureaucracies and agencies and firms concerned with the management of and supplies for navies in early modern Europe can be hazarded.

First, that all public organizations involved with the construction, mobilization, coordination and administration of the warships and other resources required by fleets to become formidable at sea seem to have been afflicted, some more than others, with all the vices of *ancien regimes*, long familiar to historians – but now expressed in the importable

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<sup>66</sup> H. Bowen and A. Gonzalez-Encisco (eds.), *Mobilizing Resources for War. Britain and Spain at Work during the Early Modern Period* (Pamplona, 2006)

<sup>67</sup> R. Sanchez-Torres (ed.), *War, State and Development. Fiscal Military States in the Eighteenth Century* (Pamplona, 2007)

<sup>68</sup> J. Black and P. Woodfine (eds.), *The British Navy and Use of Naval Power in the Eighteenth Century* (Leicester, 1988)

taxonomies and vocabularies of new institutional economics.<sup>69</sup>

Corruption, rent seeking, percolation, moral hazards, adverse selection, principle agent problems of every conceivable kind obstructed the command and incentive systems for the execution of missions assigned to navies all the way down the line from rulers at the top through ministries, admiralties, boards and other departments of state to officers on the quarter deck.<sup>70</sup>

Second, the voluminous historiography of British naval administration, glowing with the success of its fleet, does not suggest that the kingdom's Parliamentary regime, a supposedly optimal constitution for liberty with economic efficiency, could without closer investigation be plausibly represented as clearly more superior in sustaining effective naval administrations than autocratic Spain, absolutist France or the decentralized administration favoured by the Dutch republic.<sup>71</sup> British naval historians, together with neo-liberal economists, might wish, and indeed may assume, that to be the case. But it is not proven that the Admiralty and its several subsidiary Boards (acting, much of the time, as fiefdoms) effectively managed the construction, procurement and maintenance of warships; controlled the hire of vessels for transportation, victualled fleets, cared for sick and wounded seamen, solved the problems of coordination, control and collaboration with private firms or successfully aligned systems of incentives with their specialized missions for defence of the realm and the kingdom's mercantilist objectives in ways

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<sup>69</sup> D. Benjamin and C. Thornberg, 'Organization and Incentives in the Age of Sail'; M. Palmer, 'The Sails Right Hand: Command and Central in the Age of Fighting Sail, 1652-1827'

<sup>70</sup> C. Menard and M. Shirley, eds., *New Institutional Economics* (Boston 2005).

<sup>71</sup> B. Morris, *Naval Power and British Culture*; J. Dull, *The French Navy and American Independence: A Study of Arms and Diplomacy* (Princeton, 1975); J. Dull, *The French Navy and the Seven Years War. France Overseas. Studies in Empire and Decolonization* (Chesham, 2005);

that were clearly more efficient than the systems operated by their foes and European rivals.<sup>72</sup>

After 1815 when nineteenth century political reformers engaged seriously with the clean up of “old corruption” they found nothing exceptional to praise in departments of state responsible for the navy. Many new institutional economic historians like the idea that Parliamentary regimes established more efficient departments of state and bureaucracies than their “despotic” rivals. Yet investigations by Parliamentary commissions and later by historians of the administrations running the navy, the army and most other departments of the Hanoverian-early Victorian state have found all the malign features of early modern governance to be as commonplace in Britain as the rest of Europe.<sup>73</sup> Sir Lewis Namier and his school, who at least understood the nature of politics, patronage and bureaucracy under an *ancien regime*, suggested that British administration worked better than regimes on the mainland because a Parliamentary system allowed more scope for private enterprise and for the misappropriation of taxpayers’ money, which at least got things done. In other words, at that time rents may well have been a higher component of public expenditure under Parliamentary than monarchical constitutions - persistently strapped for cash and more dependent upon aristocratic traditions of noble behaviour and service to the Crown.<sup>74</sup>

Political historians will recognize, but economists may not, all such inefficient features of early modern public administration as endemic to the transition from decentralized polities to Weberian states and from

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<sup>72</sup> D. North and B. Weingast, ‘Constitutions and Commitments: the Evolution of Institutions Governing Public Choice in Seventeenth Century England’, in *Journal of Economic History*, 49 (1989), pp. 803-832

<sup>73</sup> P. Mandler, *Aristocratic Government in the Age of Reform* (Cambridge, 1990)

<sup>74</sup> L. Namier, *The Structure of Politics at the Accession of George III* (London, 1961) and M.A. Oppenheim, *A History of the Administration of the Royal Navy* (Hanover, 1961)

crude to modern forms of management for large scale complex bureaucratic organizations with multiple missions and objectives.<sup>75</sup>

Before the nineteenth century revolutions in transport and communications and the diffusion of organizational systems and techniques to communicate, monitor and audit commands and information from central governments, all European states continued to act as “coordinators” of the authority and “mobilizers” of the resources required to sustain fleets of warships at sea or armies in the field.<sup>76</sup>

Whatever claims kings made to divine rights, absolute obedience or their parliaments of rich and self-interested notables asserted about sovereignty derived from the people, their capabilities for action remained bounded, much less by constitutional forms, and much more by technologically constrained imperfections in the organizational techniques available to implement policies and strategies efficiently.<sup>77</sup> Economic historians are now pursuing hypotheses that suggest that *ancien regimes* that let in markets seem to have worked better than those who tried to deliver more autocratic and honest governance. Nevertheless, all states (Britain much less so than any of its rivals) were fundamentally constrained by the lack of fiscal and financial resources to pay both the opportunity costs and the “rents” necessary to construct, mobilize and run an effective navy.<sup>78</sup>

Meanwhile this particular historical narrative, constructed around the familiar concepts and scaffolding of a macro production function,

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<sup>75</sup> R. Ekelund and R. Tollison, eds., *Politicized Economics, Monarchy, Monopoly and Mercantilism* (College Station, Texas, 1997)

<sup>76</sup> Sanchez-Torres, ed., *War, State and Development* and N. Baker, *Government and Contractors. The British treasury and War Supplies* (London, 1971)

<sup>77</sup> D. North, *Institutions, Institutional Change and Economic Performance* (Cambridge, 1990)

<sup>78</sup> Elaborated in P. O'Brien, 'The History, Nature and Economic Significance of an Exceptional Fiscal State for the Growth of the British Economy, 1453-1815 (forthcoming in *Economic History Review*, 2010)

offers nothing more than the following brief prospectus of plausible but speculative hypotheses for refinement and research.

First, the rise of British naval supremacy from 1652 was path dependant and linked by loops of inter-connexions to the growth of the economy. Second, politically, the development of a strong navy depended upon a slow evolution (1453-1649) of a maritime strategy for the off-shore defence of an island realm, coupled with a relatively small army, which was deployed to maintain internal order in a less than united and potentially ungovernable kingdom. Third, the fiscal and financial institutions and political consensus for a sustained uplift in state expenditures on the largest standing fleet of warships in Europe was created during an interregnum of Republican rule, carried forward by the Stuarts and exploited to reach its full potential between the Glorious Revolution (1688) and the Congress of Vienna (1815). Fourth, the development and consolidation of the realm's extensive maritime sector was protected by the Royal Navy which, in turn, promoted and sustained the largest fleet of battleships on call for defence and aggression in Europe and across the oceans of the world economy. Fifth, claims by British naval historians that the long run geopolitical and imperial success of the Royal Navy could be imputed to British technology, superior seamanship, bravery in battle, tactical knowledge, the Nelson factor, well designed economic incentives, more efficient logistical support and organizational capacities are, if such things could be quantified, *prima facie* unlikely to have generated the kind of a large, residual, implied by narratives of success that flow from the production of historical writing upon a provincialized and national basis. Sixth, British naval and mercantile superiority can best be represented as the product of combined investment by the private and public sectors in a combined strategy for security, internal order and the extension of a well subsidized

merchant marine sector that led the economy towards a plateau of possibilities for precocious industrialization.

Finally, this narrative (which remains negotiable) represents the institutions and culture promoting the First Industrial Revolution as an outcome of successful policies to promote domestic trade, shipping and commercial services required for the expansion of exports, imports and re-exports makes more plausible sense than its representation as the paradigm case for parliamentary governance, liberty, democracy and private enterprise. The historical story behind the comparative advantages enjoyed by the British economy in the wake of an era of “mercantilist” policies to promote overseas commerce and industrialization emanated from kinetic energy and high wages, combined with geopolitical, power that is from coal and the Royal Navy. Though that thought may be heretical it certainly leaves less space to “economic and social histories from below”, but restores geopolitical strategy, fiscal policy and geographical endowments to a central place in British economic history. It is, we suggest, the reductionist position upon which Bob Allen’s recent reinterpretation of the Industrial Revolution may come to rest.<sup>79</sup>

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<sup>79</sup> R. C. Allen, *The British Industrial Revolution in Global Perspective* (Cambridge, 2009)

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