Transport Costs, Geopolitics and Economic Incentives in Medieval Eurasia and their role in shaping modern economic growth

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Extended Abstract

A key issue in the political economy of development concerns the factors that determine the choice of public goods by any government. These factors generally reflect the prior distribution of political and economic power in society – which in turn is rooted in parameters like geography and technology. Further, the mix of public goods affects not only the distribution of benefits but also the rate and pattern of future growth. This paper tells the story of two sets of choices of public goods that changed history. Indeed, it may plausibly be argued that these almost simultaneous, but unrelated, choices together constituted the major turning point in the economic and political history of the last millennium. They explain the much debated 'reversal of fortune' – the rise of the North Atlantic economies and their pioneering role in modern economic growth in contrast to the earlier economic and political dominance of Asia.

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Abstract

Earlier work has shown the importance of Atlantic Western Europe in determining modern economic growth and the geographical distribution of world output. Here we investigate why this particular set of countries emerged as leaders in open ocean navigation and naval warfare, as opposed to Asia or the rest of Europe. We show how the economics of transport in the era preceding open ocean navigation interacted with geographical features to give rise to differential economic and political institutions and incentives across regions. This determined the locus of innovation in ocean navigation and the distribution of benefits.

1. Introduction

A key issue in the political economy of development concerns the factors that determine the choice of public goods by any government. These factors generally reflect the prior distribution of political and economic power in society – which in turn is rooted in parameters like geography and technology. Further, the mix of public goods affects not only the distribution of benefits but also the rate and pattern of future growth. This paper tells the story of two sets of choices of public goods that changed history. Indeed, it may plausibly be argued that these almost simultaneous, but unrelated, choices together constituted the major turning point in the economic and political history of the last millennium. They explain the much debated 'reversal of fortune' – the rise of the North Atlantic economies and their pioneering role in modern economic growth in contrast to the earlier economic and political dominance of Asia.

2. The Central Question

One possible interpretation of the origins of modern economic growth is in terms of a redistribution of world income and output in favour of Western Europe, in particular Britain. The resulting concentration of output and income in a small region, the emergence of a growth pole as it were, triggered off a cumulative process of plummeting transaction costs, the emergence of external economies of scale, and the agglomeration of market-oriented industries in this nuclear region. This then induced innovations that removed short run supply constraints on growth.

Several economists have studied the role of physical geography in the rise of Western Europe. Acemoglu, Johnson and Robinson (2005) have shown that post 1500 – after the opening of the Atlantic sea routes – the "Atlantic traders" (Britain, France, Holland, Spain and Portugal)

were the chief drivers of economic growth between 1500 and 1850. Mediterranean ports and inland cities in Europe grew much more slowly. Proximity to the coast and the length of Atlantic coastline were important determinants of growth. The role of geographical features in determining the spatial distribution of growth has also been studied by other scholars. Redding and Venables (2004) show that access to the coast and policies promoting openness increase a country's per capita income by 20%, while halving the distance between trading partners increases per capita income by 25%. Gallup, Sachs and Mellinger (1999) show that proximity to the coast or to navigable rivers explains many differences in the spatial distribution of income and growth.

The importance of the "Atlantic traders" in shaping the course of modern economic growth through trade and colonization is relatively uncontroversial. However, what explains why *this* particular set of countries came up with the technologies of open ocean navigation and associated naval warfare that enabled them to obtain and maintain their mastery over the seas? Why were similar techniques not developed in Asia? Our central thesis in this paper is that this can be explained in terms of the economic geography of transport in the era *before open ocean navigation.* We argue that geographical features combined with the economics of medieval transport to give rise to spatial differences in economic and political institutions. The latter were important because innovation on the scale required to give rise to open ocean navigation and naval warfare technology was not possible without government sponsorship. Indeed, innovation by its very nature is risky, involves lumpy investments and entails huge externalities reflecting its "public good" character. We then argue that these differences in economic and political institutions – induced in the first place by the interaction of geography and the economics of transport – created different incentives and opportunities for government sponsorship of open ocean innovation. This in turn resulted in the "Atlantic traders" emerging as successful innovators, determining the course of future economic growth and the geographical distribution of world output.

Thus we seek to explore two basic questions. First, how much of the structure of pre-modern states can be explained in terms of medieval transport technology? Second, how did this structure determine the locus of innovation in ocean navigation and warfare and the distribution of the benefits?

Related literature includes – besides the papers already cited - Anderson and van Wincoop (2004) on why trade costs matter, and Behrens et al (2006) on the role of high domestic transport costs within a region.[3] In our accounts of medieval Eurasia we rely primarily on Jones (1981), Parry (1981), Saunders (1971), Lattimore (1940), Eberhard (1960) and Stephenson (1942).

3. The Economic Geography of Medieval Transport

The geography of Eurasia is central to the characteristics and evolution of transport before the modern era. From East to West, Eurasia comprises the coasts and archipelagoes of Pacific Asia, the great river valleys of China, India and Mesopotamia, the desolate Arabian peninsula, the landlocked Mediterranean and peninsular Europe pointing towards the Atlantic – all encircling a vast, continental heartland. But, interposed across the main East-West sea routes of Asia lies the compact, impenetrable bulk of Africa. Not only does this compel a vast detour, but also – because of the off-shore Trade Winds down the West coast of the Sahara – tends to deflect all shipping way out into the Atlantic.[4] Up to the fifteenth century, maritime transport moved in two restricted orbits separated by the African landmass: (1) the European orbit focused in the landlocked Mediterranean, and (2) the Indian Ocean orbit extending from the Red Sea and the Persian Gulf to the South China Sea and dominated by the monsoon. The techniques of navigation and of naval warfare in each circuit were adapted to the specialized requirements of the Mediterranean on one hand and the Indian Ocean on the other. Given the geographical discontinuity between the two circuits, it was inevitable that seafaring methods which were of value mainly in the transition from one to the other should be neglected. The technology of open ocean navigation in the Atlantic was not, of course, unknown. The great Norse voyages of the High Middle Ages to Iceland and Greenland or Leif Ericsson's fabled journeys to Labrador would have been impossible without means of accurately determining position and steering a course on the high seas. But these voyages were too unrewarding to be pursued; and the techniques they involved fell into relative disuse and oblivion. The technology of open sea warfare, based on guns and sails, on naval artillery and the naval architecture that went with it, was as yet in the future. Intercontinental commerce was primarily over land. It converged on the

[3] Other literature by economic historians, including some approaches which are complementary to ours, will be discussed in a later section.
[4] For details on Atlantic winds see Parry (1981).

caravan routes of the Middle East through the silk roads of Chinese Turkestan or the spice routes through the Persian Gulf and the Red Sea.

Land transport was exceedingly expensive. Based as it was on draft and pack animals, the costs of forage and fodder for animals on the move made it prohibitive in areas of settled agriculture. It was cheaper on the steppe where animals could find free pasture as they traveled. Even so, costs were high and the risk of drought ever-present. In addition, land transport involved protection costs to be paid to all rulers en route and the risk of brigandage. These costs were in fact highest on the steppe with its mobile war-like population.

In fact, the high costs of transport were so pervasive a feature of medieval life that in many senses the Middle Ages can be best understood as the Age of Immobility.

3.1The Economics of the Age of Immobility

The high costs of transport drastically restricted the volume of trade. In particular, intercontinental trade was reduced to a thin trickle on account of the fact that continuous communication over water was impossible between Europe and Asia. Transport costs also biased the composition of trade towards light, compact, high-value goods. Inter-continental trade in particular catered to the market for exotic luxuries, to the charmed circle of the very rich – except perhaps for the trade in pepper.

The insignificance of trade affected the pattern of production. Manufacturers by and large were limited by local materials and markets, scales of production were necessarily small and economies of scale inaccessible. With manufacturing costs and prices high, the consumption of manufactures – like the consumption of luxury goods – was confined to a tiny elite clientele. The overwhelming bulk of output originated in agriculture which was accordingly the main source of surplus and the mainstay of the tax-collector. And, if agriculture was the major source of revenue, the supplementary sources also were land-based. Thus, the marginality of the sea and the central significance of the land were accentuated by the fact that the richest (though not the bulkiest) trade – the long-distance inter-continental commerce in luxuries – traveled over land (Jones, 1981). The locus of economic power was thus continental rather than maritime. Control over rich producing land areas was more important than over sea routes and ports. Military technology was therefore primarily directed to land warfare. There was little interest in the improvement of methods of maritime combat.

3.2 Land transport and Medieval War: The Basis of Feudalism

The high cost of transport had other military implications too. It made long distance logistics inordinately expensive. The conveyance of military supplies to garrisons posed problems whose solutions often had a decisive influence on the configuration of society and state. One possible solution was military decentralization. The defence of specific pieces of land had to be based on the local resources of those pieces of land. Where the military threat was essentially peripheral, the consequences would be frontier warrior colonies or frontier feudalism (Lattimore, 1940). With a more generally dispersed threat pattern, the feudal mode of organization became universal. A second solution, typical of regions exposed to a peripheral threat on a relatively unproductive frontier, involved large scale canal construction. Food was thereby moved from the fertile heartlands to the garrisons of a barren frontier. A classic example was the transport of supplies from the rich Yangtze provinces of Ming China along the Grand Canal to the Northern garrison defending Peking and the Great Wall.

The technology of transport had operational, as well as logistic, implications for warfare. In an age of low-tech land transport and land warfare, the horse was the primary military carrier. Given the mobility conferred by the horse, the radius of military striking power of a standing army living off the land far exceeded the orbit of food supply and economic integration. Thus the prime relationships between distant peoples were military rather than economic. Predation prevailed over cooperation, security was a more compelling concern than affluence. Military capability and power tended to be the main bases of political authority. Economic power was relegated distinctly to the background.

The military use of the horse followed two distinct lines of development (Saunders, 1971). On the one hand there was the development of light cavalry, essentially of mounted archers who would capitalize on their high mobility by using the nomad tactics of rapid maneuvering, ambush and surprise attack. The domain over which light cavalry reigned supreme stretched right across the Eurasian steppe with extensions into North China and North Western India and across the Hungarian steppe to the gates of Vienna. But it could not penetrate the heavy humid forests of North and West Europe. It was restricted to the dry open grasslands which were the main breeding grounds of the light horse and which affected the optimum conditions for their deployment.

This was also the realm of the pastoral nomad – the tribesman whose way of life prepared him for the mobility *en masse* so characteristic of light cavalry. Here entire populations lived off the soil and on the move.

Things were different with the peasantry of less arid regions. Agrarian economies did not favor mass mobility, so that large armies could not live off the soil. The response of such lands to the pressures of light cavalry was based on the bigger, stronger horses that could be bred on their richer pastures. The strength of these horses coupled with the innovation of the stirrup made it possible to use heavy armor for horse and rider. The armored horseman and his mount were both expensive and specialized. Hence, a full-time warrior elite evolved and the support of each warrior required the surplus of a large agricultural territory. The high costs of transport made the collection and centralization of such a large surplus for the benefit of a central standing army prohibitive. The alternative was the dispersal of the main elements of the army, the knights, over the domain – so that each could collect and subsist on the surplus of a specific piece of territory. The foundations of feudalism were thus laid. Its basis everywhere was military – whether in Sassanid Persia, in Byzantium with its cataphract-bowmen, or in the Muslim Middle East where it was formalized under the Turks by Nizam-ul-Mulk. Of course, the fullest development of feudal institutions took place in Western Europe where the armoured knight with his lance effectively sustained the defence of Western Christendom (Stephenson 1942).

3.3 Transport and the Regional Balance of Power in the Medieval World

The insignificance of trade, the landlocked character of transport technology, the land-ward orientation of military technology all had their implications for the balance between regions. They favored hinterlands over coasts, continental interiors over ocean margins. The consequence for the vast Eurasian land mass was the dominance of the Central Asian steppe. The steppe could draw tribute from intercontinental commerce – not only because of its location but also because the free pasture it provided depressed the costs of animal-based transport and so tended to attract trade.

The steppes were also the prime breeding grounds of the horse – the basis of rapid land transport and indispensable means of land warfare. The horse trade was one of the most active and prosperous lines of commerce and a rich source of income to the steppe lords. The horse was also the basis of their devastating military effectiveness. Coupled with the locational advantage

of the steppe and the mobile way of life of the steppe-nomad, this conferred on the steppes unique military advantages: forces could be massed and deployed at the right places and the right time, intelligence could be accumulated, and effective control and command exercised over a geographical span unequalled before modern times. Conquerors based on the steppe could isolate and attack the agricultural civilizations of relatively more maritime peoples. Thus the pressures from the steppe, the waves of migration and of conquest originating in its interior were the dominant motif in medieval history. They destroyed the classical world and shaped the contours of the age that followed. From the collapse of the Roman empire to the rise and evolution of feudalism in Europe, the erosion and eventual supersession of the Arab hegemony by the Turks in the Middle East, the political anarchy and eventual downfall of Hindu India and almost the entire dynastic history of China from the Yellow Emperor to the Manchus – this entire sweep of a millennium or more of history is dominated by pressures from the steppe. It constitutes the unifying thread in this chequered pattern.

It is not only on the global scale that the dominance of heartlands is manifest. It emerges on the national scale as well. Both in India and in China right up to the colonial era, the coasts were always subordinate to the interior – whether due to the rich agricultural resources of the latter or to its essential defensive functions ("strategic depth") in an age of land warfare.

There were of course significant exceptions to the rule that coasts were not major sources of surplus. Where – for reasons connected with the geography of transport – a large volume of trade was funneled through a single point, a port may become a very worthwhile asset indeed. Witness the Red Sea ports like Aden and Socotra, the Persian Gulf ports like Hormuz, Surat, Mamallapuram and Kaveripattinam in India, Malacca and the Chinese ports.

But most of these Asian ports could never become independent sources of political power because they lived in the shadow of great land powers based in the fertile river valleys of Mesopotamia, India and China. Venice (and later Genoa) – located at the crossroads of the trans-Alpine trade of Central Europe and the Mediterranean, could on the other hand convert its commercial pre-eminence into political sovereignty because of its remoteness from any great natural centre of continental authority. Indeed the geography of Europe – the lack of vast fertile agricultural areas on the scale of India and China, the peninsular character of the entire continent, and the diversity of climates (Mediterranean to temperate to Arctic), soils, topography and

mineral resources within a small area always tended to increase the importance of trade and of the sea relative to the land.

Transport and the Rule of the Nomad

If the technology of transport and the associated technology of war changed the balance between regions in favour of the Central Asian steppe, it also selected between peoples. It made the horse-breeding steppe nomads the masters of Asia and of most of Europe east of the Hungarian steppe.

The military advantages of the nomad were manifold. His whole way of life was designed for mobility. His migratory habits, his tent-home, his mobile livestock property, the portability of his household goods – all helped in minimizing the costs of movement. Unlike the peasant who was rooted to the soil by his immovable property, his field, his farm, his terraces, his irrigation canals, the nomad was not committed to the defence of a fixed territory. He could withdraw his women and children, his herds and his home deep into the heart of the steppe, beyond the reach of the enemy, while enriching himself by plundering raids on settled agricultural or urban peoples.

The nomadic horseman's control of large herds of horses and his lifelong acquaintance with the techniques of riding and horseback archery reinforced his mobility. Speed was a strategic and tactical asset which he could exploit to a degree unequalled in the medieval world.

Finally, his means of livelihood and the geography of his homeland imposed on him a political structure and tradition ideal in many ways for the purposes of conquest. Because of the herding instinct of horses, the optimal ratio of livestock to labor in horse-breeding is very large. And, given the medieval technologies of war and transport, the market for horses was lucrative. This facilitated the accumulation of vast horse herds and large fortunes among the horse-nomads, the emergence of an aristocracy and a well-developed social stratification. The horse-nomads had a high potential for internal political organization despite their tribal character (Crone, 1980).

This was reinforced by the geopolitics of Central Asia, particularly of Mongolia – the cradle of Central Asian state-formation (Saunders 1971). Here pressures from forest invaders from the North and the Chinese civilization to the East converged on a grassland enclosed by desert and forest: the narrow Jungarian corridor was the only outlet on the West. In this region, enormous pressures could accumulate and tribal warfare became endemic. Tribes would then disintegrate through dispersal or enslavement, and free retainers cluster around chiefs, one of whom would eventually subdue his neighbours and found a state. Stratification rather than

segmentation (as in a tribal society) would be the organizing principle. The states thus fashioned were conquest states. They were naturally selected by the circumstances of their birth for warfare. And it was this political tradition which – combined with their way of life, their command over horses and their strategic location – made the Mongols and the Turks the conquerors of the medieval world.

The long line of mighty conquerors and empire-builders of Turko-Mongol origin is therefore hardly surprising. From Attila through Mehmud of Ghazni, Toghril Beg, Chenghiz Khan and his heirs and Timur the Lame to Akbar and Suleiman the Magnificent – it spans the entire course of medieval history. So does the interminable succession of Turko-Mongol dynasties. In China, the Khitan and the Kin rulers of Peking provided a foretaste of the Yuan century. In India, the Delhi sultanate was succeeded by the Moghuls. In the Middle East, the Seljuks, the Mamelukes and the Ottomans wrested control of Islam from the Arabs. Above all, there were the mighty empires of Inner Asia, culminating in that of the Chenghiz Khanite Mongols and their branches – not just the house of Kublai Khan in China, but also the house of Hulagu in Persia, the Golden Horde and the Mongol Khanates of Russia (Saunders 1971).

The pressures built up among the nomads of the almost enclosed Mongolian steppe impinged first on the Great Wall and then, through the narrow Jungarian corridor, on Turkestan and North Western Iran. From there its repercussions penetrated to India and the Middle East. But Northward, on the almost limitless expanse of the Russian steppe, the pressure was deflated: except in periods of extreme desiccation, the impetus for further nomadic advance into Western Europe was weak – at least compared to the devastating hordes that hurled themselves on North China and Persia. Further, it was not just distance and the insulating buffer of the Russian steppe that protected Europe: it was her climate and vegetation. While North China, Iran and even North Western India were continuations of the semi-arid grasslands, Europe west of Hungary was humid and thickly forested. The marshes and forests of Western Europe impeded the mobility of the nomad's cavalry: it thereby tended to arrest the march of nomadic conquest.

Europe was thus less vulnerable to pressures from the Eurasian heartland than Asia. And, unlike Asia, it did not possess extensive sub-continental core areas of its own. Europe lacked the agricultural resources of vast alluvial plains on the scale of the Huang-ho and the Yangtze valleys, the Ganga-Jamuna doab, or even the Tigris-Euphrates basin. Its patches of fertile soil were separated by formidable natural barriers (Jones 1981), so that its largest agricultural regions

(in France for example) hardly compared even with the Kaveri valley core of the Chola empire. The agricultural hinterlands of Asia generated surpluses that sustained centralized states strong enough to dominate the coasts. But European kingdoms could never marshal resources on this scale from their interiors: central powers could not in consequence overshadow the European maritime periphery.[5]

4 The European Opening to the Sea

The world of the Middle Ages faced landward. In economic and strategic dimensions, in class systems and the organization of production, in military technology and political structure, its concerns were continental. Geopolitically, Eurasia in the late Middle Ages comprised three distinct elements: (1) a heartland dominated by warlike horse-breeding nomads who exerted continuous pressure on (2) the agricultural civilizations of the Asian river valleys and (3) peninsular Europe where smaller regional entities could live in relative immunity from the pressures from Inner Asia though not from their own internecine conflicts.

Each of these three components developed its own characteristic political structures. There were the military empires of Inner Asia, based on land warfare and control of land trade routes. There were the river valley empires of China, India and Mesopotamia, based on defence of a Northern frontier against nomadic invaders and the internal trade of a fertile agricultural region. And there was the European nation-state system comprising smaller monarchies without a rich agricultural base, driven therefore to compete with each other to capture a potentially rich sea-trade.

While the conquest empires of the nomads had no connection with the sea at all, the alluvial empires flourished because of their rich agriculture and could survive only through effective defence of their Northern border against invasion. Their structure was determined by this prime function: they were dominated by warrior elites that controlled the central army and bureaucracies that collected the land revenue and used it to provision the army. Coasts and maritime trade were strictly secondary Ports, merchants and naval concerns, while tolerated as long as they knew their places, could never be permitted to grow strong enough to disturb the internal balance of power.

[5] The Ming withdrawal from the sea after the age of the great voyages of Cheng Ho can, in fact, be explained by rivalry between the centre and the coast. An empire ruled from the interior did not want its coastal regions to prosper sufficiently to become rival sources of political power.

Unlike Asia, Europe West of the Elbe evolved political structures and traditions that were not entirely insensitive to pressures and opportunities arising from the sea. This reflected (1) its distance from and natural defences against nomadic invasion, (2) its lack of a rich agricultural base for a land empire and (3) its high proportion of coastline to land area. The last factor ensured that most of Western Europe was readily accessible from the sea and that maritime influences could penetrate more deeply inland and play a more significant role in the economics and politics of the continent. In particular, as sources of funds and power, maritime trade and plunder could become important alternatives to land revenue as they never could have been in Asia. In Europe, they became major instruments in the hands of monarchs seeking to build nation-states out of feudal economies run by local lords and barons. During the recovery from the Black Death, in the late fourteenth and early fifteenth centuries, kings began successfully asserting their authority over feudal barons. Their capacity to do so was greatly enhanced by the import from China by way of the Mongols of gunpowder technology and the subsequent development of cannon, which made it possible for them to demolish the fortress-strongholds of feudal lords. And they found natural allies in a merchant class that resented feudal restrictions on internal trade and mobility. However, while the barons directly controlled the land revenue, the king needed an independent source of funds: he found this in maritime trade. Governments of fifteenth- and sixteenth-century European nation-states thus had a vested interest in ocean trade arising from the requirements of internal balance of power. The interests of the monarchical state and of maritime traders and pirates converged in a political alliance that deeply influenced the state's decisions about public investment.

The difference in geopolitical compulsions between the continents shaped the difference in political structures. And it was this difference that helped explain the locus of transport innovation when it came and the very different responses that the innovation evoked.

The rise of open ocean navigation and the discovery of the new sea routes in the fifteenth and sixteenth centuries were not random processes. They were the products of prolonged exploration and experiment. Much of the pioneering investment in the process was fruitless, and most of it financially unprofitable. All of it would have been inconceivable without the strong support of states committed to the progress of sea faring. In Spain, in Holland, in England, above all in Portugal, the state did develop such a commitment: political structures and tradition

permitted and indeed encouraged it. But after the Ming withdrawal from the sea (see footnote 4), nothing of this kind emerged in the great empires of Asia. Some of them – like the Chinese or like Tokugawa Japan later – deliberately insulated themselves from maritime contact. Others tolerated navigation and trade, but their objectives were limited and specific – the Haj pilgrimage, the import of war horses and the like; there was never the slightest semblance of any effort (apart from the early Ming voyages) to subsidize risky exploration or even technological improvement.

The greater interest of Europe in navigational methods was matched by – and indeed in part led to – her greater interest in the technology of naval warfare. In this indeed the influence of geography on the political structure of Europe acted as a stimulant. Europe emerged from the Middle Ages as a nascent states system – not as an empire or a set of empires. Its patches of fertile soil did not run together to form the core-area of a large political unit, but were divided by natural barriers that encouraged regional, rather than continental, entities. The consequence was intense political and military competition between the European states. With the rise of ocean navigation and trade, the arena of competition shifted out into the Atlantic. Guns were mounted on ships; and much effort was devoted to the adaptation of each to the specialized requirements of the other. Lighter, quicker-firing cannon were designed to replace massive bombards (Cipolla 1965).

The technological basis was thus prepared for the evolution of the field-gun and the transformation of artillery from an instrument of siege warfare alone to a lethal and mobile weapon on sea or land. Meanwhile, the maneuverability and armament-carrying capacity of ships were vastly improved and the whole concept of naval warfare changed. Battles at sea were no longer decided by ramming, grappling and boarding, but by maneuvering and gunfire from a distance.

No such revolution in naval architecture or armament or in the technology of naval warfare occurred in Asia (Qaisar 1968, Hourani 1995). The Asian empires were basically uninterested in the sea; and on the few occasions when the imperial fleets took to the water, they faced but little competition on the limited courses that they sailed. There was no real spur to improvement. Of course, when the Portuguese appeared in Asian waters, they swept all Asian fleets (except the Chinese coastguard) off the sea; but by then the technological lag of the others

was far too wide, while the Chinese chose to cut themselves off from the mainstream of naval technology.

In the long run, indifference to the sea undermined Asian military effectiveness on land as well. Fire-power in Asia was never adapted to maritime use, so it did not pass through the essential experimental phase that led to the development of light mobile field artillery. Asian artillery continued to evolve in the direction of massiveness – appropriate for siege warfare – culminating in the monstrous artifacts of the Ottoman gunsmiths. Mobility was entirely sacrificed. The eventual consequence for Asia was an insurmountable handicap even in land warfare (Cipolla 1965). Thus, when the great empires decayed and the Europeans ventured forth from their coastal strongholds to challenge for supremacy on the mainland, they were militarily as irresistible as they had earlier been at sea. And Ottoman power after its last thrust at the gates of Vienna in 1768, retreated Eastward in inexorable decline.

The Indian Ocean trade was of course first a segment of the expanding frontier of European navigation and commerce. There were the African trade, the Caribbean trade and the commerce of the American mainland. There was also the intensification of intra-European trade that stemmed from the technological revolution in navigation. All these areas offered European carriers the added advantage of relative proximity. So, once the Asian trade was captured, Europe had in effect completed the conquest of the whole world of maritime commerce.

Atlantic Europe thus acquired its undisputed mastery over the seas of the world and over its trade. Both in the initiation of the new technology of transport and warfare and in its further development, she had advantages which she defended by force of arms to ensure her mercantile superiority. Once this was assured, there was less resistance to Asian ship-building and commerce; but by then the costs of developing the new labour skills and the fund of technical knowledge and trading contacts required for success in these fields was sufficiently daunting to deter all but the most foolhardy of potential Asian entrants.

5. An illustrative contrast: China and Portugal

Nowhere is the difference in compulsions and attitudes to the ocean of Asian and European states more dramatically illustrated than in the contrast between mighty Ming China and little Portugal. The long land frontier of China proper, though protected to the West and Southwest by impenetrable mountains and deserts, lies open to the North. And no natural barriers intervene between this Northern border and the heartland of agricultural China. The north China plain and

the fertile Yangtse basin are topographically continuous and indivisible and do not permit the maintenance anywhere of stable lines of internal defence (Lattimore, 1940, Rossabi, 1975). Military equilibrium required a unitary authority over this vast region – provided the latter could effectively defend the Northern border against nomadic invaders from the steppe. Military security, and in particular the defence of the Great Wall, was therefore the prime function of the Chinese state. For two millennia, it maintained unchanged an institutional structure based on the interlocking of a Northern garrison that defended the Great Wall and a bureaucracy that collected the agricultural surpluses of the Yangtse provinces and conveyed them to the Northern army. The maritime trade of the Pacific provinces was never a focus of imperial concern.

The period that represented the exception to this rule was the era of the Southern Sung (1127—1279), when the Han Chinese rulers had been driven South of the Yangtse by the pressure of the Jurchen tribes. Deprived of their obsession with the Northern land border, the Sung established China's first standing navy, a fleet of 20 squadrons totaling 52,000 men (Needham), on ships armed with trebuchet catapults hurling gunpowder bombs and powered by paddle wheels, developed a variety of nautical innovations from water-tight bulkhead compartments to an improved mariner's compass, protected sea trade with SE Asia and fostered relations with South Eastern Asian powers. The Yuan dynasty (1279 – 1368), like the Sung, had no concerns about the Northern frontier – though for an entirely different reason. As part of the Mongol empire that stretched right across Inner Asia, it had no need to protect the North and no compulsion therefore to divert resources from maritime use for this purpose.

But with the return of the empire to its Northern borders, the Northern obsession and landward orientation of policy returned in full force. Chinese geopolitics after the Sung was typified by the Ming regime. As long as the Northern garrison had to be provisioned by sea from the Yangtse provinces, the Ming maintained an active interest in maritime trade and navigation, culminating in the seven great voyages (1405 – 1433) of the eunuch-admiral Zheng He. These voyages demonstrated the technological sophistication already achieved by China in ship-building, cartography, navigation and naval armament (Ma Huan 1970, Levathes 1997). But with the completion of the Grand Canal, the defenders of the Great Wall could be supplied by barge without resort to the riskier sea route and Ming China withdrew landwards behind a barrier of official bans on maritime activity. The records of Zheng He's voyages were destroyed, the navy gradually dismantled, even coastal settlement prohibited, foreign travel and contact with

foreigners proscribed and sea-going vessels burned with so much fervour that, at one point, a bureaucrat could boast that 'not an inch of plank now floats on the China Sea.' In the process, the Ming state not only withdrew its support from maritime enterprise, it actively did its level best to discourage and deter private maritime trade and shipbuilding. The fund of nautical knowledge and skill built up by the Southern Sung and augmented by the Great Voyages fell into disuse and oblivion. By the time that the Portuguese appeared in Asian waters, the great Chinese war-junks of Zheng He were a distant, and fast-fading memory.

One cannot imagine a sharper contrast to late fifteenth century China than the pioneer of the new technology of open-ocean navigation – little Portugal, hitherto a neglected backwater of the Mediterranean economy. Central to Portugal's pioneering role was her location. She – along with Spain – constituted the Mediterranean world's window on the Atlantic. She could tap the Mediterranean tradition of sea-faring lore, the nautical skills and ship-building technology of Genoa and Venice. At the same time, she knew the ocean and commanded – especially after the capture of Ceuta from the Moors (1415) – the West African coastal route which was the obvious springboard for Atlantic exploration and commerce with its rich trade in gold and slaves.

But the geographic compulsions that turned Portugal seaward extended beyond location. The rugged landscape of Portugal, her rocky soils and scanty irregular rainfall restricted cereal cultivation to a few fortunate plains like the fertile populous Northern province of Mino. Elsewhere, its extension depended on government investment in irrigation, a very expensive proposition on account of the violent fluctuations in river levels – perhaps the greatest in the world. On the other hand, Portugal's Mediterranean climate sustained orchards and vineyards that yielded citrus fruit, oil and wine, the forests that draped her otherwise forbidding landscape yielded cork, wax and honey. Together with the coastal fisheries, these supported a range of specialized products that could profitably exchange for grain imports from North Africa. Thus, an urban mercantile class interested in trade and shipbuilding existed – though the backwardness of inland transport confined its activities to the coast – especially to Lisbon and Oporto

Portugal was thus uniquely destined by nature for her pioneering role in the Age of Discovery. Her incremental comparative advantage lay in Atlantic trade and exploration. This was what promised the highest social returns on investment. But since the knowledge generated by the voyages was a 'public good', since it benefited later seafarers without the pioneer being able to capture a private return on these benefits, private individuals were necessarily deterred

from pioneering ventures. Central to Portugal's overseas ventures therefore was the royal patronage of the House of Aviz. From the reign of Dom Joao I (1385 – 1433), and especially from the capture of Ceuta, the Portuguese Crown encouraged, financed, often organized the commercial, exploratory and colonial ventures of the Portuguese overseas, starting with the initiatives of Henry the Navigator. The Portuguese moreover were always keenly conscious of the externalities arising from these ventures: they sought to shroud their voyages and the information they generated in the utmost secrecy so far as aliens were concerned.

The government's policy of encouraging maritime enterprise followed the dictates of comparative advantage. But it also buttressed the authority structure. The feudal aristocracy – the owners of the large latifundia – constituted the main challenge to central authority, and indeed in the rebellion of 1383-5 and the associated Castilian invasions, most of them had sided with the invaders. Extension of irrigated agriculture would have added to the power of potential dissenters. Maritime activity, the alternative channel of public investment, was in contrast focused on Lisbon, the centre of royal authority and on the local merchant community, beholden to the Crown but essentially emancipated from feudal control.

In the fifteenth century, moreover, the external threat to Portugal was no longer over land. Spain was in such internal disarray that the frontier with her caused little concern to the Portuguese. The main external enemies were in fact the Moors across the sea. Thus, even external security considerations imposed on the Portuguese state a seaward orientation.

The consequences of all this included not only Portugal's lead in discovering the sea-route to the East but the success of her caravels and galleys in wresting control of the Asian seas from local powers. The capture of Hormuz (1507), Goa (1510) and Malacca (1511) by Albuqerque gave Portugal monopoly control of the immensely lucrative spice trade (Freeman, 2003) and set the stage for more than four hundred years of European domination of Asia. But the origin of this domination lay in a mastery of the sea based on superiority in nautical technology and naval armament, which in turn reflected the comparative geopolitics of Asia and West Europe in an earlier era.

6. Alternative explanations

How does our story of the rise of the West compare with three other popular accounts of the same phenomenon?

Geoffrey Parker (1988) has argued that the really significant point of divergence between the trajectories of the West and the Rest was the Military Revolution, the transformation in European military technology and strategy in the early sixteenth century that guaranteed a growing superiority in military capacity. Certainly, such military superiority was an undeniable and overwhelming fact, initially limited in Asia to maritime conflicts but extending by the eighteenth century to land warfare as well. Just as undeniable was the role of this military hegemony in creating and perpetuating the political and economic subjugation of Asia. However, the crucial question concerns the origin of these differences – and this is what our paper focuses on.

Jared Diamond (1997) compares China with Western Europe and argues that China lagged behind as a consequence of the Ming withdrawal from the sea which left the European navies in undisputed control of Asian waters. He claims that this basic policy error was never corrected because of the monolithic unitary character of imperial China. Such errors, he claims, could never persist in Europe because ruthless competition among a host of different states would eliminate those that make major errors. In turn, the differing geographies of China and Europe account for their differences in political structure -- the continental imperial system of China as against the nation states of Europe with their maritime orientation, their many natural boundaries and small core areas. We agree with Diamond on the critical nature of the Ming withdrawal and the effects of geography on the political systems of Europe and Asia. However, it is an oversimplification to regard the Ming withdrawal as the unrectified mistake of a despotic regime or even as the simple triumph of the mandarin faction at court over the eunuch faction: it was, in our view, a reflection of the natural landward orientation of China and its traditional preoccupation with the Northern border and it is this orientation that we have sought to explain.

Finally, Kenneth Pomeranz (2000) has not only dated the divergence as late as the nineteenth century. He has also attributed it to two factors: (1) European, especially British, coal which provided the main energy inputs of the Industrial Revolution: (2) the agricultural and mineral resources of the New World which Europe could access readily and which enabled her to avert the Ricardian crisis of the early nineteenth century. While we do not go into the chronology of the divergence, we have a different account of its roots. Pomeranz ignores the abundance of coal in China: he believes that North China's rich coalfields could not stimulate Chinese industrialization because the Sung had been driven South of the Yangtse by the Jurchen

invaders far out of reach of Northern coal. While this could well be why a Sung industrialization was aborted despite all its technical innovations, it is a less convincing explanation of the failure of China to take off fully five hundred years after the Ming Revolution of 1368 had brought North China and its coal back into the Han orbit. And Europe's access to the Americas was a consequence of European exploration and trade, a phenomenon that needs to be explained rather than an exogenous circumstance: why, one may ask, did China not access the natural resources of Australia and New Zealand (as she is doing today) at an earlier date?

All these accounts therefore leave unresolved major questions that we have attempted to answer.

7.Conclusion

Why did state-sponsored innovation in open ocean navigation and naval warfare – the drivers of the course of modern economic growth and the determinants of the future spatial distribution of output - emerge in Atlantic Europe rather than in Asia or the rest of Europe? Our discussion above has sought to address this problem in some detail. Here we focus narrowly on the key factors behind the location of this innovation drive.

First, the economic geography of the age of immobility separated sea-based trade into two geographically distinct circuits. This combined with very high transport costs made trade insignificant and ensured that the richest trade was over land. Advantages in land transport via horse breeding was a major force behind the economic and military might of the nomads of the Central Asian steppes. Thus, Asia in the Middle Ages was oriented towards land. The steppe nomads were secure in their ever-expanding economic and military power while the great empires of the fertile alluvial land valleys of Asia created large enough agricultural surpluses to maintain armies in coastal areas. These Asian empires, therefore, had no incentive to be interested in the sea and indeed sought to reduce the ability of coastal towns to emerge as independent political powers. The nomads were not interested in sea power either, as the main sources of their power – the mobility conferred by the horse and the fact that land-based high-value trade passed through their dominion – were unconnected with the ocean. Similarly, Mediterranean Europe was content with its dominion over the Mediterranean trade and had no particularly strong incentive to innovate further.

Western (Atlantic) Europe, in contrast, had strong incentives to develop the technology associated with open ocean navigation and naval warfare. Geographical factors – the lack of

large alluvial river valleys as well as the fact that patches of fertile soil were separated by mountains, marshes and forests – were partly responsible for this. The natural barriers separating patches of fertile soil led to the emergence of a number of relatively small states all in fierce competition with each other. Competition was thus a driver of innovation. Moreover, the inability to draw on vast agricultural surpluses from the heartlands meant that ports were free to develop; the maritime coast was not overshadowed by powerful land-based interests. There was no parallel to the continental empires of Asia. The thick forests west of the Hungarian steppe also sheltered Western Europe in relative security so that it was safe from the constant depredations of the steppe invaders. All these factors created an environment in which state-subsidized experimentation in navigation and naval warfare could flourish and could lead to successful innovation. In addition, because of the difficulties associated with mastering navigation in the open ocean, the Atlantic countries, unlike their Mediterranean counterparts with their access to navigation and trade in a landlocked sea, could not afford to be complacent.[6]

The interplay between geography and the economics of transport in the era preceding that of open ocean navigation thus created an economic and geopolitical distribution of power that resulted in spatial differences in the incentives of governments to sponsor innovation in open ocean technologies. This is a rather different effect from the *direct* effect of (unchanging) geography on economic growth via proximity to the coast, proximity to rivers, and climate that many other scholars have expertly explored (as described in the first section of this paper).

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[6] While the pioneers in the process – Spain and Portugal – had access to the Mediterranean as well as the Atlantic and were therefore able to tap existing seafaring knowledge and skills, the other Atlantic nations that followed lacked this.

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