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**Master programme in Economic Growth,
Innovation and Spatial Dynamics**

The Chinese Maritime Frontier: 10th — 16th Century

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Abstract: China's maritime development during 200 B.C. to 1600 A.D. is usually vastly overlooked compared to its counterpart: Europe. Traditionally, Europe's maritime development has been associated as the frontier of maritime growth, which began around the sixteenth century and eventually evolved into modern economic growth. However, the thesis challenges that Europe was the frontier of maritime growth; rather, China was the leader of maritime development and trade, until seventeenth century. Not only did China present growth of the industry, but highly developed regionalization and maritime technology that contributed till the twenty century. China created an infrastructure of trade, commerce, institutions, human capital, innovations, and regional development in the maritime industry before Europe knocked on China's door. In exploring the development of the maritime industry in China a different measuring stick is used: rather than Neoclassical, Smithian Growth Model is used along with institutional and spatial proximity approaches to explore if the Chinese formed a maritime frontier.

Key words: Smithian Growth, Institutions, Maritime, China, South East Asia, Proximity, Shipbuilding, Navigation, Asian Mediterranean, pre-modern.

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“...the history of seaboard nations has been determined less by the shrewdness and foresight of governments than by conditions of positions, extent, configuration, number and character of their people — by what are called, in a word natural conditions (Elleman and Jung-pang 2012).”

Chapter 1: Introduction

Background

Sixteenth century Europe was a turning point in many aspects of maritime trade and commerce with an age exploration of both the mind and world with the first Portuguese discoveries and Spanish acquisitions along with Great Britain's mass Navy and imperialism. Europe had reached the Renaissance age — the bridge between the Middle ages and modern history, which brought about the Age of Discovery. The Netherlands had provided a technological revolution in shipbuilding leading to a competitive advantage in shipping, becoming a dominant trade power in the mid-seventeenth century. What these countries accomplished during this age and up to the first industrial revolution and further was quite remarkable both in maritime growth and exploration, however, centuries years before Europe's great expansion, China had already been leading a frontier of maritime development and commerce throughout the Asia Mediterranean.

The development of Chinese maritime actives can be traced all the way back to early Thalassic States (King of the Chou Dynasty 1046-1043 B.C.) where the art of shipbuild had advanced far beyond the stage of rafts (Deng, G. 1999). By the twelfth century China had created an infrastructure of trade and commercialization — “age of commerce” — by the means of regional proximity and technology developments in the maritime industry. In many ways, the Song (1127—1279) period was a leap forward in commercialization and technology; specifically, in the maritime industry, the Song period was commonly recognized as an era of China's medieval economic revolution. By the

time Europe reached China the country was well established and linked through various regions; especially, South East Asia where the development of regionalization — The Asian Mediterranean — was fully developed as a cohesive trade network that was linked by sea routes that even reached as far as Africa. The remarkable development of the Chinese maritime industry was a product of rapid Smithian growth, low transportation costs, and low transaction costs that allowed networks to merge and create one substantial economy that specialized in maritime products and technologies. The advancements in maritime technologies and navigation were the cornerstones of the developing maritime sector. The combination of these elements provided a frontier of maritime exploration and development centuries before Europe's “age of discovery” and the Renaissance.

The European “Scientific Revolution” of the sixteenth and seventeenth centuries is usually regarded as the foundation of modern technology, nineteenth and twentieth century China lagged behind most of Europe both technologically and economically, thus it is commonly thought that Confucianism and Chinese culture retracted scientific inquiry. However, Joseph Needham (1962) notes “China was for a time well ahead of the West in the development of several fields of knowledge about the physical world — including magnetism and optics — and Chinese advances in engineering were, at least until 1500, frequently superior to anything which Europe could show.” In addition, Lo Jung-pang presents that during the periods of the Song (1127—1279), Yuan (1271—1368), and early Ming (1368—1644) China was “more of sea power than a land power”.

Wang (1970 in Abu-Lughod, 1991) divides the pre-modern Chinese history into four phases. First, prior to the fifth century A.D. maritime trade was yet insignificant, due to population that was concentrated in the northwest region, where trade was land-based through the silk road. Second, between the fifth and eighth centuries there was significant migration that increased population in the South, where improvements of agriculture and communications developed. In relation to communication the construction of canals reduced the cost of internal transport and thus entered south periphery. During the third

period, ninth century to fourteenth century China experienced economic development and increased maritime activities. In addition, population increased in the coastal areas where rapid urbanization occurred stimulated by industrial developments and growing maritime trade. The fourth phase was during the Ming periods where China had reached its peak with the explorations on Admiral Cheng Ho.

Aim and Justification

The importance of this project is to recognize China's maritime development during Song, Yuan, and Ming dynasties and its expansion of commerce and trade networks that allowed for regionalization, but more specifically, a maritime frontier centuries before Europe that contributed to technological advancements in ship-design and navigation along with sail power. The intellectual problem(s) I may help solve through this research is (are): the contextual relationships of Smithian Growth and China's maritime development as a frontier. Smithian Growth explores the chain reaction of the maritime development in the coastal regions in China and pan-Asia in the beginning of the tenth to sixteenth century, as China was not only a land based economy or highly agrarian economy, but late twelfth century the maritime industry the biggest in the world (Juan-pang, 2012).

Thus, by illustrating the main characteristics of maritime development in China through Smithian growth, institutional, and proximity the thesis sheds light on whether China was a maritime frontier and leader in the maritime industry. This thesis will address the research gap between the European's maritime development and China's maritime development. At the moment there are paradoxes, the so-called "Needham paradoxes" where China's economic growth was stagnate. However, during the "Golden Age" (Song, Yuan, and Ming) China was not a land based economy but a maritime economy and frontier that sparked growth. This thesis aims to present that China and South East Asia's development was a frontier of maritime growth and trade and attempts to fill in the gap of

economic maritime history of China in the discourse of maritime development and technology.

Research Question

What sparked maritime development in China during the 10th to 16th centuries and did this ignition lead to a maritime frontier?

Methodology

The thesis will present a qualitative research method, this method will help present insights into the multifaceted development of a maritime frontier through Smithian growth. However, Smithian economic growth will not be the only source of theory; rather, the thesis will take on Joel Mokyr's task of theorizing. "The task of "theory" is to make sense of these facts and to help us pick and choose among them. Economic Historians are overwhelmed by data and facts, surrounded by important questions of "how" and "why". Theory builds the connection. But there is no single theory that can possibly do that for us" (Mokyr, 2005). Thus, to build the connections in the development of the maritime frontier in China the thesis also introduces institutional and spatial proximity theories along side Smithian growth.

Furthermore, the thesis will also use an inductive approach, rather than a deductive approach. An inductive approach will help narrow the scope of the study. The inductive approach provides an exploratory design of the thesis, either by exploring new phenomena or looking at perviously researched phenomena form a different perspective. Smithian growth as a measuring stick measures the geographical expansion of markets and the specialization of labor leading to a rapid development of technologies and growth.

Chapter 2: Literature Review

Frontier

The concept of a “frontier” is subject to academic inquiry; especially, the effort to conceptualize what a frontier is meant in Chinese history (Clark, 2009). When frontiers are discussed it is almost utterly land-based. According Clark (2009), *"Frontier" in both academic and popular discourse is treated as the engagement between two systems/cultures/civilizations across a continental intersection. It would be unduly bold—indeed almost certainly in error—to suggest that throughout the world maritime frontiers are equally as long as continental frontiers, yet it is equally empirically obvious that the maritime variant is hugely long and vitally important (Clark pg.1, 2009)*. It is important to first establish what the term means, in general terms it is roughly “border” (Clark, 2009): the line that delineates one zone—perhaps a state, perhaps something less tangible—from another. However, Clark (2009) points out the term “frontier” carries cultural, and often tones of superior civilization.

The European colonial history, although usually the frontier of academic discourse is not in fact the *only* frontier model (Clark, 2009). If we generalize, all empires — not only the European colonial empires — have some kind of frontier experience (Clark, 2009). However, it should be pointed out that not all frontiers are imperial, or even share the same dynamics of the European colonial frontier (Clark, 2009). Clark (2009) suggests that there are three general frontier models: (i) the expansion of a continental frontier, which an aggressive and high centralized entity against a materially and technologically inferior decentralized entity — European colonial frontiers; (ii) the static continental frontier, where two or more entities engage each other in an equilibrium — Western frontier of America (iii) and a maritime frontier, which this thesis is ultimately most concerned.

A maritime frontier is perhaps different from any other frontier, unlike a continental frontier which one culture elides into another through gradual transition, a maritime time frontier functions as an *interface*, an interface that was power by Smithian growth and developed by spatial proximity and institutions that allowed a maritime frontier to begin (Clark, 2009). In these centuries (10th—16th) water provided the cheapest — and frequently the only — means to transport bulk commodities such as wheat on a large scale. It was often the most secure way over long distances (Clark, 2009). Hence, the proximity of the sea drew Southeast Asians into long-distance trade. As a frontier incorporates cultural aspects and active interface, during the Song, Yuan, and early Ming entrepôt ports became the central dynamics for an interface to be achieved. During the early modern era: Melaka in southwestern Malaya, Hoi An in central Vietnam, and Ayutthaya in what is now central Thailand provided geographical proximity and development commerce through the entrepôts and emporiums that created a dynamic maritime industry.

In addition, population growth also pushed maritime growth and innovations. Lockard (2010) invites that the Chinese sea merchants and sailors were opportunistic and adaptable, who went to Southeast Asia to trade between 1200 and 1750. China also constructed “trade diasporas,” an interrelated net of commercial networks from the same ethnic group that formed a trade network. The diasporas were linked by common culture, language, and organization but also mobile, the Chinese were globalizing economies long before modern times (Lockard, 2010). This is only one part of a single frontier, frontier in another sense is perhaps more complex. The Southeast Asia coast is perhaps the most important as it is also known as the “Asian Mediterranean” (Gipouloux, 2011). Not all historians would find the “Asian Mediterranean” analogy compelling, due to the monsoon winds, which reverse themselves every six months, generally limiting the trading of ships to the West or North half of the year and East or South in the other half of the year, in contrast to all year around shipping in the Mediterranean (Lockard, 2010). However, the French historian Denys Lombard points out, “wanting to understand Southeast Asia without integrating a good part of southern China into one’s thinking is

like wanting to give an account of the Mediterranean world by abstracting Turkey, the Levant, Palestine and Egypt” (Cooke and Tana in Clark, pg.220 2009).

Moreover, the access to the water is perhaps overlooked due to China’s inland territory. The access to the water may be quite obvious, but it is an important feature that should not overlooked when discussing a water frontier. The degree of a country’s access to the sea depends on five physical factors: (i) the distance to the sea, (ii) the topographic features of the coast (iii) the climate patterns, (iv) the sea/ocean current and tidal patterns, (v) and inland transportation to the coast (Deng, 2007). If we look at China it has all five accesses: a nautical sea border, topographic features that lead to specialization on of ships-designs, climate that did not freeze the ports during winter, current and patterns that lead to specialization of economic centers — development of Emporiums for example — and inland transportation through the inland canals that were developed in the tenth century. A maritime frontier is developed through multifaceted context of both physical factors and intangibles, the next section will point out some of these factors.

China’s Maritime Development

As Europe emerged from the medieval times to the modern fifteenth, sixteenth, and seventeenth centuries, so did China emerge from the medieval to the “modern” world per se during the twelfth, thirteenth, and fourteenth centuries. Similar to Europe the period was also a transition that embarked on maritime enterprises and oversea expansion. Elleman, and Jung-pang (2012) explicitly expresses that the three centuries from the Southern Song to early Ming, the maritime actives of the Chinese people were so great that it was more of a sea power than a land power, perhaps a paradox. Thus, China was a sea power rather than land power where the Chinese went abroad to trade and colonize and it was also though the sea where foreign people and new ideas entered China (Elleman, and Jung-pang 2012). It has been argued that China’s maritime development and contacts with the rest of the world began with the Europeans knocking on China’s

door in the sixteenth century or imperialism in the nineteenth century, however, China's maritime development started centuries before Europe's and was well-developed by pre-modern standards.

China's maritime development from tenth century onwards promoted many economic and fiscal reforms for the purpose of expanding economic development and monetization. Pual Wheatley (in Elleman, and Jung-pang, 2012) point out, the effects of the Song oversea trade in the tenth century saw increased monetization which was consequent to the boom of domestic commerce and maritime trade. Janet Abu-Lughod (1991) in her book *Before European Hegemony: The World System A.D. 1250-1350*, argued that the thirteenth century Eurasian world encompassed a vast trade system. Important theme she points out is that it was a segmented system with regional sub-systems such as maritime East Asia, SouthEast Asia, Southwest East Asia. In other words, a sort of Asian mediterranean. By the Song period China had established maritime supervisors at various ports, these maritime trade supervisors had many functions including the inspection of incoming ships and their cargos, assessing the cargos and charging duties, registering Chinese ships and providing accommodation for maritime merchants (Elleman and Jung-pang, 2012). Song-era expansion of commercial activities facilitated the creation of Chinese maritime networks to southern Asia, consisting of intertwined private trade, governmental, and shipping segments (Elleman and Jung-pang, 2012).

Map-making also was a vital asset in this period as too were navigation skills. In the late thirteenth century maps of maritime regions were created along with maritime charts. However, navigation developments were dependent on the availability to travel in the open sea, thus during the Song period the Chinese took the monopoly of the sea lanes away from Arabs, as China then was able to lead as maritime frontier throughout Yuan and Ming periods. Due to the need and demand for trading the period also endured a revolution in shipbuilding, in Southern Song the Chinese suddenly spurred ahead in naval architecture (Elleman and Jung-pang, 2012). In addition, the development of ship-design

allowed for other maritime technologies to be developed, new types of anchors, new sail materials and new rigging. A fundamental development of iron called “Damascus steel” was quite important to ship-design and sustainability (Wade, 2009).

Mass migration took place as the Northwest was falling to the newly developed South East Asia. Economic centers had changed and Southeast China became the new economic center of China. The development the coastal areas, the new ports in South East Asia, the movement of economic centers nearer to the coast, population growth, development of Southeast Asian textiles industries, new modes of consumption, and new mercantile organizations greatly attributed to the upswing of maritime commerce between the China Seas and Southeast Asia (Deng, 1999). The exchange of goods and commerce between southeast Asia states continued to be fueled by the ever growing population and migration hence the demand for imported goods and maritime development. Revenue from trade became more important than agricultural taxes in many coastal states (Deng, 1999). Between 1400 and 1600 China’s population doubled from 75 million to 150 million (Deng ,1999). John Chaffee (in Schottenhammer, 2012), points out “never again in imperial Chinese history do we see government encouragement of trade or the levels of maritime commerce that existed during the Song and Yuan” (Schottenhammer, pg 76. 2012). However, for thirty years under the Ming period China explored through seven expeditions which were carried out by Zheng He that stretched as far as East coast of Africa and the Red Sea (Lockard, 2010). China through the Song, Yuan, early Ming were the unchallenged maritime power in the world (Schottenhammer, 2012).

Throughout history China’s coastline has be part of China’s history. There are three steps in China’s coastal expansion. First, Neolithic period (7500–3500B.C.) to Xia periods, which is 6,000 years and over time China’s coastal boundary doubled. Second, from Xia periods to Qin period roughly 1,800 years the coastline doubled again; and the third was between the Han and Tang periods of 700 years doubled a third time (Deng, 2007). Thus, as a result Qing Dynasty had a land boundary of about 16,000 kilometers and the

coastline reached over 18,000 kilometers (Deng, 2007). If we put this into perspective the land boundary to coastline is 0.9:1. According to Deng (2007), if we are to add China's 6,536 islands — 728,800 square kilometers — and its 14,000 kilometers aggregate island coastland the ratio is 0.5:1. Currently, modern China has a sea area of 3 million square kilometers with and to sea territorial area ratio 3.2:1 (Deng, 2007). Compared to the world China has the fourth longest coastline in the world — United States, Canada, and Japan.

The differentiation of the coast provided two sections that allowed for economic development; internal and open coasts. The internal coast served for maritime activities for short distance, domestic, and East Asia trade. The open section is known as “open door” coast which served for long-range sailing of overseas nature (Elleman and Jung-pang, 2012). The above points out that China was in prime position to become maritime nation and a maritime frontier through nature means. These advantages gave birth to China as a sea power and a frontier. The third-quarter of the eleventh century the manufacturing sector had developed by large scale mining — iron — metallurgy, and shipbuilding, thus employing hundreds or even thousands of workers, and serving large geographical networks along with a national water network that inspired development (Kelly, 1997). In addition, the use of monies was universal across China and much of Southeast Asia, with negotiable instruments used to facilitate transactions, especially, overseas. Many innovations such as coal smelting, printing, the adoption of the Bessemer process for producing steel, and spinning wheel (water powered) that contributed to the overall development of China and the maritime industry (Hartwell 1963, p. 54 in Elleman, and Jung-pang, 2012).

The establishment of sea routes was another key development to the frontier, the development through all types of routes: local routes along the Chinese coasts, medium and short range international travel to the east and south Asia, and long range international routes to west Asia and east Africa (Elleman, and Jung-pang, 2012). During the Han

periods long range routes were from Guangzhou and the Arabian sea and Persian Gulf regions, this was known as the south and west routes. During the Tang times and onward the routes become the so-called “silk-route” and thus marked a turning point for Chinese maritime trade: where China’s overland trade was being replaced by overseas trade.

During, the Northern Song and Southern Song Dynasties more medium and short range routes were developed that linked China to Japan and southeast Asia, the “northern and eastern” routes. However, unlike traditional coast routes these crossed sea in strait-lines, due to understanding the currents and winds patterns. For example, Sino-Japan route crossing the Yellow sea of 200 kilometers (Elleman, and Jung-pang, 2012). This shows two elements of development: sailors knew the wind and current patterns and second that open sea navigation was developed, hence, the use the compass instead of relying on landmarks for navigation. Kelly (p.953, 1997) states, “in terms of absolute output, rate of growth, scale of business enterprise, and adoption of new technology, the Northern Song had reached a level of commercial and industrial development surpassed by no society before the last decades of the eighteenth century.”

Chapter 2: Theoretical Framework

The thesis will use Smithian Growth theory in terms of geographical expansion and innovation to explore the development of China’s maritime industry as a frontier. In addition, to complement the paper will address two other theories such as spatial proximity and the use of institutions in order to examine the maritime progress of China during the tenth to sixteenth century. Each of these elements provided insightful knowledge on the development of maritime growth of China and whether we see a maritime frontier in China.

Smithian Growth

Smithian progress remains very much a poor relative among theories of economic growth (Kelly, 1997). Usually, to explain rapid growth, many economists turn to the neoclassical sources of innovation: learning by doing and/or private capital accumulation (Kelly, 1997). However, Kelly (1997) uses the Smithian growth model to analyze Song China's economy. Smithian growth analyzes geographical markets which are expanding throughout time. It is shown through Kelly that new transformations of linkages do not imply gradual growth, rather Smithian progress proves to exhibit threshold behavior. Threshold behavior through cheap transportation offered by inland canals through China allowed regions to move to large scale commercial activities causing output to rise and creating incentives for technological innovation.

The growth of the market linkages between areas lead to vertical disintegration in production (Kelly, 1997). For example, a firm in one area can specialize in the production of some subsets of goods and thus trade with the other specialized producers that are established in the same integrated market (Kelly, 1997). Smithian Growth exhibits threshold behavior, if density of market linkages are low the economy is split into isolated local markets that limit the range for specialization. Thus, when the critical density is reached these small isolated markets start to coalesce into a large market and therefore expand the economy resulting in division of labour, as local markets fuse together causing a sudden advancement of growth (Kelly, 1997). As markets coalesce labour is reallocated from the inefficient subsistence production to the more efficient commercial technology; consequently, allowing output to expand.

In other words, the more linkages that are incorporated into the larger market gives away to potential growth through increased specialization. If we look at Song dynasty Smithian growth implied a takeoff in growth through the expansion of markets which transformed the dynasty and China as a whole. China transformed into a simple subsistence economy

to a level of development that was not surpassed till late eighteenth century. This transformation expanded trade networks and introduced regionalization — spatial dynamics — that demanded a maritime industry to supply the demand of growth. “The consensus among historians of the period is that this economic revolution was the result of a commercialization of Chinese society caused by the creation of a national waterway network” (Kelly, pg. 960, 1997).

If we go further, cheap transportation affected by the above networks allowed regions to switch from subsistence to large scale commercial activities. The inland waterways raised the output and created incentives for technological innovation especially in the maritime industry. The inland waterways were created and used at the end of the 10th century, Schumpeterian growth model presented that firms invest to improve the quality of their product and gain a monopoly, by contrast Smithian growth uses a different measuring stick, instead firms invest to expand their geographical markets, and so reduce cost through greater specialization. Thus, with the creation of water networks within China it allowed markets to expand and eventually moved to the coast. Once that limit was reached, another wave of geographical expansion took place, “The Asian Mediterranean” (Elleman and Jung-pang, 2012). The increased specialization of the maritime industry produced rapid growth in technology and expansion along with development of new markets across East Asia and China (Elleman and Jung-pang, 2012). These linkages, however, needed the “glue” to hold the linkages together, thus spatial proximity became an important factor to the maritime development in China and ultimately the Asian Mediterranean.

Spatial Proximity

In order for the Asian Mediterranean to be successful spatial proximity must be present that involves innovative milieus, which presents a homogenous set of actors: (i) territorial relationships encompassing in a coherent way; (ii) different economic and social actors

generating a dynamic collective learning process; (iii) and a specific culture and representation system (Boschma and Lambooy, 1999). It is important to understand the above actors as it provides a coherence in a spatial context that fosters new variety and processes of innovation as it enables local actors to deal with the problems of uncertainty. If we relate to Coase (1937 in Claude and Shirley, 2014) he presented that people want the best outcome whether property rights are significant or not this is based on the spatial context of the people to an extent. The spatial context or in other words spatial proximity is essential because it stimulates a process called collective learning, which lowers the transaction and search cost and this encourages co-ordination; within the Smithian context the collective learning process is quite important for evolving and bringing together various industries together to create one substantial economy, but an economy that is more informal than formal relying on trust.

Collective learning is usually achieved through three processes: (i) the mobility of human capital as the carrier of knowledge the area of development — the Song, Yuan, and early Ming periods were a time of great intellectual fervor and technological advances, at the same time commercial and economic progress was achieved, there was a decline in the Northwest region and a rise in the Southeast where maritime development (Elleman, and Jung-pang, 2012); (ii) the transfer and feedback of information via networks (informal mainly) of local actors reinforced by the techno-industrial specialization of the area; (iii) a common local culture of trust, based in shared practices and rules — this third point is what separates Europe and China during this era; the differences in informal and formal institutions that dictated how the economy grew (Shearmur, 2011). Knowledge spillovers from different regions become important for development, which are facilitated by geographical proximity that are regional-specific (Shearmur, 2011). The local accumulation of human capital (rise of the merchant class), information linkages, network externalities (spillovers) — the compass was used for land navigation and when economic centers changed from the North to the South the compass became a tool for

navigating the seas — and supportive institutions, which leads to comparative advantage (Shearmur, 2011).

From this angle South East Asia and southern China are linked by an interface, which became the canvas of interaction as well as the development of trade networks that came to eventually include south Japan and the Ryukyu Islands. But, unlike the post-Roman Mediterranean, the East Asian Mediterranean had one dominate figure both politically and economically, China, which had connections with numerous smaller states. This fragmentation of little states spawned a fluid multiethnic and dynamic transnational economic zone and with flexible political boundaries in which maritime commerce and a string of ports that facilitated it were essential (Elleman and Jung-pang, 2007). Here we seen a glimpse of Smithian growth of fragmentation of industries coming together to make a universal economic zone or industry through spatial proximity.

Institutional View

Furthermore, neoclassical market model primarily focuses on exchange of private ownership, if we view economic growth in China during 9th — 17th century it points out that China looks very poor in this regard. Neo-Classical model does not reflect the thickness and complexity of behavior actually correlated in markets (Sengupta, J. 2011), nor does it present the intergraded markets of such a large country. North and Thomas point out a special detail in relation to growth: “....*the factors we have listed (innovation, economies of scale, education, capital accumulation etc.) are not causes of growth; they are growth*” (North and Thomas 1973, p. 2). Thus, institutions are the cause of growth; whereas, innovation, economics of scale, etc are products of growth. For instance, North (1990), emphasized that optimizing transaction costs can determine the efficiency of an optimal economic and institutional order (Sengupta, J. 2011). North presents:

The evolution of institutions that create a hospitable environment for cooperative solutions to complex exchange provides for economic growth. The central focus here is on the problem of human cooperation, specifically the cooperation that permits economies to capture the gains from trade that were the key to Adam Smith's Wealth of Nations. There are two forces shaping the path of institutional change: increasing returns and imperfect markets characterized by significant transaction costs. In a world where there are no increasing returns to institutions and markets are competitive, institutions do not matter (North 1990 in (Sengupta, p. 3, 2011).

Moreover, cultural embeddedness of institutions plays a major role in the development of nations or the actions of nations both formally and informally. The embeddedness of the culture to the institutions can dictate social arrangements and behaviors in both formal and informal institutions. Formal institutions are written rules of a given society; for instance, laws and taxes that are held in-check by institutions. On the other hand, informal institutions are the unwritten rules of a given society, which perhaps are more inline with Chinese development. The New institutional Economics (NIE) approach delivers a framework, which presumes that individuals are imperfect and faced with uncertain events, thus in order to reduce transaction costs humans create institutions (Ménard and Shirley 2010) both formal and informal. In addition, high-quality institutions can take a multitude of forms, there is no “one best way” to secure economic success (North, 1994). Therefore, formal economic rules from other countries are not sufficient conditions for good economic performance in other countries (North, 1994). Coase invites discussion on transactions costs whether institutions are significant for lowering transaction costs.

Coase theorem proclaims that when property rights are involved given parties will naturally gravitate toward the most efficient and mutually beneficial outcome (Coase, 1937 in Claude and Shirley, 2014). In other words, where property rights are involved or

concerned the involved parties do not necessarily consider how the property rights are granted if they can trade to produce a mutually advantageous outcome. Coase (Claude and Shirley, 2014) had skepticism about the advantages of government intervention and if a agreeable and well-informed government was the optimal solution to market failure. Regulation would produce a worse result in most circumstances, however, not all regulation is bad. Thus, instead he argued that one should analyze the advantages and disadvantages of government regulation by understanding the market, firms, and government actually behave.

Coase rejected the idea that the cost of government is always greater than they would be for free market transactions that would accomplish the same result (Coase, 1994, p. 62 in Claude and Shirley, 2014). In other words, if the government tries to do too much, it operates on such a gigantic scale that it has reached a stage at which for many of its activities the marginal product is negative (Coase, 1994, p. 62 in Claude and Shirley, 2014). Through New Institutional Economics (NIE) there are three building blocks: transaction costs, property rights, and contracts. Coase's concept of transaction costs points out through organization of transactions there are inevitable costs which determine what goods and services are produced and the capacity of an economy to take the advantage of the division of labor and specialization (Coase, 1994 in Claude and Shirley, 2014). The second concept is property rights in Coase's "The Problem of Social Cost" (1960) he explored the harmful effects when one owner's rights cause harm or cost to the owner of the other rights (Wang, 2004). Thus, if there are positive transaction costs the general institutional setting becomes quite important both in informal and formal nature.

However, Coase suggests that transaction costs are often enforced by etiquette, social custom, and social ostracism (Wang, 2004), which would be in line with twelfth century China. The third context are contracts which can be defined as written or unwritten agreements between parties. Coase (Claude and Shirley, 2014) points out that contracts

are never perfectly enforced and never perfectly complete. Williamson (1996, p. 377 in Claude and Shirley, 2014) “defined a contract as ‘an agreement between a buyer and a supplier in which the terms of exchange are defined by a triple: price, asset specificity, and safeguards’”. NIE deliverers points out that there are different institutions which are defined by formal and informal constraints where human interaction reduces uncertainty. North states, “institutions, together with technology, determine the cost of transactions (and transformation), and transaction costs are the most observable dimension of the institutional framework that underlies the constraints in exchange” (North 1990, p. 68).

In addition, institutional economists have argued that institutions can change abruptly through revolutions and by external shocks or perhaps through incremental adaptation and deliberate design — ‘bounded rationality’ (Boschma and Frenken, 2006). North (1990) also points out that history matters in the process of institutional change as it can shape the expectations of actors for the future. Therefore, this locks institutional change into certain developmental paths. Moreover, David (1985) analyzed path dependence in terms of technological lock-in were certain industries get stuck with a certain standard even through other market participants could be better of with a selected alternative. Technology lock-in represents a market failure or inefficacy when a inferior technology from the alternative is available. In China’s case at the end of the Ming period both institutions and technology entered a lock-in phase and thus retarding or stagnating the development of the maritime industry, while Europe introduced another Maritime frontier. Next chapters will discusses the the evolution and development of Chinese maritime sector.

Chapter 3: Shift to the Sea

Usually three paradoxes are related to growth in China during pre-modern era. First, *agrarian* ascendancy within China; second, that the merchant class was perhaps underdeveloped; and third China was a land based economy (Deng, G. 1997). Hence,

Needham's Paradox, which is China's achievement of science and technology in contrast to China's underdevelopment. However through Smithian growth, through the emergence of markets we see a shift to the sea. The emerging markets of Southeast China during the Song period provided well-developed infrastructure of maritime activities that produced specialized maritime merchants that were prosperous. By late Song and into the early Ming periods China was no longer dominantly a land power but a sea power that was not surpassed till the sixteenth century. China 1,000 years before the Industrial Revolution had always been the country with the most advanced technology and perhaps the most prosperous economy (Mokyr, 1990). The development of a maritime frontier was a substantial part of the technological advancement in China that should not be overlooked.

Kelly (p.941, 1997) gives an example of development of market expansion and growth through Smithian growth: there are a few villages, each start out in autarky, using basic technology to produce goods, as time passes sites may form transportation linkages with other villages, thus allowing for trade and factors. This set of connected sites is called a market, however the defining feature of these linkages between sites is that they allow large values of goods to be transported at low cost (Kelly, 1997). The inland waterways were the first step to interconnected networks and markets. The hinterland waterways allowed for reduced costs of transportation through more volume. The inland waterways created a national market — interconnected little markets — that eventually developed into prime regionalization of the Asian Mediterranean and specialization of labor.

This permits a specialized producer at one site to produce a good and to supply it to the other villages in the same market more cheaply than they can produce it themselves using subsistence technology (Kelly, 2007). Therefore, in this Smithian growth model the nearest neighbors can connect; in this case, south, southeast, Southeast Asia. All transport costs are incurred when linked: thus once linkages have been formed goods and factors can be moved in the least cost manner between connected sites — this was the case of southeast China and the Asian Mediterranean. Hence, linkage formation responds

to deepening of canals, removing obstacles and the construction of piers and harbors, warehouses, and ships, and the hiring of ship crews (Kelly, 1997).

As geographical markets expand each site can specialize more in the production of one good and thus purchase other goods from other specialized producers (Kelly, 1997). As a result, regional specialization in the production of intermediate goods — vertical disintegration in production. Each firm therefore undertakes fewer steps in the production process, and instead buys its inputs from one set of producer and sells output to other set of producers (Kelly, 1997). Since commercial emergence was drawn from the geographical markets expanding to the sea where the Asian Mediterranean would be formed. Smithian growth points out that linkages that emerge must allow goods to be transported at sufficiently low cost for this increasing returns technology to be exploited, thus this section will provide the linkages that emerge to allow the technology to be exploited.

Table 1: China's Historical Periods

	Period	Time
1.	Xia	c. 2000–1520
2.	Shang	c.1520–1030
3.	Zhou	1030–221
	(I) Western Zhou	c.1030–771
	(II) Spring and Autumn	770–476
	(III) Warring states	475-221
4.	Qin	221–207
5.	Han	206 B.C.—220 A.D.
	(I) Western Han	206 B.C.—24 A.D.
	(II) Eastern Han	25—220
6.	Three Kingdoms	221-265
7.	Jin	266—265
8.	Northern and Southern	479—580
9.	Sui	581—618
10.	Tang	619—907
11.	Five Dynasties	907—960
12.	Song	960—1279
	(I) Northern Song	960—1127
	(II) Southern Song	1127—1279
13.	Jin	1115—1234
14.	Yuan	1271—1368
15.	Ming	1368—1644
16.	Qing	1644—1911

Source: CBW 1979:Vol 3 and Choa 1989. in Deng, G. (1997)

The Shift of Economic Centers to the Sea

In Western Europe during the 16th and 17th centuries maritime expansion was due to the emergence of the Renaissance — intellectual and mental stimulus — accompanied by development of technology and geography knowledge (Elleman, and Jung-pang, 2012). This pushed men's minds to go abroad to proselyte and to conquer, which inherently rose

international rivalry that favored growth and increased the need for goods and markets. As too did China show parallel developments in Song, Yuan, and early Ming periods that gave to intellectual favor and technology advancement and produced commercial activity and economic progress.

However, what is important to the frontier of maritime development is the decline of the Northwest and rise of the Southeast, the closing of the caravan routes, which gave to the fall of Kaifeng in 1127 and thus a shift of economic and political centers to the sea coast, leading to maritime exploration and growth of commerce (Elleman and Jung-pang, 2012).

The situation of a poor South and rich North gradually changed during the period from the Han to the Sui. By the Tang and Song period, the extent of the economic development of the South as compared to the North had become the reverse of that of the ancient period, this was, without any doubt, a revolution in economic geography (Elleman and Jung-pang, p.60, 2012)

The shift of economic centers was a pivotal point for economic growth and the development of the maritime frontier, a relocation of capital after the fall of Kaifeng, Hangzhou was chosen to be the capital of Southern Song. The relocation of capital signaled the re-orientation of the attention of China from Northwest to Southeast from the land to the sea, however, latter in 1424 the capital was moved to the North, Beijing. Beijing which is located in the North, but faced the South served as a strategic point between the North and the South (Elleman and Jung-pang, 2012). This transaction sparked economic revolution — Smithian growth — and geographical markets expanded along with psychological, cultural, and intellectual changes.

The transformation of the Southeast region successfulness brought about a rise in the merchant class and development of technology. Boschma and Lambooy (1999) point out that behavioral geography accounts for the spatial patterns. The shift to the sea was also behavioral as merchants saw the properness of the Southeast region. In other words, people follow the successfulness of businesses, which is used for a selection mechanism to relocate. Not only did this relocation of capital change the economic sphere of China, but the physical, cultural, and intellectual changes which sparked Smithian growth and mass development of the littoral areas and the growth of the maritime trade. According to Boschma and Lambooy (1999), people that choose a location that falls within the spatial margin of probability have a better change to survive and prosper. Thus, a mass transformation from the Northwest to Southeast occurred. As, this migration took place an extensive water work project — inland canals — lead to market expansion in China thus spilling into littoral development and maritime development that would lead a shift to the sea and a fully operational maritime industry.

Between the tenth and twelfth centuries China changed from a simple subsistence economy to a level of development that was not supposed until the maturity of Europe (Kelly, 1997). Many economic historians agree with the fact of this economic revolution was caused by the creation of a national waterway network — inland canal network. This was due to the rise of the Southeast China and Asia and governmental provisions. The canals reached all the way to the sea, where commerce and trade was prevalent. Interestingly enough, Allen (2009) points out that in the late 1600s — around 1688 — England was developing canals and turnpikes to reduce cost of transportation, roughly 780 years after China had already committed to developing canals and 840 years after for America. Not only did the water ways reduce cost and time, but it integrated the whole market of China. What this meant for the maritime industry and China was pivotal for the emergence of a maritime frontier. Supplies could be now shipped down from other parts of China to build ships as it also created the incentive for technological innovations.

Table 2 shows the buildup of agricultural regions in China and the move towards the South and the sea.

Table 2: Population of the 8 agriculture regions of China 2.C.E. - 1080 C.E

Population (1,000 individuals)						
Regions	2	140	609	742	980	1080
North						
<i>Region 1</i>	3,253	628	688	728	109	344
<i>Region 2</i>	7,919	3,057	10,053	9,921	4,797	12,775
<i>Region 3</i>	31,034	26,470	30,053	20,996	9,147	19,673
South						
<i>Region 4</i>	4,971	4,073	5,576	6,839	4,834	16,261
<i>Region 5</i>	1,475	5,113	1,365	6,435	8,726	22,875
<i>Region 6</i>	3,406	4,343	2,078	5,472	6,776	6,178
<i>Region 7</i>	391	803	955	1,697	2,112	6,178
<i>Region 8</i>	1,142	2,898	24	202	34	153
North Total	42,206	30,155	40,794	31,645	14,053	32,792
South Total	11,385	17,230	9,998	20,645	22,482	57,497
North/South	3.71	1.75	4.08	1.53	0.63	0.57

Source: Robert Hartwell, private communication, 1976 in Clark, 2009

The migration from the Northwest to Southeast was extremely important, even though the above graph points out that agriculture was quite prevalent in the South by 1080 — to supply the needs for the growing region — it shows the mass migration to the sea and the southern regions. One factor that remained constant to maritime development are the sea ports which were the utopia for private traders. The North Song government consensus shows that in 1102 A.D., of the 298 prefectures, ten of the prefectures had over 200,000 households and among them were four which are located along the east-coast and three can be identified as ports — Lin-an in Zhejiang, Quanzhou in Fujian and Fuzhou. The table 3 points out there was steady growth between 980 to 1102 under the Southern Song, the rate increased to roughly 127 percent of that in 1102 A.D. (Deng, 1997).

Table 3: Household Index

Year (A.D.)		980-89		1078-80		1102	
Name	Province	Household	Index	Household	Index	Household	Index
Tanzhou	Hunan	52,906	100	357,824	676	439,988	832
Jizhou	Jiangxi	126,453	100	273,397	216	335,710	265
Shaoxing	Zhejiang	-	-	-	-	279,390	-
Ganzhou	Jiangxi	-	-	-	-	272,432	-
Kaifeng	Henan	178,831	100	235,599	132	261,117	146
Longxing	Jiangxi	-	-	-	-	261,105	-
Jizgzhao	Shanxi	-	-	223,312	100	234,699	105
<i>Fuzhou*</i>	Fujian	94,470	100	-	-	211,552	224
<i>Lin-an*</i>	Zhejiang	70,457	100	202,806	288	203,574	289
<i>Quanzhou*</i>	Fujian	96,581	100	-	-	201,406	209
Mean			100		282		296
Median			100		216		224

Known Ports*

Source: Elleman, B. A. and L. Jung-pang (2012)

In addition, table 4 shows the trend of city building in the Northwest and the Southeast: not only was the Southeast building more cities, but larger ones as well — absolute index provides the number of cities built per century 10,000 square miles (Deng, 1997). The shift to the sea — migration and population increase — led to a rise in maritime activity and consequently sea ports and cities being built along the coast (Deng, 1997). The increased population along the coast was an important factor for the development of a maritime frontier to begin.

Table 4: Development of Cites Between Northwest and Southeast Han-Ming

Period	The Northwest (Gansu, Shaanxi, Shanxi and Henan)		The Southeast (Jiangsu, Zhejiang, Jiangxi and Fujian)	
	Number	Absolute Index	Number	Absolute Index
Han-Three Kingdoms (206 B.C.—264A.D.)	220	5.665	81	2.859
Six Dynasties (265—617)	214	6.760	91	4.643
Tang-Five Dynasties (618—959)	154	4,498	91	4.810
Song (960—1279)	127	3.791	65	3.166
Yuan (1280—1367)	37	3.413	24	5.557
Ming (1368—1644)	61	2.137	125	5.930

Source: Li Ji, *The formation of the Chinese people; an anthropological inquiry* (cambridge: Havard University Press, 1928), pp. 72-89 in Elleman, B. A. and L. Jung-pang (2012)

New formation of markets allowed for geographical markets to expand each sight specializing in more of the production of a specific good while other areas were specializing in different products. In addition, migration and population growth in the southern regions posed a demographic advantage, especially, in the maritime industry due to behavioral geography and the rise of the merchant class. On the other hand, “both pre-modern and modern society, the mechanism of technological innovation is essentially the same: through ‘trial and error’ (Elleman and Jung-pang 2012 p.g 56). Thus, in terms of probability movement to the South to the growing maritime industry, the number of random trial and error experiments done would be higher. Therefore, its rate of technological advancement should be greater than other industry or country with lower population and so will be its economic development (Simon 1986, chapter 1 in Elleman and Jung-pang 2012).

Furthermore, the development of irrigation enabled a region to increase its food production to support the increasing population, but above all it further the progress of civilization. Thus, more manufactories moved to the Southeast region that were free from war, but the location added greater opportunities for export. Factories such as textiles and paper — a major contribute to sail development and map-making, which reduce transactions cost as the producer and seller are in geography proximity— moved from North China to Southeast China. The agriculture development, rather was a key source to development of maritime sector, rather than a paradox. The next section covers the going commercialization of the sea and the opportunities that come with sea commerce.

Shift to Sea Commerce and Linkages

An important factor for a shift to the sea, especially in terms of commerce is the linkages that emerge, allowing goods to be transported at sufficiently low cost for increasing returns in technology to be exploited (Kelly, 1997). Similar to specialization of ports/harbors: inland versus seafaring ports, there are two types of commercial establishments within China that developed during the Song periods. First, emporiums were redistribution centers that collected wide variety of goods and redistributed them on a

stable and regulatory scale (Gipouloux, 2011). The emporium was not a domestic market place rather it was an international and long-distance trade holding facility.

Emporiums were quite important due to the monsoon winds giving Emporiums an immediate role. In other words, the Emporiums made it possible for sea merchants not to sell their cargo immediately, but to store it and thus reap the benefits of a better price at a later date as too keeping the merchandise safe while waiting for the winds to change (Gipouloux, 2011). As mentioned above many historians believe that the monsoon winds created a problem for trade. However, it only created opportunity for merchants and specialized trading and ships-design. Cities were built around emporiums due to the facilities necessary for trade that had to be present on permanent bays (Gipouloux, 2011). However, geography was not the driving motivation to form emporiums, but cooperation — milieu and proximity. Contracts were contracted through informal means as it reduces transactions costs.

Linkages and regionalization were important for a continuing frontier. If not for linkages the frontier would stall. In other words, maritime traders congregated in the ports, thus the interaction between land and sea linked hinterland to the wider world (Gipouloux, 2011). China boasted favorable geographical advantages, especially, for natural harbors that provided good locations usable harbors that had adequate facilities which became the entrepôts — super-centers for trade (Gipouloux, 2011). Entrepôts were the center for import-export, above all re-export. Many of these entrepôts were the center of production and many times became the actual production itself (Gipouloux, 2011). For example moving economic centers close to production facilities reduced transactions costs and transportation cost. Today we see silicon-valley located in a cluster formation where production takes place along with Pacific trade routes connecting California, USA to Japan and China, which reduces transportation costs.

But, most importantly most of the ports were not final destinations rather they were median points in the always-changing atmosphere of political and economical environments. Ports whether in Europe, Asia, America, etc consisted of foreign and

cultural diverse communities, these ports foster not only economic dimensions but cultural exchanges and diffusion. According to Lockard (pg. 245, 2010) “A port city is open to the world . . . In it races, cultures, and ideas as well as goods from a variety of places jostle, mix, and enrich each other and the life of the city.”

The trade and development of harbors presented “trade diaspora” — an integrated net of commercial communities from the same ethnic group that formed trade networks (Gipouloux, 2011). Such diasporas, linked by common culture, language, and organization but also were mobile, the Chinese were globalizing economies long before modern times (Gipouloux, 2011). Regional Innovation Systems (RIS) were just important in premodern times as it is today. According to Asheim (2002) there are three different types of RIS, however one type stands out with clarity: the territorially embedded regional innovation systems. This is where innovation is localized through geographical, social, and cultural proximity (Asheim, 2002). Thus, network-based innovation and infrastructure that promotes adaptive technological and organizational learning in a territorial context (Asheim, 2002). Ship traders were knowledgeable about market conditions and customs in various ports and thus were able to adjust their tactics to the local conditions (Asheim 2002). By the 1400s the Asia Mediterranean societies were expanding economically, Anthony Reid (Elleman, B. A. and L. Jung-pang, 2012) has been noted to use the term “age of commerce” that extended to the 1600s.

The age of commerce — Chinese — was an era of sustained urban growth in Southeast Asia, with super-centers being built to accommodate the rising maritime trade. Revenue from trade became more important than the agricultural taxes (Elleman and Jung-pang 2012). For example, the development of ships and trade was important to the overall economy of China during the Song to early Ming periods. The government obtained funds from the collection of duties and imports and the resale of imports. According to Elleman and L. Jung-pang (2012), maritime trade yield an annual revenue of 2,000,000 strings — strings current used at the time — 20 per cent of the total cash revenue of the

state. Never before had foreign trade occupied such an important place in the economy of China (Elleman, and Jung-pang, 2012). The commercialization of the maritime industry was serving as the foundation for a maritime frontier, the increasing revenue, and the rise of the merchant class.

Table 5: Revenue: Amount and percentage derived from Maritime trade

Year	Total Cash Revenue	Revenue from Maritime Trade	Percentage
960	16,000,000	300,000	1.87
1049-54	39,000,000	530,000*	1.36
1057-63	36,800,000*	—	1.43
1064-7	—	630,000*	1.43
1078-78	50,600,000*	—	—
1076		540,173	1.08
1086-93	48,480,000*	417,000*	0.82
1102-11	60,000,000*	1,111,000	1.70
1128	10,000,000	2,000,000	20.00
1147	—	2,000,000	—
1159	40,000,000	2,000,000	5.00
1162	60,000,000*	—	—
1174-89	65,300,000	—	—

Source: Elleman, B. A. and L. Jung-pang (2012)

Port-cities were the powerhouse of the regional economies, leaving the inland or hinterland to operate less on mercantile criteria (Gipouloux, 2011). These cities cooperated on their own terms rather than following the rules of the nation state (Gipouloux, 2011). These cities controlled a large amount of the trade, thus making the regional systems quite important to the development of a maritime frontier and regionalization for trade. Melaka with low custom duties and free trade policies Melaka became a strategic point for the development of the booming maritime industry in China and Southeast Asia. The city was located on the eastern end of the Indian Ocean trade network and thus link between the Indian Ocean and South China Sea trading systems,

the diaspora for goods moving north, east, or west. Melaka was easily accessible to ships due to the monsoon winds, in addition, it produced a natural harbor for protection, by early fifteenth century Melaka was the connection point between India and China. Regionalization can be observed as the growth of societal integration within a certain region, including the undirected processes of social and economic interaction among nation-states, or perhaps in this case city-states (Gipouloux, 2011).

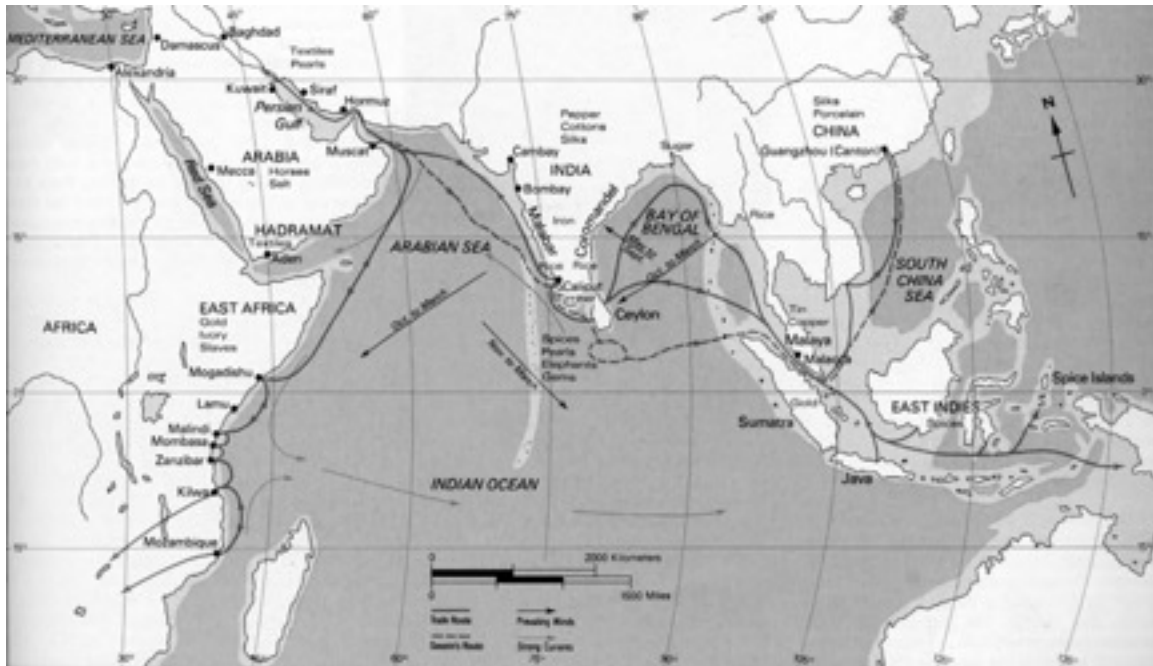
The Asian Mediterranean can be viewed not only as a maritime space, in-which trading crossroads and a link between different civilizations, but also can be seen as transnational space, which many autonomous cities and urban regions jointly control the flow of goods and monies, thus making up together a matrix of economy supremacy (Gipouloux, 2011). The Chinese had founded many colonies abroad in the Southern Song period and thus established well-organized informal and semi-formal institutions that allowed the flow of goods to be transpired. They had an advanced commercial system where monetary exchange rates and even extension of credits were used (Elleman and Jung-pang, 2012). China and South East Asia was relative decentralized, thus geographical specialization combined with international and national linkages yielded a competitive industry that drove up technological advancements that drove exploration and commercial activity.

The ever expanding linkages of innovation milieu overtime favored informal relationship in the geographical areas — this is why the Asia Mediterranean was so unique. The Asia Mediterranean in short was composed of collective learning, reducing uncertainty, and building trust in the innovation processes and among each other. As a consequences the norms, values, and rules that shaped the community were gained from maritime interaction. Innovative milieu points out that local culture, traditions, and trust lead to knowledge exchange and collaboration between firms (Asheim & Gertler, 2006), hence, the individual contracts mentioned earlier. China rather benefited from milieu and regional districts which gave more importance to supplier and client relationships within sectors, division of labor, and shared labor markets.

Without milieux the Asian Mediterranean or perhaps regionalization would have never occurred, due to the lack of formal institutions. Asheim & Gertler (2006), present the merger between interrelated industrial sectors and communities provide mutual knowledge through a regional context. Thus, not only does Smithian Growth — the interconnectedness of networks — and technology reduce transaction costs, but relations that can reduce transaction cost and an atmospheres that facilitates knowledge development and technological spillovers. Lunvall (1992) points out, localization as a factor of growth is quite hard to be supported through quantitative methods or even empirical studies, however, interactions are necessary to further evolve innovation capabilities, hence, are enabled by the proximity between actors — South East Asia. With the transition from the agrarian economy to a money economy, commerce and industry flourished, the ports in southeast Asia. “In the twelfth century, initially with the Song court’s (960-1279) encouragement of maritime commerce (Shiba 1968, 1970, 1983), Chinese merchants began to travel to southern Asia (Tansen, 2006, pg. 422)”. Song periods of commercial expansion facilitated the creation of Chinese networks in southern Asia, these networks allowed intertwined private trade, governmental, and shipping segments to emerge. During the age of commerce Melaka was the entrepôt of the Song, Yuan, and Ming periods that was transforming the maritime industry.

With the factors emerging together: population increase and migration, merging markets, specialization, and human capital, gave birth to rapid development of Smithian growth in the maritime industry. Commercialization of the maritime sector transformed urban life, trade from the urban markets to the entire country were developed through a complex hierarchy of articulated markets, thus ranging from giant specialized markets in the the large cites to markets in small villages (Kelly, 1997). Linkages lead to specialization and specialization in turn lead to economic returns with in the industry. Thus, the returns reinforced the incentives to specialize. However, Smithian growth also requires the economy to posses an increasing returns in technology, thus allowing production to be undertaken by more efficient specialized producers as the market expands (Kelly, 1997). The next section will provide the evolution in the maritime development of technology.

Trade Routes



Source: Schottenhammer, A. (2012).

Chapter 4: Maritime Innovations

Shipbuilding was a major industry during the Song period that benefited from such technology advances such as both floating and graving docks in the shipyards, and the use of models and blue prints to standardized production of ships (Mokyr, 1990). Many of the ships that were built for domestic commerce, but the seagoing ship were additionally just as important. John Chaffee (in Mokyr, 1990) point out, the economic transformation that occurred in the Song era made Song China the economic centre and motor of contemporary maritime trade and development. As a result, the upswing and development of the region sparked rapid growth in the port cities producing more demand for ships and thus ship technology expanded along geographical knowledge. By the the late 13th century, the Chinese had devised a four-masted, four-sailed merchant ships that consisted of 60 cabins, a rudder and a bulkhead-built hull (Mokyr, 1990).

According to Kelly (1997), if transportation costs are sufficiently high the largest feasible market for specialized producer will reach a certain peak then the accelerated

growth of markets will have little additional output. Before the Han periods transportation cost were high (Kelly, 1997). But as time passed, transportation networks with successively lower cost were built and thus vehicle technology improves (ship designs, sails, masts, navigation, canals) this allowed a feasible market for a specialized producer to expand. Each improvement would have little economic activity until transportation costs are sufficiently low and allow the market to expand. When this occurred, expansion of transport networks led to a general takeoff, Han to Song periods was the general takeoff that produced rapid development of the maritime industry. The next section will cover the innovation that lowered the transaction and transportation cost that allowed for a takeoff.

Shipbuilding

The most notable technological achievements during the Song period was the two ship designs. The first type was *louchuan* (or the ‘Fuzhou type’) which boasted four main uses: (1) ballasted keel and bilge keels with a low deck for stability; (2) a V-shaped bottom and the multiple sails — three to twelve sails that were used for speed; (3) multiple stern rudders for enhanced steering — “The stern-post rudder [was a] steering device mounted on the outside or rear of the hull. [It] could be lowered or raised according to the depth of the water. This type of rudder made it possible to steer through crowded harbors, narrow channels, and river rapids” (Mokyr, 1990). (4) clinker-arranged wood for hull strength (Mokyr, 1990).

In comparison, Europe had not even reached this sophistication of shipbuilding until the 1500s — 1600s were the Renaissance gave to new heights of technology. In addition, the Chinese ships were built using a technique called “bulkhead construction”. The bulkhead construction allowed watertight buoyancy chamber to help prevent the ships from sinking in case of leaks. Despite the advantages Europe and/or the West did not adapt this innovation till the 19th century (Mokyr, 1990). Needham (1970, p. 63 in Mokyr, 1990) concludes that Chinese ships were of “a much more solid construction than that found in

other civilizations.” In addition, Chinese ships were much more maneuverable than anywhere else in the world.

According to Joel Mokyr (1990) the Chinese led Europe by a millennium and a half or more in the use of blast furnaces, which gave to the use of cast iron and to refine wrought iron. The casting iron did not arrive in Europe till the late fourteenth century, but what was important for ship building was cast iron nails to hold the ships together, which made them stronger than any ship in the world at the time. In addition, textiles, and the invention of the spinning wheel that would appear in the thirteenth century advanced much faster than that of Europe — development of sail cloth. One use of this invention was to create sails for the growing industry of shipbuilding and trade. Moykr (1990) also points out achievement of maritime technology was far superior than that of Europe's before the fifteenth century. By the end the Song era specialization and division of labor had developed in shipbuilding.

Table 6 shows the number of ships that were built between Song and Ming periods. On average there were 100 plus ships built per month during the Song and Yuan periods; yearly there were little over a thousand ships built on average. The table also shows that shipbuilding was quite important during these times; especially, for transportation and unspecified ships — Song period in 995-97 was building 3000 ships per year, roughly five centuries before Europe. According to Dang (1997), these ships can be estimated or justified by the transportation of salt and iron products, which has been reported to have over 2,000 ships . In addition, by looking at shipyard documents other estimations can be built along with grain transportation (Deng, 1997).

Table 6: Ships built by Song-Ming Periods

	Year	Total output	Average per year	Average per month
(i) Unspecified Ships				
Song	995-97	-	3,237	269.8
	1090-1100	-	3,000	250.0
	1114	-	2,500	208.3
	1165	500	500	41.7
Subaverage for Song			2,309	192.4
(ii) Transport Ships				
Song	1128	-	2,700	225.0
Yuan	1282	120	120	12.0
	?-1314	1,800	-	-
	?-1328	1,800	-	-
Ming	1403	525	525	43.8
	1405	1,180	1,180	98.3
	1412	2,000	2,000	166.7
	1142	350	350	29.2
	1451	180	180	15.0
	1460	1,200	1,200	100.0
Subaverage for Ming			906	75.5
Subaverage for transportation ships			1,032	86.0
(iii) Warships				
Song	1042	500	500	41.71
	1129	200	200	16.7
	1169	270	270	22.5
	1192	100	100	8.3
Subaverage for Song			1,070	89.2
Yuan	1270	5,000	5,000	416.7
	1273	2,000	2,000	166.7
	1274-92	9,900	9,900	45.8
Subaverage for Yuan			1,275	106.3
Ming	1372	660	660	55.0
	1451	440	440	36.8

Subaverage for Ming	550	45.8
Subaverage for warships	1,080	90.0
Subaverage for Song	1,445	120.4
Subaverage for Yuan	1,918	160.0
Subaverage for Ming	817	68.1
Average	1,296	108.0

Source: Deng, G. (1997). *Chinese Maritime Activities and Socioeconomic Development, C. 2100 B.C.-1900 A.D.*, Greenwood Press.

Market expansion and shipbuilding not only caused output to grow by permitting increased specialization; it also increased the incentives for innovation. Iron in the industrial sector developed quite well as shown in table 7 within China from the Han dynasty and reached its peak in the Song dynasty. For example, the utilization of iron both in everyday development, but more importantly ship design, — iron nails and semi iron hulls — a fundamental metal for industrial development. According to Lin (2007) Chinese output of iron reached 150,000 tons by the end of the 11th century, China’s per capital level was five to six times larger than that of Europe. This is shown by the substitution of coke for charcoal in smelting iron to produce iron nails that supported more stable ships increasing the reliability and longevity of the ships, reducing transportation costs.

Table 7: Iron Development

	Tang		Song	
<i>Year</i>	806-20	847-59	1049-56	1078
Gold	—	—	15,095	1078
Sliver	10,200	25,000	219,829	215,385
Copper	266,000	655,000	5,308,835	14,605,369
Iron	2,070,000	532,000	7,241,000	5,501,097
Lead	—	114,000	98,151	9,197,335
Tin	50,000	17,000	330,695	2,321,898

Source: Elleman, B. A. and L. Jung-pang (2012)

Evolution of the Sail

The initial diffusion of the sail experienced several evolutionary steps and/or incremental innovations. First, the materials of the sail had changed over time, the early sail was made by woven leaves. Second, the shape of the sails as well as the structure of the sail had evolved. In the Warring Period, the sail hung like an open fan (Deng, 1997). But more importantly the evolution during the Song Periods the sail had changed more rapidly, the sail had become a square shape with a rigid supporting frame (Deng, 1997). However, it took some time to introduce high quality sail cloth, not until the late Song period was cloth sails introduced, which transformed the speed and mobility of the ships, thus there was a case of path dependency. In addition, sail shapes for sea and rivers vessels differed, specialization of the ships also required specialized sails. The sea going vessels sails were wider and lower than the river vessels (i) the lower sail was easier to wear and jibe in strong winds at sea; and (ii) a low sail also improved stability, hence reducing the *risk* of capsizing the in strong winds and heavy seas (Deng, 1997)

Third, the size of the sail had changed due to the increase of the masts in the Fuzhou ships. Song commercial ocean ships had two large masts, 10 meters long and 8 meter long (Deng, 1997). The evolution of ship design in the Ming times consisted of three

masts of similar height, this also enhanced the speed and maneuverability. In addition, Needham (1971) and Deng (1997) point the mechanical ingenuity; for instance, the Chinese rig reduced the stresses and shock of the sail, which made it easier to trim the sails — trimming the sails is positioning the angle of the sails in the right manner to catch the wind more efficiently. Forth, the number of sails that installed on the ship (). For example, during the Han times (206 B.C.—220 A.D.) the technology of multiple mast and sails had already been developed. These types of masts and sails were only effective at catching the wind from the sides and thus was not effective to catch the wind from astern — behind or towards the rear of the ship. Thus, during the Song periods once again area of the sail increased, the commercial ships were developed to have five large sails and ten jiggers, which all were made of cloth to catch the wind from all directions (Deng, 1997).

The impact of sail technology on the Chinese maritime actives was twofold: first, it made long distance travel feasible by lowering the transactions cost; second, it removed the constraints associated with coefficient between the size of the vessel and crew for rowing the boat as propulsion source (Deng, 1997). Thus, the limit to the size of the ship was only determined by the strength of materials and the skill to construct ships. However, shipbuilding and sail technology are only part of the equation for a formation of maritime industry, navigation was an essential part for delivering goods back and forth, with the development of navigation transaction cost are lowered.

Navigation

Ocean sailors locate ship positions by watching stars at night, watching the sun during the day, and following the compass on cloudy days (Deng, 1997).

In order to cross the ocean and commence in trade and return safely requires accurate navigation. This requires four elements: (i) fixing the ships position in open waters were

land it out of sight, (ii) knowledge of sea routes, (iii) understanding the current and monsoon winds, and (iv) control of the ship with sails and rudders (Deng 1997). Early navigation was determined by time and distance of latitude and longitude with references to the stars. Thus, to position the ship required four elements: knowledge of the position of the stars, accurate calendar system, mapping, and measurements of time and distance.

During the times of the Warring state (475 B.C.—221 B.C.) the Chinese had already grouped celestial bodies, fixed stars, and planets (Deng, 1997). According to Needham (1959), in the Han period six treaties on star navigation were written with a total of 136 volumes, showing the vast knowledge accelerated after the Warring period. From Han (206 B.C.—220 A.D.) to Tang (619—907) three important developments of navigation were developed. First, the relation between an object's altitude latitude (A), declination (D), and latitude of the observer (L): $L = 90 + D - A$ (Deng, 1997). Second, was the locations of the Big Dipper and the Polaris star during the different seasons. Third, the discoveries of coefficients between cosmic objects and locations on earth (Deng, 1997). In general the above laid a foundation for the development of maritime navigation.

Inventions of tools such as “handy ruler” and the “star-measuring ruler” were devised for astronomic observation-based navigation. These tools helped to position ships in open waters (Deng, 1997). During the Song period the imperial calendar was devised which divided the year into twelve months, the calendar gave the sailor an important tool for operations. However, the above was not significant to determine the ship's position, in order to find the position of the ship, knowledge of longitude with coordination of time and distance is needed. Thus the invention of the “Log” measured the time-distance coordination of the ship's movement, which was devised in late sixth century. However, navigation could only be done through clear skies. The Chinese invention of the compass (960 A.D.) was a major advancement in navigation. During the Song, astronomical navigation was widely practiced, however, on cloudy days navigation would be a problem. A breakthrough occurred around 1044 which was the portable compass, which allowed

travel on cloudy days. The compass was first used on Chinese ships perhaps around the early twelfth century as reported in 1117 (Mokyr, 1990). In the fourteenth century Yuan period a more sophisticated navigation was invented the “all-weather” navigation system (Deng, 1997). The invention was a new type of sea chart that included “seaway compass charts” (Deng, 1997). These charts consisted of terrestrial seaways that described detail sailing sources and travel distance coordination based on the terrestrial positions on the compass. From the Yuan period the compass charts become the standard equipment for all ocean ships was required by the government (Deng, 1997). In addition, Yuan period also produced sailor manuals, sea traveler maps, and sea charts which became a standard at the time.

Chapter 5: Maritime Institutions

One of Joseph Needham (in Deng, 1999) paradoxes includes that institutions or the Chinese bureaucratic system emphasized agricultural production and discriminated against merchants and artisans, but this is not absolute. The political environment in Europe right before the its scientific revolution was no better than that of China (Monter 1985 in Elleman, B. A. and L. Jung-pang, 2007) People such as: Copernicus, Kepler, Galileo, and other pioneers of the scientific revolution in Europe risked their lives in religious courts. Maritime trade became prosperous in China in the beginning of the Han period, however, it was not till Song times (960—1276) that the coastal regions began to form economies that had noticeable integrative market characteristics. There was notable marketization in the premodern economy, China’s maritime industry witnessed many economic developments. Surly, the combinations of institutions and other obstacles prevented China from an Industrial Revolution, institutions were not a problem during the ninth to fifteenth centuries, but were quite favorable to sea merchants due to the lack of formal involvement in the beginning and formal institutions to sustain growth.

This section presents the New Institutional Economics of both North and Coase on relation to transaction costs, along with Madeleine Zelin whom gives a revisionist perspective that is somewhere in-between North and Coase ideas. Therefore the

institutional dimensions on behaviors in the markets that may have reduced the transactions costs are: the legal dynamic, the cultural dynamic, and the change dynamic.

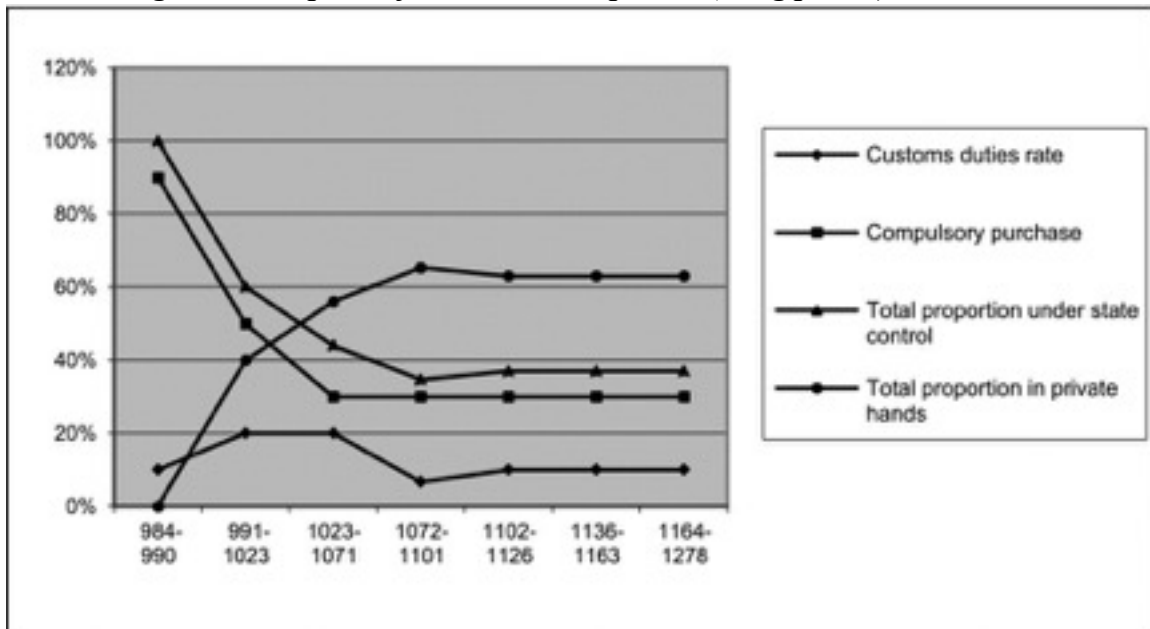
Coase's (in Sengupta, J. 2011) theory presents: that when property rights and involved, given parties will naturally gravitate towards the most efficient and mutually beneficial outcome. Madeleine Zelin (2007) points out that the imperial state's recognition of rights in this case property rights, were more in lined with a laissez-faire manner of control and enforcement. This point of view seems to be more relevant to Coase's in the since that people will gravitate towards the natural agreement so that both parties win. Thus, contracts and laws could be formed through a laissez-faire manner, this would help to portray the rapid development of China's maritime industry through Smithian Growth by lowering transaction costs and providing specialization of industries. If laissez-faire manner of laws and contracts allowed for commerce to be engaged while at the same time laws and contracts provided security. She argues that by the late imperial China the country was using contracts which was used as means to establish property rights and relationships "*individually*". This type of formate became universally used, in addition, when the state become weakened and unreliable — through informal means — the self-enforcement would strengthen.

The Chinese government was aware, active in, and benefited from maritime involvement (Deng, 1999). Maritime policies was a logical step, however, there were two stages to the governments actives. The promotion of Maritime trade was from Han to Yuan, although in certain periods Chinese citizen needed permission to undertake oversea trade, but for sea traders from other countries trade was allowed on a consistent bases. This indicates that the door was wide-open for trade from pan-Asia. Stage one was characterized by laissez-faire (Deng, 1999). Before Tang Dynasty, the administration for foreign trade was decentralized, regulations was, if at all, in the hands of local officials (Deng, 1999) meaning that informal contracts were extremely important, rather people gravitated towards the natural agreement so that both parties win lowing the transaction costs. The less regulation allowed for rapid growth and markets to emerge, trade was quite free, however corruption became a problem. For instance, Governor of Guangzhou reportedly received bribes constantly, but market and institutions adjusted itself: number ships to the

port declined as it lost favor among sea merchants and resumed as the administration was corrected (Deng, 1999). The case shows laissez-faire institutions within the Han to Tang periods as later a reform ensued to protect merchants (Deng, 1999).

The second stage was the Tang trade bureau system which began in 714 A.D. where a commissioner for maritime trade was established to regulate trade policy. This marked an era of active support by the government through more centralized institutions leaning towards North's view of institutions and transaction costs. The bureau was responsible for inspection of foreign trading goods and collection of duties from imports. There were financial benefits for the government through levies on imports. The levies was a kind of tax "drawing a proportion" and compulsory purchase of imports by the government "purchasing a proportion"; thus a direct tax and an indirect tax or hidden tax (Deng, 1999). Song maritime trade provided revenue in three ways: (i) taxes imposed on ocean-going ships; (ii) duties were levied on imports; and (iii) the majority comes from the purchase and resale of products (Juag-pang, 2012). The idea of considering maritime trade as a financial source had already emerged in the Song as it became important to the Chinese economy. Table 8 points out the customs duty rate during the Song period, it shows that it was quite low giving incentive to trade.

Table 8: High-value imports of both state and private (Song period)



Source: Heng, D. (2013)

Song period also added new practices, custom law was established in 1080 A.D., which included: (i) custom duty rates were fixed and publicly announced; (2) individual officials were forbidden to participate in trade activities; (3) rewards were granted to people who promoted overseas trade; (4) government monopolized certain imported commodities (Deng, 1999). Song government encouraged merchants to build ships to undertake trade, thus for those who promoted trade official titles and positions were given (Deng, 1999). Most importantly tax on maritime trade was light; for example, Deng (1999) presents during the Song periods the tax rate on traded goods varied between 2 and 5.5 percent to commerce (Deng, 1999).

Furthermore, the Song officials even understood the tax revenue from trade and the turnover rate of the trading ships (Deng, 1999). Maritime revenue in the Song period from trade reached 20 percent of total cash revenue (Deng, 1999). “Discriminative Duties” enabled the revenue to climb where it pushed fast turnover: for example if a ship returned to China within five months a lower tax rate was imposed and if the ship returned in a year normal tax rate applied (Deng, 1999). Han to Southern Song seem to be promoted through laissez-faire sort of institutions with minimal control, rather contracts reduced transaction cost. Maritime policies that were developed in China helped to spark Smitian growth allowing linkages to emerge with governmental intervention. Thus, we see both informal maritime institutions in the earlier development of the maritime sector and more formal institutions in the latter period.

Chapter 6: Reative Decline

Path-dependency

Path dependency is concerned with regional adjustments, dealing with problems of adjustment. Path dependency explains the cause of difficulties for regions to generate or adept to new basic technologies, due to limited learning capabilities when faced with new things. Path-dependency may show why the maritime and regional development stagnated after the sixteenth century when Europe was coming of age. Negative lock-in

developed in China which was the lack for adaptability. Usually, old industries are quite homogenous and thus characterized by a certain techno-industry structure, but also the institutional atmosphere may be stuck towards the old industrial past, which was the case with China's maritime industry. In other words, industrial regions were locked into certain trajectories because their industry has been weakened by their ability to adjust to the new technology in the West.

Therefore, the industrial regions became victims of their early success; hence, they lost their innovative capacity for numerous reasons. The most detrimental reason is that the market structure becomes oligopolistic or monopolized over time. This is precisely what happened at the end of the 17th century. But, more importantly institutional sclerosis (Olson, 1982) may have been the problem with continued progress of China before imperial Europe re-opened China to trade with the rest of the world. According to Grabher (1993), such institutional lock-ins fall into the so-called trap of rigid specialization. In others words, the lock-in phase is a double-edge sword that one creates in a growing economy, but when it reaches its peak it is locked-in and fails to adjust. The Chinese stayed with the development of monsoon wind patterns of wind-powered sailing and the development of commercialization really never passed the pan-Asia area with exception to voyages to Africa but were more on exploratory suit rather than economically.

Chapter 7: Conclusion

This thesis argued that the four centuries from the 10th century to 14th century can be seen an age of sea commerce, age of sea-borne technological advancement, and a maritime frontier that was sparked through Smithian growth — increased specialization caused by the geographical expansion of markets — and developed through institutions and proximity. The collocation of changes both external and internal provided an environment where maritime trade boomed, and with it included social, political, and

economic changes throughout the centuries. Thus, what sparked maritime development in China during the 10th to 16th centuries and did this ignition lead to a maritime frontier? To answer the question the following is examined through a number of categories.

Transfer of Economic Centers

The shift of economic centers to the South meant an overall transfer of demographics and relocation of capital. Through these two means regional development took place in the Southeastern coast, where more capital was available and new industries were sprouting such as the maritime industry. The transfer of economic centers were due to the closing of routes in the Northwest and the prosperity that was taking place in the southern coast. Mass migration ensued and the development of a water works project was built that connected new networks and markets making it easier to relocate to the south or southeast regions. Through behavior geography an increase in migration followed where people followed the successfulness of it surroundings, in this case, the development of new cities and markets on the coast; which, provided more opportunities for merchants via maritime trade. Table 9 presents the comparison of cities built through time Han to Ming, which shows the transaction from the Northwest to the Southeast. By southern Song 58% of the cities were in Southeast region compared to 14% in the Northwest.

Table 9: Comparison of Cities built form Han to Ming

Period	Nation's Total	Norwthwest	Southeast
Early Han	208	81 (38.99%)	26 (12.51%)
Later Han	457	276 (60.39%)	30 (6.46%)
Tang	1,282	715 (56.80%)	125 (9.17%)
Northern Song	1,461	547 (37.44%)	357 (24.41%)
Southern Song	604	83 (13.81%)	346 (58.50%)
Ming	1,771	282 (15.90%)	796 (43.88%)

Source: Elleman, B. A. and L. Jung-pang (2012)

Entrepôts for the booming sea trade and linkages

The development of commercial establishments such as emporiums and entrepôts were essential as they were the linkages and trading centers which boasted new development of cities, transactions, and diffusion of technologies that reduce transportation and transaction costs. In addition, they served as strategic point for maritime development as they specialized in different actions. The emporiums were international and long-distance trade holding facilities as the entrepôts were inport-export communities. However, geography was not the driving motivation to form emporiums and entrepôts, but cooperation — milieux and proximity.

Trade diasporas provided an integrated net of commercial communities through same ethnic group that formed trade networks (Gipouloux, 2011). Such diasporas, linked by common culture, language, and organization. Through trade diasporas the Asian Mediterranean was formed as trading crossroads that linked between different civilizations. It was also transnational space, which many autonomous cities and urban regions, jointly control the flow of goods and monies, thus making up together a matrix of economy supremacy. The linkages of the Asian Mediterranean lead to specialization and specialization in turn lead to economic returns with in the industry.

Maritime Technologies

Smithian growth requires two things. First, the economy must possess an increasing returns in technology, thus allowing production to be used by more efficient specialized producers to expand; second, linkages that emerge must allow goods to be transported at sufficiently low cost for this increasing returns technology to be exploited (kelly, 1997). If costs were too high a pattern of production would not change as new linkages appear. The returns on maritime technologies proved to be quite real as it allowed specialized producers to expand. The development of maritime technologies was a large part of the development of the maritime sector in China and the South East region. The innovations

in shipbuilding and specialization in shipbuilding lowered transaction costs and transportation costs, consequently this also led to other innovation within the ships, such as sail design, rigging, and a new design in the rudder. In addition, specialization of ship designs as one ship was meant for coastal and inland routes and another ship for ocean-going routes. Sail design also improved the efficiency of sailing. The development of iron nails allowed for stronger ships, which allowed ships to cross the oceans more reliably.

Technology development in navigation was perhaps a single key feature that continued development of a maritime sector, as it allowed ships to cross the seas and oceans to trade. In addition, it allowed the returns of technology of shipbuild to increase, the development of astronomy and star navigation allowed for early development of the sector as it allowed ships to travel in open water during the night, however, during cloudy days and nights this was a problem. Thus, the invention of the portable compass allowed for travel in all types of weather. Map making became a positive factor that showed destinations and routes which made travel easier for sea merchants.

These achievements can be highlighted as follows: (i) development of specialized ships; (ii) invention of the rudder and bulkhead construction; (iii) knowledge of astronomy and development of navigation tools; (iv) the use of several masts; (v) evolution of sail design; (vi) understanding the weather patterns and currents; (vii) establishment of sea routes; (viii) the use of the compass in navigation and; (ix) enhanced navigation charts. After the twelfth century Chinese sailors were very technologically capable not only to sail in coastal waters but also able to sail to the Pacific and Indian ocean and return home. The linkages that emerged allowed goods to be transported at sufficient low cost, thus there was an increasing return of technology that was exploited, these inventions led to specialization of labor, shipbuilding, navigation, textiles, and iron that sparked rapid Smithian Growth in the maritime industry.

Institutions

A another key component to the development of the maritime sector was both formal and informal institutions, how behaviors in the market shape the incentive structure through the effect on transactions costs. Thus, if institutions can development such that the transactions costs concerning the most productive sector of the economy are reduced, this change would alter the incentive structure and thus encourage resources to flow into that sector (maritime) and thus lead to economic development (So, 2013). However, if there is no improvement in the institutional structure there should not be any change in transactions costs or incentive structure thus negating development (So, 2013). If we look at Chinese maritime institutional structure through the two stages we see the the lack of formal institutions for early development as a key point to sparking Smithian growth that allowed networks and linkages to expand without governmental intervention, thus Coase's theorem presents itself where more market intervention and informal agreements were used to lower transaction costs. Nonetheless, the system was taken advantage which needed formal intervention. Thus, it called for an incentive structure to re-lower the transaction cost due to taking advantage of the laissez-faire framework.

In Late Song and Yuan institutions become an important part of the continued development of the industry where they supported maritime networks and provided protection, but did not over step on the boundaries to stagnate the maritime industry, thus a North's explanation of institutions and lowering transactions. Therefore, there was an evolution of institutions within the maritime industry that allowed the threshold growth and lowered transportation and transaction costs with incentives that allowed continued growth. This should also take into account the interactivity and interchangeability of both formal and informal intuitions in Chinese history. For example, an institution of contract may not be clearly set forth/out as either formal or informal, as it depends on operational context. In other words, at times it may be legal and other times extralegal (So, 2013); a

type of *lassie-faire* institution but may represent the social aspect of Chinese development in the maritime sector.

China as Maritime Frontier

To many economic historians the Song Dynasty was perhaps early modern, which boasted impressive major cities, urbanization in littoral areas, technological progress, the expansion of trade and ship building, the use of paper currency which was hardly conceivable in other countries and institutions both informally and formally promoting growth, (Dean and Liu 1988). But more importantly the development of the maritime frontier was an interface or interaction of different societies.

Transportation linkages of the economy were split into small markets that only had a limited scope for division of labor. However, once the critical density was reached the small markets began to coming together into a large economy creating an interface with a economy-wide market. The above was the first wave, the second wave was the interaction of regional-wide market system where the fragmentation of little city-states within spatial proximity came together to create a regionalized and specialized maritime economy. With low transaction cost through both Coase and North theorems specialization occurred in the maritime sector, the result was increased specialization which caused an acceleration in growth.

In addition, China has never been landlocked and has always had a sea boundary. Second, topographically China boasted many natural harbors though bays and gulfs. Third, climatic patterns of China's coastal regions are beneficial for sailing. For instance, China's ports are ice free all year around; second, wind patterns are dictated by season monsoons (trade winds). The monsoons have two advantages: (i) they blow largely along the longitudinal line (ii) they link China to the Asian Mediterranean (South East Asia). Another advantage is China coast is situated at 0 degree - 30 degrees N where storms are

relatively infrequent all year around (Deng, 2007). Forth, seas and ocean currents move seasonly in two directions along the China's mainland coast — northernly during the summer and southernly in the winter. Fifth, China's inland transportation to the coast was quite developed by premodern standards, well above Europe.

In sum the Chinese did present rapid growth within the maritime industry and was certainly a frontier in maritime actives between 10th and 16th centuries through the above points. However, the frontier stalled in the late 16th centuries as Europe formed another frontier. Like the the 1st and 2nd industrialization there were 1st and 2nd maritime frontiers. However, China fell victim to path-dependency, institutional sclerosis, and the trap of rigid specialization, which marked the end of an era in maritime development for China and a new era of maritime development in Europe.

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