Introduction

Food is at the core of civilization. Therefore, famine ranks with war and epidemic as one of the greatest fears of both ancient and modern peoples. The ancient concern with famine has inspired much modern scholarship on food production, distribution, and crisis during historic times. However, previous studies failed to wed the topic of famines in history with modern economic theory and analytic tools; therefore, past scholarship has struggled to account for the variation in the occurrence of famines between ancient empires. The New Institutional Economics (NIE) perspective offers a unique lens on this question, in particular on the relationship between famine, information, and institutions in ancient empires.

This paper claims that by facilitating the dissemination of information between those with and those without food, institutions helped reduce the occurrence of famine in ancient empires. To show this, I first establish a framework for my analysis by reviewing the literature on the economics of famine, institutions, and ancient empires. I then develop a theoretical model that predicts that empires with more institutions that facilitated information transmission suffered famines less frequently. I next perform a comparative case study test of the theoretical model by analyzing the institutions and famines of four ancient empires – the Roman Empire, the Holy Roman Empire, Mughal India, and Han China. I conclude by noting limitations and suggesting further expansions to this paper. In the end, I conclude that information institutions do have a notable effect on the occurrence of famines within ancient empires.

Literature Review, Part I: The Economics of Famines

What is famine? Unfortunately, there is little consensus on how famine should be defined. For example, Garnsey argued that a famine is a particularly acute food emergency that
must increase the mortality rate and lead to the break down of the social order.¹ Therefore, Garnsey claimed that there were many harvest failures in history but few famines; yet Erdkamp, with a more liberal definition, suggested that famine occurred much more regularly.² Pinto proposed that famine should be noted particularly as a lack of grains for bread.³ Even though their definitions vary, however, there is general agreement among scholars that famine and other forms of food shortage should be seen as part of a continuum – famine is a dynamic process.⁴ Scholarship on modern famines analyzing the concept of hunger and the transparency factor can help nuance these conflicting definitions.

The Economics of Hunger

Hunger has been a constant and universal condition throughout human history.⁵ Most people in most places and most times have flirted with the state of hunger, and therefore the more serious and radical episode of famine must be distinguished. Sen writes that “famine reflects widespread failure of entitlements on the part of substantial sections of the population,” where an entitlement represents the ability of a person to establish command over alternative bundles of a good (in this case, food).⁶ In short, famine is normally a problem of relative distribution of food, not of absolute food production: food production technology does not seem

² Garnsey, Famine and Food Supply in the Graeco-Roman World, 6; Paul Erdkamp, Hunger and the Sword: Warfare and Food Supply in Roman Republican Wars (264-30 B.C) (Amsterdam: J.C. Gieben, 1998), 188-189.
⁵ Garnsey, “Famine in History,” 272.
to correlate with the event of famine.\(^7\) As well, Drèze showed that famines not only reduce food intake, but also disrupt the rural economy by putting farmers out of work and by exacerbating hunger to the point that people are unable to work.\(^8\) Thereafter, a reinforcing cycle might develop, with rural inhabitants unable to find or do work in order to prepare next year’s crop, which drastically increases the probability of food shortages continuing into the next year.\(^9\)

*Transparency and Government Intervention*

The nature of political and institutional responses to famines has also received significant attention. Sobhan noted that while there is no evidence that famines precipitate political revolutions in the short run, in the long run they might destabilize governments by delegitimizing the regime in the eyes of the citizens.\(^10\) However, for governments to intervene they must have the organizational capacity and the ability to identify targets, obtain excess grain, and deliver it to where it is needed.\(^11\) Therefore, as Drèze argued, a reliable system of famine prevention requires an intervention procedure that ensures an early decision to respond to a famine takes place.\(^12\) Drèze also argued that one must distinguish government action between the categories of “famine relief” – alleviating present famines – and “famine prevention” – combating future famines.\(^13\) Platteau noted further that food security (the number of people actually hungry) might be different from food self-sufficiency (a people’s accessibility to food resources, often

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\(^7\) Sen, “Food, Economics and Entitlements, 37: “famines can occur even without any decline in food output or availability per head”; Jean Drèze, “Famine Prevention in India,” in *The Political Economy of Hunger, Volume II: Famine Prevention*, ed. Jean Drèze and Amartya Sen (Oxford: Clarendon Press, 1990), 13-14, also notes that in post-WWII India famine was reduced while food productivity decreased.

\(^8\) Drèze, “Famine Prevention in India,” 16-17.

\(^9\) Garnsey, *Famine and Food Supply in the Graeco-Roman World*, 17; however, note that crop failure was much less likely over two successive years.


\(^12\) Drèze, “Famine Prevention in India,” 98.

\(^13\) Drèze, “Famine Prevention in Africa,” 126.
measured with the proxy of food imports), which can affect how a state responds to famines.\textsuperscript{14} The problem for the state with a proper mechanism of response becomes a question of information: as Sen notes, “neither food output nor prices, nor any other variable like that can be taken to be an invariable clue to famine anticipation.”\textsuperscript{15}

One major modern institution closely studied in relationship to famine is the media. While the oft-quoted statement that “no democracy has suffered a famine since the Second World War” is misleading, institutions of the press assist in the prevention of famines by both disseminating information about regions suffering from food shortages while also holding governments accountable for responding to those food shortages. A review of studies by Ram concluded that “information, especially the news media, can play a substantive and progressive role in shaping public policy combating hunger.”\textsuperscript{16} As well, the actual form of the media matters less than the function the institution itself plays in facilitating transparency of information. Therefore, while food output and price seem to have no correlation with famines, modern scholarship has offered evidence that credibility of information and length of existence of media institutions do have a positive correlation with successful famine prevention.\textsuperscript{17}

\textbf{Literature Review, Part II: The Economics of Information}

New Institutional Economics (NIE) has become a major school of political economy by critiquing the neoclassical economic assumption that “the costs of acquiring information,

\textsuperscript{15} Sen, “Food, Economics and Entitlements,” 42.
\textsuperscript{17} Ram, “An Independent Press and Anti-hunger Strategies,” 187-188.
uncertainty, and transaction costs do not exist.”¹⁸ Instead, NIE posits that the costs of information, risk, and transaction are significant but are reduced and resolved through the creation and maintenance of institutions. North defines institutions as “humanly devised constraints that shape human interaction” by structuring “incentives in human change,” while also shaping “the way societies evolve” by reducing “uncertainty by providing a structure to everyday life.”¹⁹ Institutions have already been explored in the historical context, both by North as well as by Acemoglu in his work on colonial empires and modern day institutional structures, where he found that historic institutions are “sticky” and therefore can significantly influence present day societies.²⁰ In this study, the intersection of information and institutions will be explored through three overlapping information channels: transaction costs, agency, and asymmetric information.

*Informational Economics: An Overview*

The importance of information and institutions in running an efficient economy has been noted by both ancient and modern commentary.²¹ As North summarizes, “the costliness of information is the key to the costs of transacting, which consist of the costs of measuring the valuable attributes of what is being exchanged and the costs of protecting rights and policing and enforcing agreements.”²² As Frier and Kehoe note, “the accurate information that is required for sound economic decision making” may be “not readily available, often difficult to obtain, and


therefore expensive – at times prohibitively so.” 23 If information is expensive, the following paucity of information might limit possible choices available to an economic actor by making a certain hypothetical act unavailable, unknown, or too risky. This “path dependency” can lock in individual actors, groups of actors, or even whole societies into inefficient solutions to economic problems, including famine and food shortages. Because institutions are the means by which human beings process information, these institutions are also subject to “path dependency” in what kind and how much information they produce or transmit; therefore, institutions may not be efficient and might vary from one society to another. 24 In short, information oils the economic system, but only so much as institutional constraints do not undermine its effective diffusion across economic actors in the society.

**Transaction Costs**

Transaction costs are the barriers to exchange that are independent and often unrelated to the actual production and consumption costs of a good or service. The cost of entering into an exchange, negotiating within that exchange, or exiting that exchange following the transaction’s completion can ultimately be so expensive that negotiations and bargaining do not occur in the first place. 25 Such transaction costs can be formal, such as entry fees, or informal, such as difficulty in communicating between parties. As Coase notes, the existence of transaction costs are what make legal rights of economic actors relevant, for otherwise a natural contract between the two parties might be too expensive to achieve. 26 This finding, called the Coase Theorem,

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therefore explains why “transaction costs are crucial to any understanding of an actual economy.”

The key factors determining transaction costs are institutions. By providing a set of agreed upon rules, norms, and channels for transacting, institutions “allow people to go about the everyday process of making exchanges without having to think out exactly the terms of an exchange at each point and each instance.” For example, North notes that the cost of measuring an object, such as the weight of a coin, would increase transaction costs because the need to test the weight and metal content of every coin used in a transaction would add significant costs to an exchange of non-bullion goods. Therefore, the promulgation of a common reliable currency would act as an information institution by transmitting trust in the unit of exchange across actors in the market.

Agency

Agency relationships are common in economic life. As Arrow describes, an economic relationship usually requires at least two parties: the agent, who chooses from a number of actions that affect both the agent’s welfare and that of the other party, the principal, who determines the payoff matrix. One major problem in agency relationships is the right of access to economic goods and services by the parties, also known as property rights. According to North, property rights include the right to use, the right to derive income, the right to exclude, and the right to exchange. While the issue of property rights is most evident with public goods,

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28 North, Institutions, Institutional Change and Economic Performance, 6, 61.
29 North, Institutions, Institutional Change and Economic Performance, 83.
30 North, Institutions, Institutional Change and Economic Performance, 28-32.
32 North, Institutions, Institutional Change and Economic Performance, 28.
both transacting and contracting require the parties to agree upon the property rights of the goods and services in question.33

Institutions play an important role in governing agency relations and, in particular, enshrining property rights. Coase’s paper on “The Problem of Social Cost” is the most famous scholarship on the topic, where he suggested that under perfect market conditions ownership was arbitrary, and therefore economic agreements could naturally reach efficient outcomes. However, in the imperfect conditions under which nearly all economic transactions take place, the costs of bargaining are so high that property rights need to be assigned in order to facilitate efficient outcomes.34 These property rights allow for the constructing, monitoring, and enforcing of contracts.35 As well, when the institutions defining property rights and other agency relationships are stable, they allow for economic parties to take greater risk in their contracting. Therefore, North argued alongside Coase that property rights need to be defined and enforced, normally by a legal mechanism but also possibly by social norms or communal pressure.36

*Asymmetric Information*

Another major problem in economic interactions is asymmetric information.37 When an economic agent and principal engage in a transaction or contract, it is possible the information possessed by each of the two parties might be different.38 Two basic theoretical models of information asymmetries are hidden action and hidden information. Hidden action, or moral hazard, derives from the inability for the principal to measure the full effort of an agent, in part because of the agent’s superior skill or knowledge at the task; an example of this phenomenon is

that insuring against certain risky activities actually encourages people to do those activities.\textsuperscript{39} In contrast, hidden information, or adverse selection, occurs when an agent possesses some special observation used to make a decision, but the principal is unable to ensure that said observation is used for the principal’s best interest; Akerlof’s Lemon Market is the most famous example of this issue.\textsuperscript{40} North also notes that information asymmetries can arise because of the difficulty in measuring a good or service more generally.\textsuperscript{41}

Institutions alleviate information asymmetries by either making information common to both economic parties or preventing parties from exploiting exclusive information during transactions.\textsuperscript{42} To be effective, these institutions have to equalize information, ensure monitoring of the transaction by a third party, or facilitate repeated interaction between the parties.\textsuperscript{43} For example, information asymmetries can arise when one party cannot trust that the measurements of another party accurately reflect the reality of the transaction. Therefore, a set of common measurements, enforced by a third party such as the state, reduces the information gap and speeds up transacting.

**Literature Review, Part III: The Economics of Ancient Empires**

The use of economic analysis, statistical tools, and methodology to study historical cases is a recent but growing addition to the scholarly literature on ancient empires. A few examples suffice to show the extent of its development. From an institutional perspective, North’s study of development and decline in the ancient world through an institutional lens is perhaps the most

\textsuperscript{39} Arrow, “The Economics of Agency,” 38-39.
\textsuperscript{40} Arrow, “The Economics of Agency,” 39-40; Akerlof 490-493
\textsuperscript{41} North, *Institutions, Institutional Change and Economic Performance*, 30.
\textsuperscript{43} Arrow, “The Economics of Agency,” 45-48.
famous.\textsuperscript{44} However, Acemoglu also left his own impact on the field by surveying the differences in European mortality rates to estimate the effect of institutions on modern economic performance in former European colonies.\textsuperscript{45} As well, Puga and Trefler used modern economic analysis to explore the impact of globalization on Venetian trade institutions between AD 850-1350.\textsuperscript{46} Pearson investigated the development of proto-mechanisms of fire and life insurance in 18\textsuperscript{th}-19\textsuperscript{th} century Britain, with particular focus on the conceptualization of moral hazard as understood by contemporary writers.\textsuperscript{47} Classical scholar Archer Martin examined trends in food importation to the Roman city of Ostia over time through statistical analysis of amphorae remains excavated in the urban area.\textsuperscript{48} Historical economic analysis, therefore, has proven diverse both in its theoretical models and case selections.

The economics of ancient empires is a broad topic, and the distinctions and variety between various empires should be noted. However, a brief presentation of major literature bridging economic theory with the Roman Empire can help situate the remainder of this paper in a proper context. Economic scholarship on ancient Rome has come a long way since Moses Finley’s 	extit{The Ancient Economy}, which put forward the primitivist position that economic reasoning played little to no role in commercial and other economic decisions in ancient economies; instead, ancient economies were supposedly dominated by ideology.\textsuperscript{49} Three major camps have arisen in contrast to Finley’s class-based analysis. Walter Scheidel has led the

\textsuperscript{44} North, 	extit{Structure and Change in Economic History}, 90-157.
\textsuperscript{47} Robin Pearson, “Moral Hazard and the Assessment of Insurance Risk in Eighteenth- and Early-Nineteenth-Century Britain,” (\textit{The Business History Review} 76.1, Spring, 2002).
\textsuperscript{49} Moses Finley, 	extit{The Ancient Economy} (Berkeley, California: University of California Press, 1973).
“formal institutionalists,” who, encouraged by the proliferation of New Institutional Economics in scholarship, have argued for a complex arrangement of institutions and networks that responded to transportation and transaction obstacles within the Roman economy.\textsuperscript{50} Peter Bang, in contrast, has been the strongest proponent of “informal institutionalists,” suggesting that irregular and unregulated rules and norms in Roman transactions provided a reasonably efficient response to extensive uncertainty and constraints of the ancient world.\textsuperscript{51} Finally, Peter Temin has spearheaded the revival of a “free market” scholarly perspective, using new econometric tools and unorthodox data compilations to posit a largely unencumbered and efficiently running Roman economy without significant involvement by the state.\textsuperscript{52} While this scholarship reviewed has only focused on the Roman Empire, the potential ramifications for the study of all ancient empires are quite evident.

\section*{Theory and Model}

In light of this literature, the question remains unsatisfactorily answered on how famines were prevented in ancient empires. In particular, the current literature does not offer a viable rationale for the variation in relative famine occurrence between ancient economies.\textsuperscript{53} I argue that information-transmitting institutions reduced the occurrence of famine within ancient empires, especially when transportation and political factors are controlled.

Information transmission is the channel that connects institutions to famine reduction. Institutions reduce the information costs within an economy, whether by lowering transaction costs, lessening information asymmetries, or strengthening agency relationships between

\textsuperscript{51} Peter Bang, \textit{The Roman Bazaar: A Comparative Study of Trade and Markets in a Tributary Empire} (Cambridge, UK and New York: Cambridge University Press, 2008)
\textsuperscript{53} See for example Bang, \textit{The Roman Bazaar}, 78.
economic actors. Therefore, information is disseminated more extensively and rapidly between actors within the economy. When a food shortage occurs, the lower information costs allow grain customers in food-scarce regions to inform grain holders in food-abundant regions about their need, while also reducing the risk for merchants of bringing their grain to a market flush with supplies and therefore unprofitable. The increased fluidity and ease of information transfer allows grain supplies to more rapidly move into a food scarce region, preventing famine from developing out of a food shortage.

In detailing this model, one immediate consideration of importance is that the dependent variable of this model, famine, derives from climatic exogenous shocks to the economy. While war is often associated with famines and may at times be a contributing factor to their occurrence, it seems not to have been the prevalent cause of famine in the ancient world, especially in large empires. Instead, famine in the ancient world depended on weather and climatic randomness. For example, in India the irregular monsoon schedule was the best “predictor” of coming food shortages, and Pinto notes that in the Middle Ages “famine was almost always sparked off by bad harvests due to bad weather.” Food shortages, therefore, can be described as exogenous climatic shocks that are randomly occurring within and between empires. Famines occur when these food shortages are not alleviated in due measure because of political, transportation, or informational reasons.

Three main variables seem to be at work then in determining whether a climatically induced food shortage becomes a more serious famine: information, the state, and transportation

54 Erdkamp, *Hunger and the Sword*, 241. Garnsey, however, disagrees, suggesting that humans may influence famines through “negligence, selfishness, maladministration, ideological blindness or dogmatism” (“Famine in History,” 273). Pinto saw famines, wars, and epidemics as interwoven phenomena but did not prescribe causation (“Food Security,” 57). For this study, the selection of internally peaceful periods of each case study helps alleviate the potential influence of this factor; see the section on the Case Studies.

infrastructure. Taking the state first, political leaders often established mechanisms and policies relating to food distribution because their ability to rule effectively depended in part on popular consensus, which in turn depended on food policy.\textsuperscript{56} Examples of such political action included the Roman grain dole, Mughal famine kitchens, and ecclesiastical food charity in the Middle Ages.\textsuperscript{57} However, the limitations of ancient governance meant that political leaders were often at the mercy of their institutions to respond to food shortages, as detailed strategies of alleviating food shortages were nearly impossible to develop. Instead, most political action was limited to major urban areas for immediate, one-time food agendas.\textsuperscript{58}

Another important factor in ensuring proper access to food during famines were transportation networks. No matter the extra grain one had, if one could not move the food to an area of shortage, the grain would rot and people would still go hungry. Therefore, limitations in transportation technology or infrastructure would increase the occurrence of famine. However, the emphasis on physical transportation costs is overstated in analyzing ancient economies. Many ancient empires, in fact, developed extensive networks of roads and canals while utilizing rivers and open-water routes for trade, tax collection, and military movement. As well, some scholars have noted that social obstacles formed as significant a hindrance for the movement of people and goods, if not more so, than physical barriers.\textsuperscript{59}


In summary, my model theorizes that exogenous climatic shocks caused random food shortages that developed into serious food crises called famines when some combination of political, transportation-institutional, and information-institutional factors failed to alleviate the shortage. In particular, institutions of information helped facilitate the transmission of information between areas of food abundance and food shortage, allowing excess grain to be more rapidly delivered and certain famines therefore prevented. This theory, then, predicts that the more information-transmitting institutions an ancient empire had, the lower the occurrence of famine would be for that empire. This survey allows for the creation of a simple theoretical model to use as a framework for the rest of this paper.

*The Model*
Figure 1 presents the theoretical model’s predicted relationship between number of institutions that transmit information and occurrence of famine in ancient empires. The model predicts an inverse, negative, downward-sloping relationship between information institutions and famine occurrence. A linear relationship is selected because the model’s limitations prevent a more complex prediction about the magnitude or rate of change; instead, the significant prediction is the inverse relationship.

Case Studies

In order to test the hypothesis that institutions of information helped reduce famine occurrence in ancient empires, I have selected four imperial case studies for analysis: the Roman Empire, the Holy Roman Empire, Mughal India, and Han China. There are a couple of reasons for choosing these four cases. For each of four cases, there exists scholarship comparing that empire with one of the other imperial cases selected. As well, though great diversity exists for each of the empires selected, these four cases possess many similar qualities or characteristics that can be held as control variables, as presented in Table 1.

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To briefly offer an overview of each of the four cases, the Roman Empire developed out of the Roman Republic that was traditionally founded in 509 BC. Following a series of civil wars, Gaius Octavius Caesar, later called Augustus, took unitary control of the Roman state that stretched from Britain and the Atlantic Ocean to Egypt and Syria. The legionary army, extensive road network, and control of the Mediterranean Sea were all key features of the Empire. The time of this case study spans from the first settlement between Augustus and the Roman Senate in 31 BC to the start of the Severan dynasty in 193 AD, a period also called the Pax Romana.

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The Holy Roman Empire serves as a reasonable proxy for the diverse states that made up Medieval Europe. The successor of both the Roman Empire and the short-lived Carolingian kingdom of AD 800-888, the Holy Roman Empire ruled over present-day Germany, Italy, Switzerland, the Low Counties, and parts of France from AD 962 well into 19th century. Though Roman in name, the Empire was Germanic in culture with a highly developed administrative system to ensure proper management. The case study of interest here spans from AD 1004-1282, which covers the heyday of the empire before stopping short of the Bubonic Plague of the 14th century.
The Mughal Empire ruled India, Pakistan, and a number of modern South Asian states from 1526 until the full British colonization of India in the 19th century. Originally a nomadic and Muslim people from the Central Asian Steppe, the Mughals ruled over Hindu India during a significant period of cultural growth and trade expansion. From the time of the ascension of its most famous king, Akbar the Great, in 1556, the Mughal Empire thwarted internal dissention and European colonial attempts. The time period of interest for this case study is AD 1526 to 1720, a set of dates suggested by Mughal scholars as spanning the high point of the empire.62

The Han dynasty ruled China from 206 BC to AD 220, a period of time considered a golden age in Chinese history. Balancing a mixture of centralized bureaucracy and semi-autonomous client kingdoms, the Han developed a Chinese script still in use today, established the Silk Road, and engrained a monetary system in Chinese economic life. The Chinese Emperor maintained a firm grip on power and expanded China closer to its modern day boundaries. The time period of interest for this study is 206 BC to AD 25, known as the Western Han period, being divided from the remaining Eastern Han period by the short-lived regency of Wang Mang.

As Table 1 shows, though these four imperial cases come from different historic periods and varying geographic locations, a number of key variables offer enough similarity to warrant comparison. The geographic size and population size of each empire are fairly similar. As well, each of the empires falls within a similar span of latitudinal lines ranging from fifty-four degrees North to twenty degrees North; since latitude is a key factor in determining climate, this latitudinal span serves as a reasonable proxy for climatic controls between the four cases.63

62 Richards, The Mughal Empire, xv.
Further, the four case studies also shared many ecological features common to the temperate zone, such as flora and fauna. While the imperial periods covered are diverse, each period spans a similar length of time for each empire (constrained by available data on famine occurrence). As well, the selected years of study cover periods of relative internal peace in each empire, which help controls for the influence of war on fostering famine-possible conditions.

This paper’s theoretical model accounted for two other factors that influence famine occurrence in ancient empires: state structure and transportation infrastructure. The four imperial cases selected, however, are reasonably controlled across these two alternative variables. Scholarship on famine in the modern world suggests that democratic, transparent, and press-friendly political structures reduce the occurrence of famine. However, while significant variation in the details of statecraft is evident over the four imperial cases, each of the cases possesses a crucial similarity: each is an autocratic empire ruled by either an emperor or king. Therefore, government transparency, press autonomy, and democratic accountability are irrelevant factors for this survey, allowing a basic “autocratic” control to be maintained across the four cases.

Transportation infrastructure also has a significant effect on the ability for food and information to travel across an empire. Therefore, the four cases have been selected with comparable transportation infrastructure in mind. The Roman Empire was renown for possessing nearly 100,000 kilometers of roads that networked together its provinces, but the common usage

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65 See the section on test data below.
66 For the time periods selected, the Roman Empire was undergoing the Pax Romana, the Holy Roman Empire underwent the Henry-Hohenstaufen-Barbarossa period of strong central leadership, the Mughal Empire was not yet warring with the British Empire, and the Han dynasty had little internal instability until the Wang Mang rebellion during the last couple surveyed years.
of canals, rivers, and the sea may have been of even more significance. The Holy Roman Empire recycled its Roman predecessor’s roads while expanding sea-routes in the Mediterranean and Baltic. Roads, rivers, canals, and Indian Ocean coastlines were all used as transportation channels in Mughal India. China’s system of roads and canals, as well as the use of river networks and the East and South China Seas, was regular by the time of the Han dynasty. In short, each of the four cases possessed extensive transportation networks consisting of roads, rivers, canals, coastlines, and open water transportation, and therefore a general transportation infrastructure control can be maintained between them.

In summary, while the Roman Empire, Holy Roman Empire, Mughal India, and Han China were not carbon copies of each other, they possessed similar geographic, demographic, political, and infrastructural characteristics to warrant appropriate comparison.

The Test

With a theoretical model and imperial cases developed, it is now possible to test the hypothesis that institutions of information decreased the occurrence of famine in ancient empires. However, before the results from such a test can be properly understood, a couple of notes must be mentioned on data selection and the operationalization of this comparison.

Data

Data is a notorious problem in the scholarship of ancient economics. Census-style records are rare and limited, and most other documentation has become corrupted, lost, or damaged while passed down through the ages. The limitations of ancient data require innovative and

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69 Horden and Purcell, The Corrupting Sea, 10-11, 23, 123, 126.
unorthodox solutions to provide analyzable material. Textual sources, archaeological evidence, and climatic analysis offer some assistance as evidence for this study.

Famine figures are an excellent example of this problem. No annual statistics of grain production and consumption exist for any empire or large state prior to modern times, and therefore systematic records of famine occurrence are nearly impossible to compile. Instead, the most reliable source of accounts of famine in historic times comes from literary sources or other textual forms such as inscriptions, funerary stones, or papyri. However, textual sources have their own limitations: usually written by authors who are part of the elite classes, they can be selective in their historical coverage, and there is no standardized definition of what constitutes a famine on which they might report.\textsuperscript{72}

This study’s solution to the problem of famine data comes from an insight by Erdkamp, who noted that one might distinguish more serious incidences of famine from more regular food shortages based on whether the event affects members of the elite classes.\textsuperscript{73} The poor are always hungry and at risk of a poor crop, but normally societal and political elites are not affected during a food shortage because they utilize stored food or extort from what remains of the commoners’ agricultural stock. However, when even the members of the elite class have difficulty acquiring food, then the shortage of grain is serious enough to be described as a famine. This brilliant definition solves the famine data conundrum, allowing for the use of catalogues of textual accounts of famines as a proxy for famine occurrence in ancient empires. As these accounts are written by elites, one would expect that the events they recount were of the magnitude and wide scale effect required by the definition of famine established here.

\textsuperscript{72} However, it should be noted that the same definition problem occurs in modern discussions of famine; see the first part of the Literature Review of this paper.

\textsuperscript{73} Erdkamp, “Food Security, Safety, and Crisis,” 73-74.
With famine catalogues acting as a proxy to provide data on the years in which famines occur, the next obstacle to overcome is the variation in source data. The available catalogues on famines in each of the four case studies selected do not cover the equal number of years. Therefore, I use “Average Number of Years between Famines” as the measure of famine occurrence for the test, operationalized as total number of years surveyed divided by the total number of years of famine; a higher value represents a low occurrence of famine in the empire. This allows for the results of each case to be compared to one another.

**Institutions of Information in Ancient Economies**

Sample ancient institutions are needed to operationalize the three channels of information transfer previously explored. The choice of ancient institutions is constrained by their comparability across multiple empires and the presence of recordable data on them. Though these institutions have been categorized under certain informational channel headings for organizational purposes, in reality the boundaries between transaction costs, asymmetric information, and agency are very gray. As all three channels interact and affect one another, so too each institution of information engages multiple channels of information transmission. Nevertheless, the institutions have been categorized under the institution’s primary information transmitting channel.

The institutions of common language and common coinage provide the best perspective into transaction costs in the ancient economy. A common language facilitates easier communication, reducing the costs of translation and the potential for misunderstandings arising out of different linguistic patterns. The more languages spoken within a particular region, the greater the probability that two random economic actors will not speak the same language when they meet; to combat this, separate firms or guilds of a particular linguistic background need to

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be created and operated, which can also drive up costs.\textsuperscript{75} In a similar vein, a common currency allows for faster and more efficient exchanges between economic actors by reducing the transaction costs associated with currency exchanges. As well, because a common currency is normally regulated by a state, the stability of the currency in terms of weight and quality has an important effect in building trust within economic interaction, reducing transaction costs. Therefore, both a common language and a common, stable currency should reduce transaction costs within an economy.

Uniform weights and measures and market structure operationalize the asymmetric information channel. Weights and measures such as length, area, heaviness, and time define the quantity and quality of goods and services being exchanged in an economy. When weights and measures are uniform and standardized across a region, they facilitate faster and more efficient trading while also reducing the information gap between buyers and seller, building trust.\textsuperscript{76} By market structure I mean the characteristics of the type of markets available to economic actors: fairs, urban markets, bazaars, etc.\textsuperscript{77} Markets and fairs facilitate transactions by ensuring the production, transfer, and quality of goods, while creating patterns of trust and reliance that would otherwise be lacking or uncertain in one-time transactions.\textsuperscript{78} By fostering multi-iterated interactions between economic agents and transmitting information through social networks, the market structure of an ancient empire’s economy can exacerbate or constrain information asymmetries, as well as other information channels.\textsuperscript{79}

\textsuperscript{75} In modern political economics, this concept is referred to as “linguistic fractionalization” or “ethno-linguistic fractionalization.” On the costs of creating and operation firms, see Frier and Kehoe, “Law and Economic Institutions,” 126-134.

\textsuperscript{76} North, \textit{Structure and Change in Economic History}, 43.

\textsuperscript{77} William G. Skinner, \textit{Marketing and Social Structure in Rural China} (Ann Arbor, Michigan: Association for Asian Studies, 1965), 1: “marketing structures inevitably shape local social organization and provide one of the crucial modes for integrating myriad peasant communities into the single social system that is the total society.”

\textsuperscript{78} Frier and Kehoe, “Law and Economic Institutions,” 119.

The aspect of the agency channel of interest not already covered under the transaction costs or asymmetric information variables is legally enshrined property rights.\textsuperscript{80} Property rights define “agency” over certain economic goods or resources to certain individuals or organizations, thereby helping to reduce overuse, combat the tragedy of the commons, and incentivize expansion and improvement of the good or resource.\textsuperscript{81} However, doling out property rights on a case-by-case basis is extremely expensive. Therefore, the use of the law reduces the cost of assigning property rights by offering a general framework for disputes over ownership and rights to be defined and settled. Further, property rights not only help to facilitate bargaining over contracts, but they also help alleviate transaction costs in the economy.\textsuperscript{82}

To summarize, the five independent variables for this compared study are common language, common currency, standardized weights and measures, market structure, and legally-enshrined property rights. These five institutions of information are given equal weight in this test due to limitations of data: therefore, the more of these institutions an empire has, the less famine should occur within that empire.

<table>
<thead>
<tr>
<th>TABLE 2 - CASE STUDY INSTITUTIONS OF INFORMATION</th>
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<tbody>
<tr>
<td><strong>Variable</strong></td>
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<tr>
<td><strong>Transaction Costs</strong></td>
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<td>Transaction Languages</td>
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<td>Coinage</td>
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<tr>
<td><strong>Asymmetric Information</strong></td>
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<td>Weights and Measures</td>
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<td>Market System</td>
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<tr>
<td><strong>Agency</strong></td>
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<tr>
<td>Legal Property Rights</td>
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\textsuperscript{80} Frier and Kehoe, “Law and Economic Institutions,” 134-137.
\textsuperscript{81} Frier and Kehoe, “Law and Economic Institutions,” 135.
\textsuperscript{82} North, \textit{Structure and Change in Economic History}, 43.
Predictions

Table 2 presents the institutions of information possessed by each of the four comparative empires. As can be seen, I have taken care not only to list whether the institution exists but also some of its general characteristics. Based on the theoretical model and operationalized institutions of information transfer, I predict that the Holy Roman Empire (having the weakest institutions of information) should have the lowest average number of years between famines, followed by the Roman Empire, Mughal India, and then finally Han China. Figure 2 presents the four case studies mapped onto the theoretical model based on these predictions.

Analysis

The results of the comparative case study can be found in Table 3 and Figure 3. In short, the results show that the catalogued famines in the four imperial cases generally match the theoretical predictions of the model. The cases with few and weak institutions of information, the Roman Empire and the Holy Roman Empire, had the fewest average years between two famines.
(6.47 years for the Holy Roman Empire and 7.66 years for the Roman Empire), which should be interpreted as having famines more frequently. In contrast, the empires with many and strong information institutions, Mughal India and Han China, had large average years between famines (8.82 years for Mughal India and 11.55 years for Han China). In the next four sections I take each imperial case and discuss its information institutions and its response to famines.

<table>
<thead>
<tr>
<th>Table 3 - Case Study Independent and Dependent Variables</th>
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<tbody>
<tr>
<td><strong>Variable</strong></td>
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<td><strong>Transaction Costs (IV)</strong></td>
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<td>Transaction Languages</td>
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<td>Coinage</td>
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<td><strong>Asymmetric Information (IV)</strong></td>
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<td>Weights and Measures</td>
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<td>Market System</td>
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<td><strong>Agency (IV)</strong></td>
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<td>Legal Property Rights</td>
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<tr>
<td><strong>Famines (DV)</strong></td>
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<tr>
<td>Total Years of Famine</td>
</tr>
<tr>
<td>Average Number of Years between Famines (Total Years/Total Years of Famine)</td>
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</tbody>
</table>

**Figure 3 - Relationship between Information Institutions and Average Years between Famines in Imperial Case Studies**
Roman Empire

The information institutions of the Roman Empire were relatively strong but showed limitations when compared to Asiatic empires. Generally, the imposition of the Pax Romana at the start of Augustus’s reign is believed to have significantly reduced transaction costs and information asymmetries, only to see them rise slowly again over time.\textsuperscript{83} As Bang argued, the Pax Romana brought “the imposition of a common currency, standardized measures, the highly developed system of Roman law and more orderly administration” which “all worked to improve economic efficiency, lower the costs of trading and promote market integration.”\textsuperscript{84} However, while Roman coinage maintained its value better than its small neighboring kingdoms, it was not as well developed as in empires such as Mughal India.\textsuperscript{85} Roman coinage, based off the silver denarius, was fairly stable but suffered periods of irregular debasement.\textsuperscript{86} As well, the Roman Empire was held together by a unity of two languages, Greek and Latin, though that unity at times could show signs of fragility.\textsuperscript{87} The Romans developed a network of fairs and urban markets that worked together with a standardized system of weights and measures.\textsuperscript{88} Further, Roman law possessed many aspects that promoted trust and private ownership, including a legal definition of Roman citizenship that helped to create social networks and maintain property rights.\textsuperscript{89} Roman law even explicitly recognized the value of a legal and universal system of coinage as a means of cross-regional famine relief.\textsuperscript{90} However, the law stopped short of fully protecting the property rights of traders and merchants who might ship grain from one place to

\textsuperscript{83} Bang, \textit{The Roman Bazaar}, 237.
\textsuperscript{84} Bang, \textit{The Roman Bazaar}, 70.
\textsuperscript{85} Bang, \textit{The Roman Bazaar}, 181-182; Young 225-226.
\textsuperscript{87} Horden and Purcell, \textit{The Corrupting Sea}, 23.
\textsuperscript{88} De Ligt, \textit{Fairs and Markets in the Roman Empire}. However Bang in \textit{The Roman Bazaar} suggests the measures might have been tampered with (193).
\textsuperscript{89} Bang, \textit{The Roman Bazaar}, 241.
\textsuperscript{90} Horden and Purcell, \textit{The Corrupting Sea}, 152.
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another; although the Roman state offered insurance on contracts against enemy action, it would not insure against natural disaster.\(^91\)

Based on these findings, we should expect that the Roman Empire would suffer moderately from famines during the years of survey. Based on the textual evidence, the Roman Empire had twenty-nine years of famine between 31 BC and AD 193, for an average of 7.66 years between any two famines.\(^92\) The Roman state had limited itself to supplying the capital and the army with grain, and as such where those two entities were, grain was sure to follow.\(^93\) However, the serious difficulties in law, communication, and distance made it difficult to obtain grain during significant food shortages, especially in regions far away from the main grain-growing provinces of Egypt, Sicily, and North Africa.\(^94\)

**Holy Roman Empire**

The Holy Roman Empire lacked many of the information-transmitting institutions that in other ancient empires seem to have helped reduce the occurrence of famine. While Latin was the “official” language of the empire, there were dozens of other languages used in everyday interactions, including Germanic and Latin-based dialects that were normally regional in dispersion. Coinage and other monetary forms were also localized to small geographical units, especially in the quasi-independent city-states that sailed the Mediterranean from the Italian coasts. Following a particular period of famine, Charlemagne had attempted to standardize weights and measures in the Carolingian kingdom, but centuries later this had become under-

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\(^92\) Garnsey, “Famine and Food Supply,” 218-227, 251. The years of famine are 28 BC, 23, 22, 18, 5 AD, 6, 7, 8, 9, 19, 32, 40, 41, 51, 62, 64, 68, 69, 70, once during Domitian’s reign, 99, once during Hadrian reign, once during Antonius Pius, 161, 189, and 193AD. I assume an average of two years of famine for each “once” period.

\(^93\) Bang, *The Roman Bazaar*, 69.

regulated and un-enforced. The tradition of the rural fairs of the Roman Empire continued into the Medieval period, and in urban centers guilds and other organizational units developed to fill the niche left by the now disintegrated urban markets. Further, the laws of the Holy Roman Empire, developed out of the civil laws of Rome, maintained many of the same strengths and weaknesses as their Roman counterparts.

As such, it is not surprising to see how frequently the Holy Roman Empire suffered from famines. Pinto suggests that a regional or continental famine occurred in Medieval Europe once every 2 to 3 years. Such a high incidence may suggest an overly broad definition of famine that borders on food shortage. However, even accounting only for “particularly bad” famines, between AD 1004 and 1282 at least forty-five years of famine are recorded, for an average of 6.47 years between famines. Ironically, the high occurrence of famine during the Middle Ages may have actually helped to increase connectivity in Europe as a whole, as urban centers were forced to import grain from overseas by means of diplomatic channels while merchants served as information-gathering agents to track and record famine occurrence. However, it was the urban centers that had the greatest availability to information because of their long-distance trading networks, such as Venice, that suffered the least from famines during the period.

Mughal India

95 Devroey, “Food and Politics,” 76-77.
96 De Ligt, L. Fairs and Markets in the Roman Empire.
97 Pinto, “Food Security,” 66.
98 Pinto, “Food Security,” 66 and Devroey, “Food and Politics,” 77. The years of especially bad famine were AD 1004, 1005, 1006, 1031, 1032, 1033, 1042, 1043, 1044, 1045, 1046, 1047, 1048, 1090, 1091, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1124, 1125, 1126, 1150, 1151, 1195, 1196, 1197, 1198, 1233, 1234, 1235, 1252, 1257, 1258, 1259, 1271, 1272, 1281 and 1282.
99 Benito, “Food Systems,” 39, 42; Pinto, “Food Security,” 59, 66. Note especially Benito, “Food Systems,” 41: “the international grain trade was extraordinarily supple: in periods of famine, it expanded in proportion to the severity of the crisis. When famines reached a certain level of intensity, the two primary trade areas - the Western Mediterranean and the North sea - became connected.”
100 Pinto, “Food Security,” 67-68.
The Mughal Empire, comprising the northern two-thirds of modern India and the lands surrounding it, possessed a number of strong information-transmitting institutions. Mughal imperial coinage – a trimallecular system of gold, silver, and bronze coins – was widely accessible for use in daily transactions and strictly maintained by the state, which controlled both the mints and stamping facilities.\textsuperscript{101} This ensured a standard uniformity, purity, and quality of the coin in circulation, which was augmented by a government-backed bill of exchange called a hundi.\textsuperscript{102} The official language of the Mughal Empire was Persian, and standardized weights and measures (gaz-i Ilahi, gaz-i Sikandari, and the bigha-i daftari) were used throughout the various regions of the empire.\textsuperscript{103} While the two systems of law in the Mughal Empire (Muslim sharia and non-Muslim law) did occasionally come into conflict, this tension did not seem to significantly impact Mughal law toward agency and property rights.\textsuperscript{104} Instead, both Muslim and Indian law enshrined the property rights of peasants by allowing them to retain their land from any seizure save that of the king himself.\textsuperscript{105} Mughal law even offered proto-insurance mechanisms that traders could utilize to protect against risk.\textsuperscript{106}

However, the key information institution of interest unique to India is the bazaar. A bazaar is a type of market that works primarily through the establishment of clientele and personal networks of buyers and sellers as opposed to posted prices; therefore, for the average trader the bazaar is a low information and high uncertainty institution, with poor access to

\textsuperscript{101} Bang, The Roman Bazaar, 181; Irfan Habib, “Monetary System and Prices,” in The Cambridge Economic History of India, ed. Dharma Kumar and Tapan Raychaudhuri (Cambridge: Cambridge University Press, 1982), 360-361; Habib, The Agrarian System of Mughal India, 432-449; Moosvi, People, Taxation, and Trade in Mughal India, 35-80; Richards, The Mughal Empire, 4.
\textsuperscript{102} Bang, The Roman Bazaar, 149; Richards, The Mughal Empire, 3.
\textsuperscript{103} Habib, The Agrarian System of Mughal India, 406-431; Moosvi, People, Taxation, and Trade in Mughal India, 186.
\textsuperscript{104} Bang, The Roman Bazaar, 183. The tension was much more over taxation.
\textsuperscript{105} Habib, The Agrarian System of Mughal India, 123-127; Raychaudhuri, “The State and the Economy in the Mughal Empire,” 176.
\textsuperscript{106} Habib, The Agrarian System of Mughal India, 76.
information, fragmented organization, and low standards.\textsuperscript{107} The market structure, therefore, of Mughal India worked against the transmission of information.

In light of these information institutions, the occurrence of famine fits well into the theoretical pattern. Famine was a significant event in the history of Mughal India, but occurred less frequently than it did in either the Roman or Holy Roman Empires.\textsuperscript{108} Between AD 1526 and 1720, twenty-two years of famine are recorded, for an average of 8.82 years between famines.\textsuperscript{109} Recognizing the serious nature of famine, Mughal law included a provision that allowed for the remission of revenue taxes on land suffering from famine or harvest failure, as well as food kitchens for suffering areas.\textsuperscript{110} The information network that eventually developed in India was so extensive that the British later had difficulty integrating the grain market under their Indian colonial administration because of independent rural networks that could still be maintained even though the Mughal central government had collapsed.\textsuperscript{111}

\textit{Han China}

The Han dynasty of China also developed extensive and impressive institutions that helped transmit information. Han officials were aware of and expressed serious concern over transaction costs.\textsuperscript{112} Therefore, during the Han period, the state transformed original private mints into a standardized bronze currency based on the gold standard, and by 112 BC the currency had become uniform and publicly minted across the empire. State officials controlled

\textsuperscript{107} Bang, \textit{The Roman Bazaar}, 4-5, 198; see also Habib, \textit{The Agrarian System of Mughal India}, 112. Of particular note is Bang, \textit{The Roman Bazaar}, 195: “Imbalances, asymmetries and bottlenecks in transport, good, information and social institutionalization, were a chronic feature. This makes for relatively low transparency and high unpredictability. It was a high-risk, high transaction-cost environment.”

\textsuperscript{108} Moosvi, \textit{People, Taxation, and Trade in Mughal India}, 229-240.

\textsuperscript{109} Habib, \textit{The Agrarian System of Mughal India}, 113-122. The years recorded are 1554, 1555, 1556, 1574, 1575, 1596, 1630, 1631, 1644, 1645, 1646, 1647, 1648, 1650, 1658, 1659, 1660, 1661, 1662, 1663, 1702, 1703, and 1704.


\textsuperscript{111} Bang, \textit{The Roman Bazaar}, 144.

\textsuperscript{112} Bang, “Commanding and Consuming the World,” 102.
the metal quantity and quality in the coins produced, and as such though debasement did occur, it was slow and managed.\textsuperscript{113} The common Chinese language and a system of standardized weights and measures, originally developed in the Qin dynasty, supported the stable coinage, with a government-regulated \textit{Li} (Chinese mile), \textit{Mou} (Chinese acre), and Chinese weight measure that saw little change over time.\textsuperscript{114} Markets became so proliferated throughout the empire that in the Han dynasty almost every subject had access to a market, with the location of markets both formally and informally being established through a pathway grid and uniform district system.\textsuperscript{115} Common features of Han markets included \textit{fang-chih}, who were gazetteers who provided information about local markets to others, and \textit{Hsiao fan-tzu}, who were commission agents who could act as information middlemen within and between local markets.\textsuperscript{116} Trust and information accessibility was so normal that regular customers to markets could utilize credit toward present or future purchases.\textsuperscript{117} As well, Chinese internal rural developments included systematized laws that theoretical “gave” land to peasants for a set period of time before they would have to “return” it.\textsuperscript{118}

The strength and extensive promulgation of information institutions in Han China seems to have had some impact on the number of famines that occurred in the empire. Famine was relatively rare in Han China.\textsuperscript{119} A textual document called the \textit{Han Shu}, a primary source account

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\textsuperscript{113} Swann, \textit{Food and Money in Ancient China}, 377: “theoretically at all times there was a legal coin of a certain weight, made of standard ingredients with which for business transactions and government calculations were balanced coins of more or less weight”; also Swann, \textit{Food and Money in Ancient China}, 15; see also Scheidel, “The Monetary Systems of the Han and Roman Empires,” 144-169.

\textsuperscript{114} Swann, \textit{Food and Money in Ancient China}, 361-365; Scheidel, “Roman and Qin-Han State Formation and Its Aftermath,” 15.

\textsuperscript{115} Skinner, \textit{Marketing and Social Structure in Rural China}, 4 and Scheidel, “Roman and Qin-Han State Formation,” 15. Scheidel suggests the grid and districts served the Chinese administration “for collective surveillance and liability.”

\textsuperscript{116} Skinner, \textit{Marketing and Social Structure in Rural China}, 2, 24.

\textsuperscript{117} Skinner, \textit{Marketing and Social Structure in Rural China}, 23.

\textsuperscript{118} Elvin, \textit{The Pattern of the Chinese Past}, 30; Bang, \textit{The Roman Bazaar}, 43.

\textsuperscript{119} Mallory’s citation of a study by the Student Agricultural Society at University of Nanking that suggested that a famine occurred 1828 times between 108 B.C. and 1911 AD, or about once per year, must be dismissed for using an
of political, economic, and social events during the Han period, records only twenty famines between 205 BC and 25 AD, for an average of 11.55 years between any two famines. The reliability of this evidence is augmented by a known linguistic distinction between famine and food shortage in the Chinese language. Even more directly, scholars have shown that Han officials promulgated knowledge of agriculture amongst farmers throughout the empire.

**Limitations and Possible Expansions**

As previously noted, the quality of the data available on ancient economies acts as a common limitation to all papers of this nature. Notwithstanding the aforementioned discussion of famine records in the ancient world, even basic data categories such as population size, GDP, and wages are derived from a combination of limited textual resources, archaeological finds, and statistical modeling. As such, ancient data nearly always possesses some variability and maintains wide confidence intervals. The continued development and testing of models, as well as newly discovered archaeological remains and texts may allow for more confident or more nuanced explorations of the topic of famine and institutions in the ancient world in the future.

An example of this sort of limitation entails intra-imperial variations in data. In this analysis each case study empire was viewed largely as a uniform whole, even though the size and scale of each empire indicates the potential for variation in famine occurrence or institutional framework within different regions. For example, the Roman Empire consisted of a newer, Latin-speaking West and an older, Greek-speaking East, and this division may have facilitated different responses to famines. Intra-imperial data is even more difficult to come by than data for


120 Swann, *Food and Money in Ancient China*, 3, 389-391. The years of famine recorded are 205 BC, 178, 120, 115, 90, 48, 47, 46, 45, 44, 15, 7 BC, AD 10, 17, 18, 19, 20, 21, 22, and AD 23.

121 Swann, *Food and Money in Ancient China*, 389-391.

a whole empire, but that should not dissuade further research to explore these possible variations.\textsuperscript{123}

This study provides a framework for a number of expansions on this topic. While the conclusions and focus of this paper are broad and general, a future paper could explore any one of these cases in further detail by comparing famine occurrence before and after the imposition of a common currency, market structure, or other information institution in that empire. Another more specific approach would look at how each empire responded to a particular famine or other climatic shock as a case study within a case study. A city such as Rome, for example, might be viewed at different periods of its development, such as during the Roman Republic, Roman Empire, Middle Ages, Renaissance, and early Italian state, to look for differences in how the city responded to famine over time. As well, possible factors not explored by this study were cultural and religious variables, such as the Catholic Church or Confucianism, and they might influence how empires responded to famines as some literature on this subject suggests.\textsuperscript{124} Another simple extension would be to apply the theoretical model used in this paper to other empires or large civilizations. The four case studies of this paper were selected due to extant literature that presented each empire as comparable to one of the others. Tokugawa Japan, ancient Persia, and the Hellenistic Empire of Alexander the Great are only a sample of possible choices for further research.

Conclusion

This paper has offered evidence that information-transmitting institutions had a significant role in reducing the occurrence of famine in ancient empires, as tested in the cases of the Roman Empire, the Holy Roman Empire, Mughal India, and Han China. While common

\textsuperscript{123} Yet, see Bang, \textit{The Roman Bazaar}, 86 on why regional variations on measures of wealth tend to become less relevant as the area of study is expanded, especially in Asia and the Mediterranean region.

\textsuperscript{124} See, for example, Horden and Purcell’s \textit{The Corrupting Sea}.
language, common currency, standardized weights and measures, market structures, and property rights enshrined in a legal code represent only a sample of the possible information-transmitting institutions that might have been explored, these examples nevertheless show that extensive and diverse mechanisms to prevent and combat famine were developed by historic peoples. Famine is a universal and endemic problem to both ancient and modern times, but the use of modern NIE and other economic tools offers insight into how ancient civilizations endure the dearth of food. The value of this insight should not be understated, as the significant variation of famine occurrence between these four autocratic empires indicates that alternative factors influence famine alleviation in states besides democratic institutions and an independent press, which are the primary variables of modern scholarship on famine. Therefore, this study not only offers a new perspective on ancient famine, but also shows how the disciplines of economics and history might continue to engage one another in scholarship to come.
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