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(Article begins on next page)

The Economic and Institutional Determinants of Trade Expansion in Bronze Age Greater Mesopotamia

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Highlights

- We analyze the long run/large-scale changes in the trading patterns of Bronze Age Mesopotamia and their determinants.
- We build on theories and methods from economics and employ proxies for trade expansion and their determinants extracted from archaeological, environmental, and historical records.
- Our sample is a novel panel dataset on the 44 major Greater Mesopotamian polities observed for each half-century between 3050 and 1750 BCE.
- Regression analysis supports the idea that trade expansion over the Bronze Age was favored by spatial-proximity, risk-sharing needs and the rise of merchant institutions.

Keywords: Mesopotamia; Trade; Gravity trade models; Risk-Sharing; Merchant institutions.

Abstract

The focus of archaeologists on reconstructing exchange and communication networks in the past resulted in the enormous improvement of methods for analyzing material flows and detecting trade routes. However, our understanding of the determinants of trade patterns over time and space is still limited. To help tackle this issue, we study through regression analysis the rich economic and institutional experience of Bronze Age Greater Mesopotamia. Our testable predictions originate from three main economic theories of trade expansion. First, because of trade costs, mutually beneficial exchanges are discouraged by distance and encouraged by the relative size of markets. Second, trade expands when more suitable farming conditions in neighboring polities allow consumption risk-sharing. Finally, trade develops when interlocking exchange circuits ease the canalization of goods from the outside by providing secure routes, a more certain resolution of legal disputes and credit provision. Ordinary Least Squares—OLS—estimates based on data on 44 major Mesopotamian polities observed for each half-century between 3050 and 1750 BCE are consistent with these predictions. Our approach provides a robust theory-based empirical strategy for integrating archaeological, environmental, and historical data and calls for a tighter interdisciplinary cooperation.

1. Introduction

Archaeological research on the development of long-distance interconnections based on material and historical records boomed in the last decades (e.g., Bauer and Agbe-Davies, 2010; Brughmans, Collar and Coward, 2016; Hirth and Pillsbury, 2013; Kristiansen, Lindkvist and Mydal, 2018; Moreno Garcia, 2021). As a result, methods for analyzing material flows and detecting trade routes have greatly improved (Altaweel and Palmisano, 2019; Ibáñez et al., 2016; Barjamovic et al., 2019; Kennedy Thornton, 2011; Minc and Emberling, 2016; Artioli 2010;

Martinón-Torres and Rehren 2008; Knappett, 2013), and network and quantitative approaches have been developed to integrate archaeological proxies, historical records, landscape features and geographical distance (Wilkinson, 2014; Knappett, 2013; Barjamovic et al., 2019; De Soto, 2019; Wilson, 2009; Izdebski et al., 2020). These innovations went together with the shift from a view seeing trade as an exogenous factor (Oka and Kusimba, 2008: 341) to one recognizing its endogeneity to economic incentives and its crucial impact on socio-economic and political development (among others, Massa and Palmisano, 2018b; Garfinkle, 2010; Benati and Guerriero, 2021a, b). Yet, none of the existing approaches has developed an organic framework to evaluate the causal impact of the returns on mutually beneficial exchanges, their technological constraints, and the institutional environment on the incentives to undertake long-distance trade and build interrelated exchange and communication networks.[1] To help fill this gap, we develop an empirical approach informed by economics theories and methods and identifying the impact of the distance from trade routes, bio-productive changes, and the rise of merchant institutions on the trade patterns prevailing over the Bronze Age in Greater Mesopotamia.[2]

Two are the stylized facts that we wish to explain. First, Greater Mesopotamia experienced between 3000 and 1500 BCE a rising complexity of exchange networks, a concomitant extension of their reach and growing levels of economic inter-dependency and regional specialization (Wilkinson, 2014: 37; Massa and Palmisano, 2018b; Kristiansen, 2018). Second, between 3000 and 1500 BCE, major technological innovations, such as the spread of metallurgy, the diffusion of precious stones, innovations in transportation technologies and the fibers revolution induced an even larger trade expansion accompanied by a series of unprecedent institutional changes (Wilkinson, 2014: 37; McCorriston, 1997; Barjamovic et al., 2019; Benati, Guerriero and Zaina, 2021; Benati and Guerriero, 2021a, b). We propose three explanation for these epochal changes, each put forward by one of the main economic theories of trade expansion (Antràs, 2015). First, because of trade costs, mutually beneficial exchanges were discouraged by distance between markets and encouraged by the relative size of commercial partners. Second, trade expanded when more suitable farming conditions in neighboring polities allowed consumption risk-sharing. Finally, trade developed when interlocking exchange circuits eased the canalization of goods from outside regions by providing more secure routes, a more certain resolution of legal disputes and easier credit provision.[3] Ordinary Least Squares—OLS—estimates based on a panel of the 44 major Greater Mesopotamian polities observed for each half-century between 3050 and 1750 BCE are consistent with these testable implications.

Our article delivers three contributions. First, we provide an empirical strategy for integrating archaeological, environmental, and historical data which does not just incrementally innovate over the existing archaeological and anthropological literatures, but fundamentally departs from the methodologies embraced by these disciplines. Second, we introduce in the related body of

[1] With "long-distance trade/exchange," we refer to the exchange of commodities among geographically distant communities through either barter or a medium of exchange.

[2] We label with "Lower" ("Upper") Mesopotamia the regions of Southern (Northern) Iraq and Southwestern Iran (Northern Israel and Syria and Southeastern Turkey), with "Greater Mesopotamia" the union of the two areas, with proto(city)-states the Late Uruk (Jemdet Nasr and Early Dynastic) period(s) and with the kingdoms (empires) era the Pre-Sargonic (Akkadian, Ur III and Old Babylonian) period(s) (Liverani, 2014: table 1.1).

[3] Although some of the structural parameters that drove trade expansion in the ancient Near East have been correctly identified (e.g., Wilkinson, 1997; Kohl, 1978), explanations of long-term/large-scale trading patterns largely rely on "zonal" theories (Lamberg-Karlovsky, 1975), "world-system" approaches (Algaze, 1993) and post-colonial models (Stein, 1999). Similar Marxist anthropological models seeing trade as socially embedded in elite behaviors have been also applied to explain intersocietal interactions (e.g., Frangipane, 2018; Adams, 2004; Peyronel, 2014).

research three explanations of the trade patterns of ancient societies, and, notably, of Bronze Age Mesopotamia, developed by a long literature on the economics of trade. Finally, we setup an agenda for interdisciplinary research grounded on the mix of the superior knowledge of the sources possessed by archaeologists and historians and the more credible theory-based empirical methodologies developed by social scientists (Smith et al., 2012; Smith, 2017).

The article is organized as follows. In section 2, we discuss the intuitions behind our three testable predictions. In section 3, we present the rationale guiding the construction of the dependent and independent variables. In section 4, we present the empirical strategy and the main estimates. In section 5, we discuss historical evidence supporting the conclusions of our analysis. In section 6, we conclude by stressing the methodological ramifications of our work.

2. Testable Predictions: Trade Potential, Risk Sharing and Merchant Institutions

To construct our predictions, we build on the three main economic theories of trade (Antràs 2015: 28-29). First, a long tradition establishes the existence of "gravity" relationships among trade interactions. To elaborate, costs created by differences in relevant traits—e.g., language, ethnicity, legal system, and cultural norms—as well as physical distance discourage mutually beneficial exchanges, especially with smaller partners (Eaton and Kortum, 2002). Then, in our specific case, polities with a higher trade potential because physically closer to major partners—and, thus, faced with lower trade costs—should trade more. Second, the literature on the international consumption risk-sharing assumption suggests that economies subject to idiosyncratic shocks—e.g., droughts, crop failure, political upheaval, warfare—trade among them to share consumption risks, i.e., to buy (sell) consumption goods from (to) neighbors spared (hit) by adverse chocks (Canova and Ravn, 1996). As a result, in our sample, the intensity of each polity's participation in inter-polity trade should positively respond to better farming conditions in neighboring polities. Finally, a long economic history tradition suggests that the rise of merchant institutions allowed rulers to commit to the security of alien merchants by strengthening their rights and, in this way, to expand trade (Greif, 1992; Greif, Milgrom and Weingast, 1994). In our historical case study, such a strategic dynamic entails that trade should expand when merchant ranks were able to establish interlocking exchange circuits providing secure routes, a more certain resolution of legal disputes and credit provision.[4]

To credibly test these predictions, we need, on the one hand, appropriate proxies for trade expansion, trade potential, the possibility of risk-sharing via trade and the diffusion of merchant institutions and, on the other hand, an appropriate empirical methodology.

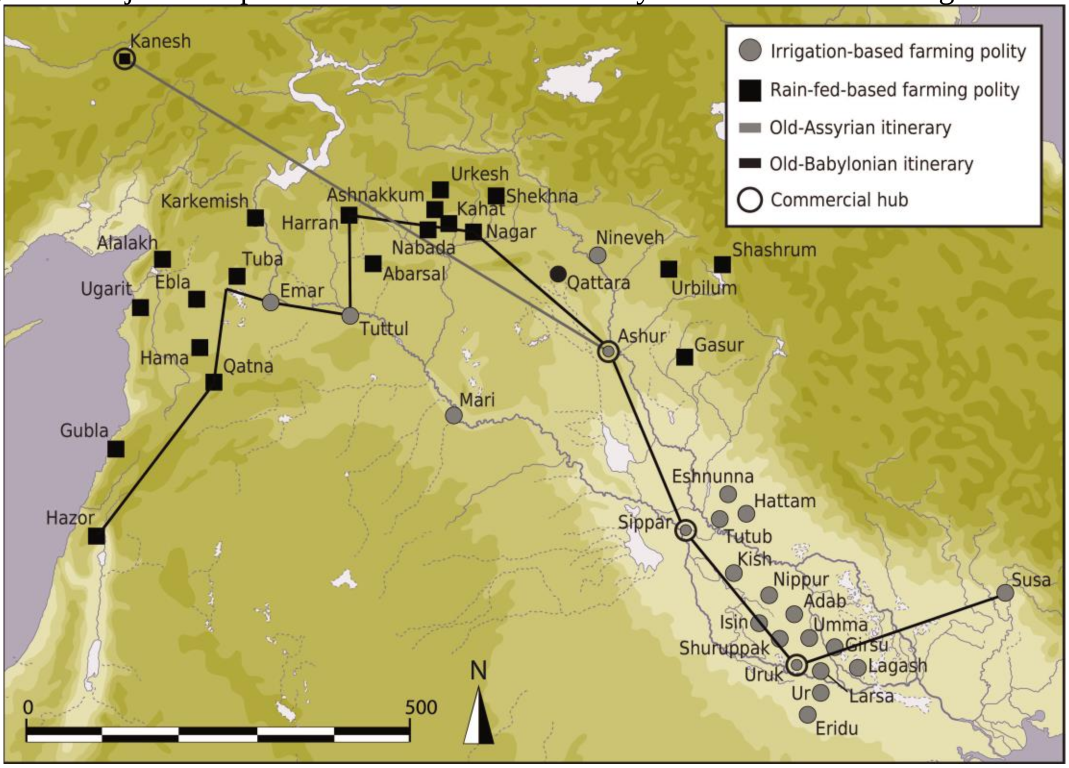
Next, we describe our measurement strategy, first, and our estimation strategy, then.

3. Data

To construct our sample, we focus on 44 major Greater Mesopotamian polities for each half-century between the Early Bronze Ages I-IV and the Middle Bronze Age I (Liverani, 2014: table 1.1), i.e., 3050-1750 BCE. The logic behind our sample selection is based on four observations.

[4] Information on third millennium merchant ranks is provided by institutional and legal records (Wilcke 2007; Benati and Bonechi, 2020; Prentice, 2010; Garfinkle 2010). In the second millennium the appearance of private archives brings additional data on shipment consignments, expenses, contracts, and legal procedures conducted by merchant groups (Barjamovic et al., 2019; Snell, 1982). A more general review of the role merchants and trade in ancient societies is provided by Hirth (2020: 194-236).

Figure 1: Major Mesopotamian Polities over the Early and Middle Bronze Age



Note: The shapes of the Old Assyrian and Old Babylonian circuits are based upon fig. 12.4 from Liverani (2014). Polities located in the "zone of uncertainty" may have practiced mixed farming (Wilkinson et al., 2014: fig. 3).

First, we have selected those sites displaying steady urban, political, and economic relevance as attested by the available information on the evolution of the settlement size, farming and trade (see table 1 and figure 1). Crucially, these polities are distributed across all the four major geo-cultural regions of Greater Mesopotamia, i.e., Anatolia, Levant, Mesopotamia, Iran.[5]

Second, the chronological limits of our sample have been set based on both the existence of sizable variation in trade expansion and the availability of relevant information. Even if inter-regional exchanges expanded at the end of the Chalcolithic era (Algaze, 1993), the written sources on their institutional determinants remain scant, and we could not include this period in our analysis (Liverani, 2014: 62-77). On the contrary, Early and Middle Bronze Ages witnessed both an unprecedent trade expansion and the production of a rich array of sources on our polities' institutional trajectory (Massa and Palmisano, 2018b: 66; Crawford, 2013: 452; Kristiansen, 2018: 87-90). Similarly, we selected as cut-off date the death of Hammurabi of Babylon in 1750 BCE (Sallaberger and Schrakamp, 2015: Table 39). This event was followed by a shrinkage of written sources in Upper Mesopotamia and by the formation of regional states obscuring the evolution of the single polities in Lower Mesopotamia (Liverani, 2014: 252-253, 271).

Third, we rely on the Ancient Near East Placemarks and the "Middle Chronology" to locate polities and events in our sample (Manning et al., 2016; Sallaberger and Schrakamp, 2015). Not only are these datasets widely accepted in the literature, but they also allow us to match more

[5] Although Near Eastern trading networks at times interlocked with "global" ones (Kristiansen, 2018), we focus on Mesopotamia due to the exceptional cluster of trade-related data and because the Greater Mesopotamian region can be treated as a coherent "interaction sphere" (Yoffee, 1993).

precisely historical to archaeological data and observe changes in trading patterns across four institutional phases, i.e., proto- and city-states, kingdoms, and empires/territorial states periods.

Table 1: The Sample

RAIN-FED-BASED FARMING: Abarsal (*Tell Khuera*),[6] Alalakh (*Tell Atchana*), Ashnakkum (*Chagar Bazar*), Ebla (*Tell Mardikh*), Gasur (*Yorgan Tepe*), Gubla (*Byblos*), Hama (*Hama*), Harran (*Harran*), Hazor (*Tell Hazor*), Kahat (*Tell Barri*), Kanesh (*Kültepe*), Karkemish (*Karkemish*), Nabada (*Tell Beydar*), Nagar (*Tell Brak*), Qatna (*Tell Mishrifeh*), Qattara (*Tell Rimah*), Shashrum (*Tell Shemshara*), Shubat-Enlil (*Tell Leilan*), Tuba (*Umm el-Marra*), Ugarit (*Ras Shamra*), Urbilum (*Erbil*), Urkesh (*Tell Mozan*). IRRIGATION-BASED FARMING: Adab (*Bismaya*), Ashur (*Qal'aat Sherqat*), Emar (*Tell Meskene*), Eridu (*Abu Shahrein*), Eshnunna (*Tell Asmar*), Girsu (*Tello*), Hattam (*Tell Agrab*), Isin (*Ishan Bahriyat*), Kish (*Tell Uhaimir*), Lagash (*Tell al-Hiba*), Larsa (*Tell Senkereh*), Mari (*Tell Hariri*), Nineveh (*Ninive*), Nippur (*Nuffar*), Shuruppak (*Fara*), Shush (*Susa*), Sippar (*Abu Habbah*), Tuttul (*Tell Bi'a*), Tutub (*Khafajah*), Umma (*Tell Jokha*), Ur (*Tell al-Muqayyar*), Uruk (*Tell al-Warka*).

Notes: 1. Ancient toponyms of the polities that constitute the cross-section identifiers are in regular lowercase type, and those of the present-day archaeological sites are in Italic lowercase font. Locations are collected from the Ancient Near East Placemarks (https://www.lingfil.uu.se/research/assyriology/earth) and displayed in figure 1.

Finally, the choice of observing each variable for any of the 44 polities every half-century between 3050 and 1750 BCE —rather than, for instance, for one-degree cell over a century—is based on two observations. First, whether dominated or independent states/kingdoms/empires, the polities in our sample evolved around one major urban site with a radius never larger than 30 km (Westenholz, 2002: 26; Liverani, 2014: 106; Palmisano, 2017a: fig. 2; Wilkinson, 2003: 125). This fact allows us to aggregate the wealth of available reconstructed climatic, soil and trade data over the well-defined, narrow, and stable boundaries defined by the Ancient Near East Placemarks. Second, a vast literature on economic history has relied on 50-year time-blocks for the analysis of the long-run co-evolution of trade expansion and institutional evolution (e.g., Acemoglu, Johnson and Robinson, 2005; Boranbay and Guerriero, 2019). This choice is made feasible by the fact that the Middle Chronology is affected by errors ranging between 8 and 30 years (Sallaberger and Schrakamp, 2015: Table 39; Manning, Barjamovic and Lorentz, 2017).

Next, we introduce both the variable that we want to explain—i.e., the dependent variable—and the variables that we use to explain it, i.e., the independent variables.

3.1 Dependent Variable

To evaluate long-distance trade in Greater Mesopotamia, Massa and Palmisano (2018a, b) focus on a selected array of objects—among which, notably, metals, ivory, lapis lazuli and balance weights—that circulated widely across the region and that, because of their durability, are accurately documented by the archaeological record. Building on a similar reasoning, Wilkinson (2014) and Quenet (2008) consider also soft and chipped stones, bitumen, pigments, shells, textiles, and wood. To construct our variable on trade expansion, we follow the same approach, and we select the seven non-perishable items that because of their non-local origins and diffusion seem to capture more faithfully the variation in far-flung exchanges. To illustrate, *Trade-Expansion* equals the number—between one and seven—of the main costly-to-obtain items archaeologically attested in the 44 polities over the preceding half-century, i.e., soft, chipped, and precious stones, ivory, shells, metals—i.e., gold, silver, copper/bronze, and lead—and balance weights (see table 2 for a summary of each variable). These durable items were

[6] The alternative physical location for the polity of Abarsal is supposed to be the site of Tell Bazi-Banat (Winters, 2019: 155-160). The conclusions of our empirical exercise do not change when we consider this alternative.

highly demanded by elites, first, and by the general population, then (Wilkinson, 2014; Massa and Palmisano, 2018b). Soft stones were used to produce decorated artifacts and containers, chipped stones were irreplaceable part of blades, and precious stones, ivory and shells were employed to craft jewelry and art pieces (Wilkinson, 2014). While bronze items during most of the Early Bronze Age were only available to the elites (Wischnewski, 2017), tin bronzes, became, from the inception of the second millennium, ubiquitous in most households (Barjamovic, 2018: 123). Finally, tradable goods were weighted through specific widgets (Massa and Palmisano, 2018b: 66). To construct *Trade-Expansion*, we have, first, recorded on-site occurrences of the selected materials and their positions within the local stratigraphy (Massa and Palmisano, 2018b: 66). This information is available from Massa and Palmisano (2018a), Quenet (2008) and the polity-specific secondary sources listed in the Internet Appendix. Next, we have harmonized local archaeological phasing through regional chrono-stratigraphic synchronizations (e.g., Lebeau, 2011, 2018; Rova, 2019; Finkbeiner et al., 2015) and we have assigned absolute dates to the sampled assemblages. Finally, we binned these observations into series of 50-year time slices across the selected time frame and for each sampled polity.

Table 2: Summary of Variables

	Variables	Definition and Sources	Summary Statistics
Trade expansion:	*Trade-Expansion*:	Number—between one and seven—of the main costly-to-obtain imported items, i.e., soft stones, chipped stones, precious stones, metals, ivory, weights, and shells. Sources: see the Internet Appendix.	2.636 (2.299)
Determinants of trade expansion:	*Trade-Potential*:	Normalized—between 0 and 1—sum of the ratios of the product of each polity's estimated settled area over the previous half-century and that of another polity in the sample to the distance between the two. Sources: see the Internet Appendix.	0.056 (0.131)
	Risk-Sharing:	Normalized—between 0 and 1—ratio of the farming return over the previous half-century in the remaining polities weighted by the inverse distance to each of them to the polity's value of farming return. Sources: see the Internet Appendix.	0.048 (0.099)
	Merchant-Institutions:	Normalized—between 0 and 1—variable equal to a) 0 if the polity did not have, over the previous half-century, any access to a trade networks; b) distance to the nearest node of the networks to which the polity belonged if it was part of at least one trade network but not a node; and c) distance to the nearest hub of the networks to which the polity belonged if it was part of at least one trade network and a node. Sources: see the Internet Appendix.	0.028 (0.112)
Control variables:	*Temperature*	Growing season temperature in Celsius, averaged over the previous 50 years. Sources: TRACE dataset at https://www.earthsystemgrid.org/project/trace.html	25.837 (1.647)
	Rainfall	Growing season large scale and convective precipitation in mm, averaged over the previous 50 years. Sources: TRACE dataset at https://www.earthsystemgrid.org/project/trace.html	5.091 (5.311)

Notes: 1. The first figure for each variable is the mean, whereas the second in brackets is the standard deviation; 2. Mean and standard deviation are calculated for the basic sample of 1,188 observations.

3.2 Independent Variables

In the following, we will illustrate our three key explanatory variables, in turn.

To capture trade potential, we rely on a naïve gravity trade model (**Antràs, 2015**), and we define the variable *Trade-Potential* as the normalized—to range between 0 and 1—sum of the ratios of the product of each polity's estimated settled area in ha over the previous half-century and that of another polity in the sample to the distance between the two (see also Barjamovic et al., [2019]).[7] Since the settled area is strongly correlated with population density and urbanization (Colantoni, 2017: 95-10; Palmisano et al., 2021: 3), *Trade-Potential* increases the more economically relevant are the trading partners and decreases with physical distance. This last feature implies that the inclusion in the sample of the peripheral sites of Kanesh and Susa and, possibly, also of the additional trade networks to which they were linked and further discussed in section 5 does not affect our estimates.

Turning to the possibility of consumption risk-sharing, we construct a proxy for the payoff from sharing with neighboring polities and via trade the risk of idiosyncratic shocks. To illustrate, we calculate the normalized—to range between 0 and 1—ratio of the average farming return over the previous half-century and the remaining polities, weighted by the inverse distance to each of them, to the polity's value of the farming return over the previous half-century, i.e., *Risk-Sharing*. To measure the farming return, we rely on a "Storie" index obtained multiplying the growing season temperature in Celsius by both the maximum among the land suitability for either wheat, barley, or olive and the large scale and convective precipitation in mm (Storie, 1978), all averaged over a surface of 30km radius around each polity. Three are the key reasons behind our choice. First, cereals were the dominant crops in Greater Mesopotamia, whereas olive oil became widely exchanged over the second millennium BCE (Paulette, 2013: 102-103). Second, botanical evidence suggests that wheat and barley (olive) farming need a temperature ranging between 5 and 38 (higher than 4) degrees Celsius, suffers from water scarcity and requires an altitude between 0 and 3050 m (Serna-Saldivar, 2010; Oteros et al., 2013). Third, considering the altitude is irrelevant in our sample since the maximum one is that of Kanesh, i.e., 1106 m. While the climatic data are simulated by the Transient Climate Evolution—i.e., TRACE—project for each of the last 22,000 years and the entire planet at a 3.75-degree spatial resolution (He, 2011), soil suitability has been estimated by the Global Agro-Ecological Zones—i.e., GAEZ—project for the entire planet at a 5 arc-minute resolution, two categories of water supply—i.e., rain-fed and irrigation—and three levels of inputs, i.e., high, medium, and low. To prevent reverse causality, we focus on the values available for the agro-climatic conditions considered by GAEZ as arguably unaffected by human intervention, i.e., low input for polities embracing rain-fed farming and middle input for irrigation farming.

Finally, to gauge the institutional relevance of merchant organizations on the expansion of long-distance trade, we focus on the rise of two interlocking circuits that organized long-distance trades in the first quarter of the second millennium, i.e., the Old Babylonian and Old Assyrian networks. We restrict our attention to these networks for a key reason. While the third millennium trade circuits were organized by institutional operators employing travelling agents that were not involved in policy making, the early second millennium trades were dominated by private entrepreneurs that were able to accumulate increasing political power and shape relevant trade policies, i.e., providing secure routes, supporting a more certain resolution of legal disputes

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[7] We have obtained the settled area by collating urbanization databases, archaeological reports and satellite imagery on walled area, distribution of pottery fragments and extension of settlement remains (see the Internet Appendix). To enhance systemization, we have gathered data across standardized cultural periods defined in absolute dates and, then, we have grouped the resulting information into 50-years bins across the sample. Although settlement sizes are provided with a variety of chronological schemes, urban data for Greater Mesopotamian show considerable robustness across the Early and Middle Bronze Ages due to the general agreement with other archaeo-demographic proxies, such as distributions of radiocarbon dates and raw site counts (see the Internet Appendix).

and expanding credit provision (Garfinkle, 2010: 187-188; Van de Mieroop, 2015: 89-92; Liverani, 2014: 163, 190, 212-218; Yoffee and Barjamovic, 2018: 816). As a consequence, our measure of the institutional relevance of merchant organizations captures only the establishment of trade institutions able to favor far-flung exchanges by shaping policy-making.

The Old Babylonian and Old Assyrian networks were structured around connecting nodes and were characterized by three aspects (see figure 1). First, almost all polities were involved in a single network by law (Barjamovic, 2013: 128). Second, the connecting nodes channeled into the system goods produced by the nearest polities not laying on the routes (Liverani, 2014: 216-217; Barjamovic, 2018: 120-125). Finally, these nodes were divided in simple transit points and full-fledged hubs in which professional merchants organized the inter-hub exchange through a *karum*, i.e., Ashur, Babylon, Larsa, Kanesh and Sippar (Barjamovic, 2018: 122-128; De Boer, 2019). Overall, we define *Merchant-Institutions* as the normalized—to range between 0 and 1—indicator equal to: a) zero if the polity did not have, over the previous half-century, any access to the Old Babylonian and/or Old Assyrian trade networks;[8] b) the distance to the nearest node of the networks to which the polity belonged if it was part of at least one network but not a node; c) the distance to the nearest hub of the networks to which the polity belonged if it was part of at least one network and a node. As a result, *Merchant-Institutions* assumes higher values when cooperating in long-distance trades was more appealing, and it distinguishes not only between polities with or without access to trade but also between polities on or off the trade itineraries.

3.3 Measurement Exercise: Discussion

A key issue in the social sciences literature on ancient societies is how to accurately measure dependent and independent variables (Ahmed and Stasavage, 2020). Ideally, we would like to observe the total revenues from long-distance exchanges, the value of the transaction costs faced by traders, the monetary returns from sharing consumption risk via trade and the number of disputes and credit contracts managed by the merchant institutions rather than *Trade-Expansion*, *Trade-Potential*, *Risk-Sharing* and *Merchant-Institutions*. Yet, provided that these proxies are sufficiently related to the underlying concepts of our interest, our empirical exercise will deliver consistent estimates (see Angrist and Pischke, [2008]).

4. Empirical Strategy and Results

A glance at figures 2 suggests that the model predictions square with our data. To illustrate, while the inverted U-shaped evolution of the trade expansion of the irrigation-based farming polities closely follows the evolution of the Lower Mesopotamia's trade potential and the establishment of the Old Babylonian trade circuit, the diffusion of long-distance exchanges in the rain-fed-based farming polities seems linked to the ability of the Upper Mesopotamian communities to share consumption-risk as well as the rise of the Old Assyrian trade network.

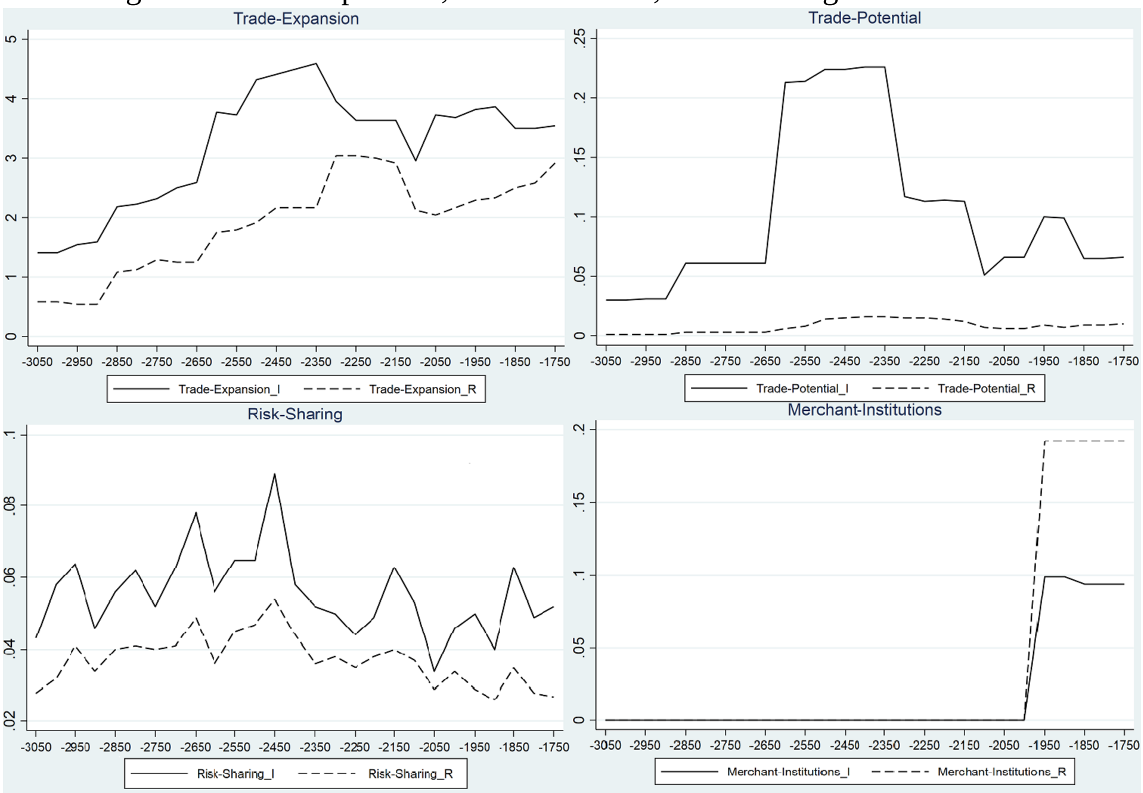
4.1 Empirical Strategy

Having discussed anecdotal evidence consistent with the model predictions, we now turn to the more formal regression analysis. To illustrate, we evaluate the effect of variation across polities and over time of one or all three proxies proposed by the three main economic theories

[8] Information on the access of the sampled polities to the Old Babylonian and the Old Assyrian trading networks is provided by itineraries reconstructed from large amounts of texts detailing the routes taken by merchants (e.g., Barjamovic, 2011; Hallo, 1964; Palmisano, 2017b).

of trade development on similarly granular variation in our trade expansion variable. For *Trade-Potential*, *Risk-Sharing* and *Merchant-Institutions*, the regression analysis returns two crucial pieces of information: an estimated coefficient and the relative *p*-value.

Figure 2: Trade Expansion, Trade Potential, Risk-Sharing and Merchant Institutions



Note: While the subscript "_I" labels the group of polities adopting irrigation-based farming, the subscript "_R" indicates the group of polities relying on rain-fed farming (see table 1 for more details on each sample). The definitions, sources, and summary statistics of each of the four variables are reported in table 2.

The coefficient measures the effect of each explanatory variable on trade expansion. While the sign of the coefficient indicates whether an increase in the relevant explanatory variable is related to a rise or a fall in long-distance trade, its magnitude clarifies how much *Trade-Expansion* changes because of a unitary change in the dependent variable. Crucially, in a large dataset, variables could be related to each other by chance. Accordingly, the information coming from the *p*-value is key. This figure represents the probability of observing a distribution of data producing a coefficient even more different from zero. If these odds are lower than the confidence level 1%, which is indicated with three asterisks in the table, there is low chance, according to the social sciences standards, that a coefficient equal to zero has spurred the observed variation. As a result, our reduction ad absurdum allows us to reject at the confidence level of 1% that the coefficient is null and, thus, that its estimate is simply due to chance. We label with two and one asterisk, respectively, the two less stringent confidence levels of 5% and 10%. To avoid, that our estimates are driven by the impact of unobserved relevant determinants of trade expansion correlated with the three independent variables, we also consider the effect of polity and half-century fixed effects as well as those of the growing season temperature and the growing season large scale and convective precipitation, both averaged over the previous half-century and indicated, respectively, by *Temperature* and *Rainfall*. While including these last two variables assures that *Risk-Sharing* is not indirectly picking a direct effect of climate on trade development, evaluating the first two indicators avoids, instead, that the economic and institutional determinants of trade expansion are capturing the effect of unobserved polity-specific and time-invariant or time-specific and polity-invariant forces.[9]

4.2 Main Empirical Results

Table 3 displays the basic OLS estimates, which are consistent with each and all our testable predictions. Focusing on the more credible specification considering all explanatory variables at the same time (column (3) of table 3), the coefficients attached to *Trade-Potential*, *Risk-Sharing* and *Merchant-Institutions* are all significant at the 10% or better, positive, and large.

To elaborate on the last point, because of the normalization of the independent variables, it is straightforward to see that a rise in *Trade-Potential* from its minimum—0—to its maximum—i.e., 1—induces an increase in *Trade-Expansion* of almost five items out of the possible seven.

Table 3: Economic and Institutional Determinants of Trade Expansion in Bronze Age Mesopotamia

	(1)	(2)	(3)	(4)
	The dependent variable is: *Trade-Expansion*			
Trade-Potential	4.639 (0.815)***			4.540 (0.823)***
Risk-Sharing		3.621 (1.235)***		3.825 (1.249)***
Merchant-Institutions			2.342 (1.208)*	1.900 (1.171)*
Estimation	OLS			
Number of Observations	1,188	1,188	1,188	1,188
Within R^2	0.28	0.24	0.25	0.30

Notes: 1. Standard errors in parentheses; 2. *** denotes significant at the 1% confidence level; **, 5%; *, 10%; 3. All specifications include polity and half-century fixed effects, *Temperature* and *Rainfall*.

Similarly, an increase in *Risk-Sharing* from 0 to 1 entails a rise in *Trade-Expansion* of almost four items, whereas a similar rise in *Merchant-Institutions* produces an increase in *Trade-Expansion* of almost two items.

4.3. Discussion: Credibility of the Estimates

Ascertained that neither unobserved heterogeneity nor reverse causation seems to be a relevant issue for the consistency of our estimates (see also footnote 9), a remaining issue is whether data gaps and the heterogeneous quality of the available primary sources might bias our results. In our case, the key dimension of measurement error is that observations on the

[9] Results, available upon request, suggest that our analysis remains unaffected when we also consider the severity of external and internal conflicts or when we also include our independent variables lead one time period. The fact that these lead values are insignificant also excludes reverse causation (Angrist and Pischke, 2008).

beginning of third millennium are obtained from deep stratigraphic soundings and not from the more reliable extensive excavations and modern surveys that have produced the data on the rest of the sample (Matthews, 2004: 12-15, 159, 163; Banning, 2002; Wilkinson 2003: 33-43).[10] The fact, however, that this asymmetry in the quality of the data uniformly affects the entire sample greatly limits its dangerousness. To elaborate, since time fixed effects capture half-century-specific shocks common to the entire sample, measurement errors assume a "classical" form, i.e., they are independent of all the true variables that are the objects of interest. This remark has two key consequences (Angrist and Pischke, 2008). First, errors in the measurement of the dependent variable do not affect the magnitude of the coefficients attached to the independent variables but inflate their standard errors decreasing, in this way, their statistical significance. Second, measurement errors in the independent variables decrease the relative coefficients making our estimates a lower bound of the true impact of the economic and institutional determinants of trade expansion. Together the two effects do not affect the message of our empirical analysis.

5. Trade Expansion in Bronze Age Mesopotamia: Stylized Facts

Next, we identify several stylized chrono-spatial patterns for the evolution of trade between the fourth, third and second millennium, which are consonant with the roles of trade potential [a], risk-sharing [b], and merchant institutions [c] documented by our empirical test.

5.1 Urban revolution and Proto-states period (3800-3100 BCE)

Even if farming was relatively advanced, proto-states lacked valuable inputs, such as stones, metals and construction materials (Kristiansen, 2018: 87; Algaze, 2008: 93-99, 150). Hence, during the fourth millennium BCE, long-distance trades between Mesopotamian cores and resources-rich neighboring regions were seemingly fueled by the elites' demand for non-locally available goods [a] [Algaze, 2008: 150, 156]. These exchanges shrunk in the aftermath of the collapse of the "Uruk trading network", around 3200 BCE (Crawford, 2013: 451-452).

Discussion.—Albeit not analyzed in our empirical exercise, these patterns are consonant with the positive but limited levels of *Trade-Expansion* and *Trade-Potential* that we measure at the beginning of our sample (see figure 2).

5.2 City-states period (3100—2500 BCE)

The arid conditions experienced by the entire region at the onset of the third millennium caused Upper Mesopotamia to revert to subsistence farming (Ristvet, 2017: 38-40), with significant trading attested only in the port town of Gubla (Massa and Palmisano, 2018b: 70, 77, 82), and interrupt the connection with Lower Mesopotamia (Ristvet, 2017: 40) [b]. There, the decreased farming returns kept trading potential low, as attested by the limited trading activities organized with the Gulf regions by polities such as Girsu, Shuruppak, Tutub, Ur and Uruk (Crawford, 2013: 452; Ristvet, 2017: 38) [b]. The post-2800 BCE improved climate conditions increased yields, triggered urbanization throughout Mesopotamia, and revitalized north-south connections, as attested by the spread of metal items (Palmisano and Massa, 2018b: 81) [a, b]. To sustain the unprecedented urbanization and face fierce high climate variability, the Northern polities started to import an increasing amount of farming output from the more stable South [b]

[10] Another source of noise in our estimates might be the asymmetry in the methodologies adopted for each archaeological site and reflecting, in turn, the different periods in which they were applied. Nevertheless, "several studies have shown broad agreement in the demographic trends produced by the SPD of radiocarbon dates and other archaeological indices (e.g. raw site count, estimated settlement size)" (Palmisano et al. 2021: 4).

(Wilkinson, 1997: 67, 92-93, 100). Meanwhile, the irrigation-based Southern polities enjoyed higher yields and more limited climate variability. Empowered by the more favorable conditions, the elites of these polities started to exchange with neighboring polities part of the harvest for metals and precious materials [a]. As a result, the opposite needs of the Northern and Southern polities led to the re-opening of the Euphrates and Gulf trade routes [a, b] (Crawford, 2013: 454, 458; Massa and Palmisano, 2018b: 81-82; Edens, 1992: 127).[11] By 2500 BCE, Adab, Ashur, Eshnunna, Girsu, Hattam, Lagash, Kish, Nippur, Tutub, Umma, Ur and Uruk became the main Southern trade nodes, whereas Ebla, Kanesh and Nabada gained an edge in the North.

Discussion.—These facts are consistent with the rising consumption risk-sharing needs faced by both the irrigation-based and rainfed farming polities as well as the spike in *Trade-Potential* driven, especially in the South, by the unprecedent urbanization (see figure 2).

5.3 Kingdoms period (2500—2350 BCE)

In Upper Mesopotamia, trade remained stable up to the emergence, around 2400 BCE, of the "Ebla network," a trading system conveying metals, timber and olive oil from Anatolia and the Levant downstream to the South (Benati and Bonechi, 2020; Massa and Palmisano, 2018b: 81-82). This discontinuity was eased by the post-2500 BCE drying up, which magnified the need of sharing consumption risk in a region which had just experienced a "second urbanization" wave [b] (Riehl et al., 2014: 12351; Wilkinson, 1997: 67, 92-93). Although most scholars agree that these interactions consisted of exchanges of low-bulk/high-value items mainly organized by palatial institutions (Massa and Palmisano, 2018b: 80; Crawford, 2013), records from the Ebla archives suggests the emergence, at least in Upper Mesopotamia, of a stable cooperation between palaces and private traders in the exchange of substantial volumes of commodities [a] (Winters, 2019; Benati and Bonechi, 2020). To further illustrate, the Syrian long-distance trades were both regulated by political treaties and supported by institutional infrastructures such as specialized merchant settlements, affiliated markets, and armed escorts [a] (Bonechi, 2016).

Discussion.—Consonant with these facts, the Kingdoms period witnessed both the largest values of *Trade-Potential* and *Risk-Sharing* and the most intense trade expansion (see figure 2).

5.4 Empires period (2350—2000 BCE)

The evolution of Lower and Upper Mesopotamia diverged because of the variegated climate and political conditions (Riehl et al., 2014: 12351). Lower Mesopotamia experienced increasingly harsher farming conditions, internal warfare, and a consequent fall in the levels of trade, exemplified by the reported scarcity of bronze items during the Akkadian period (Crawford, 2013: 455). Next, during the "Gutian" spell (2150-2100 BCE), further political conflicts and droughts caused the desertion of the trading routes (Riehl, 2014: 10; Frayne, 1993: 285). Finally, a transitory improvement of climatic conditions induced, under the Ur III empire (ca 2100 BCE), the revival of trade and, notably, a sharp rise in grain exports towards the Gulf [a, b] (Laursen and Steinkeller, 2017: 59; Crawford, 2013: 457; Edens, 1992: 127). Meanwhile, in the North, the mix of the population's need of sharing the consumption risk created by the

[11] Although the high costs related to overland transport of bulk commodities have been often cited as a deterrent for long-distance trade in comestibles (e.g. Steinkeller and Laursen, 2017: 59, n. 66), both literary and administrative records provide overwhelming evidence of the fact that the Southern polities exported to neighboring regions – either overland or by water – barley, textiles, dried fruits, oils and dried/salted fish in exchange for precious stones, metals, and other exotic goods (Crawford, 1973; Kohl, 1978; Postgate, 1992: 210-211; Steinkeller, 2018: 182-183; Zaccagnini, 1993; Edens, 1992: 127; Laursen and Steinkeller, 2017: 6-7, 59).

rising climatic volatility and the Akkadian kings' pull towards the resource-rich northeast induced, between 2350 and 2150 BCE, an unprecedented trade expansion [a, b] (Crawford, 2013: 456). The acceleration of trade was followed by a sharp decline favored by the mix of deurbanization and loss of political importance (Weiss, 2016; Massa and Palmisano, 2018b: 82).

Discussion.—These patterns match the fall in *Trade-Potential*, *Risk-Sharing* and, in turn, *Trade-Expansion* experienced by Greater Mesopotamia over the imperial period (see figure 2).

5.5 Trade revolution and territorial states period (2000—1750 BCE)

The transition from the third to the second millennium BCE witnessed, first, a decline of long-distance exchanges and, then, a revival due the combination of two key factors (Massa and Palmisano, 2018b: 82). First, Lower Mesopotamia enjoyed slightly improved farming conditions, which increased its trading potential [a], whereas the rain-fed regions of Upper Mesopotamia had to rely even more on risk-sharing strategies because of the severe droughts [b] (Riehl et al., 2014: 12351). Second, the diffusion of tin-bronze and the growing importance of silver dramatically increased the demand for the metals coming from mineral-rich peripheral regions [a] (Crawford, 2013: 459; Barjamovic, 2018: 122-123; Massa and Palmisano, 2018b: fig. 15). As a result, the Amorite kings attracted by the large gains from long-distance trade incentivized exchange in polities with a larger trade potential by empowering their merchant groups [c]. For instance, in Ashur, exchange was facilitated through the reduction of trade taxes, the ratification of exchange agreements with neighboring polities, the formalization of trade contracts, and the assignment to the City Hall of a crucial supervision role (Dercksen, 2014: 66-67). Together, these three factors contributed to reconfigure interregional exchanges into two major interlocking circuits: The Old Assyrian and the Old Babylonian trade networks [c] (see figure 1).

The Old Assyrian trade network linked merchants in Ashur to their representatives in Kanesh, which, in turn, tapped into a commercial network extending throughout Anatolia (Barjamovic, 2018: 128; Palmisano, 2018). Texts from Sippar, moreover, indicate that the Old Babylonian network linked Ashur to Sippar, Uruk and Susa towards the East and Hazor towards the West (Barjamovic, 2018: 125; De Boer, 2019). To illustrate, Sippar operated as hub for both the routes that brought tin across the Zagros and down along the Diyala River and the itineraries that shipped copper from Dilmun along the Euphrates River through Mari into Syria (Barjamovic, 2018: 125). These exchanges were organized by communities of private traders who relied upon free agents and foreign commercial settlements [c] (Barjamovic, 2018: 124-125). Moreover, each hub could count on a *karum*-organization, which represented both a merchant guild and a chamber of affairs regulating trade-related contracts and credit provision [c] (Palmisano, 2018: 22). Crucially, the *karum* cooperated with the institutionalized decision-makers—i.e., temples and palaces—in the provision of public goods supporting trade and assured, in this way, a rising political and legal power to the merchant ranks (Yoffee and Barjamovic, 2018: 816) [c]. In Ashur, Emar, Tuttul and Sippar, the same individuals acted as commercial agents, financial intermediaries, and oligarchs [c] (Yoffee and Barjamovic, 2018: 817-818). As a result of such institutional discontinuities, the 2000-1750 BCE period in our sample displays a revived trade expansion. Only the accession to the Babylonian throne of Hammurabi, who unified Lower Mesopotamia in 1755 BCE and favored the "palace [at] the expenses of the private sector" [c] (Liverani, 2014: 242), blocked these dynamics.

Discussion.—These stylized facts are summarized in figure 2 by the sharp acceleration of *Merchant-Institutions* followed by a resurgence of *Trade-Potential*, despite the substantial stability of both *Trade-Expansion* and *Risk-Sharing*, over the 2000-1750 BCE period.

6. Conclusions

Archaeologists have long recognized the pivotal role of long-distance trade in the rise of the first urban, state and "global" cultures (Peyronel, 2018; Wilkinson, Sherratt and Bennet, 2011; Jennings, 2011; Algaze, 2008: 155-157). Yet, the determinants of trade expansion remain relatively ill-understood in the archaeological literature, to the extent that narratives that oversimplify, or misinterpret, causal mechanics have spread out (e.g. Algaze, 2008: 93; Chew and Sarabia, 2016). To help tackle this issue, we have developed an economics theory-driven empirical approach emphasizing the impact of each polity's trade potential, consumption risk-sharing needs and access to merchant institutions on the expansion of its trading activities. Over and above providing innovative explanations for the evolution of trade in the first state-level societies in human history, the framework that we propose can be fruitfully used in other environments to integrate and analyze archaeological, historical, landscape, and biological data.

We close by stressing three key avenues for future research. First, to further reduce measurement error, more detailed proxies for trade expansion, trade potential, the need of consumption risk-sharing and the activity of merchant institutions should be devised. To this end, archaeometric characterizations and provenance analyses of archaeological materials as well as textual records and a more systematic integration of paleoenvironmental data would be useful (e.g., Kennedy Thornton, 2011; Henderson, Ma and Evans, 2020; Barjamovic et al., 2019; Izdbeski et al., 2020). Second, to improve the credibility of statistical inference, future studies should evaluate more systematically the spatial correlation among observations through spatial, and notably network, econometrics techniques (Verhagen, 2017; Gillings, Hacıgüzeller, and Lock, 2020; Paula, 2020). Finally, our approach can be usefully extended to explore the causal mechanics of the coupled human and natural systems evolution of pre-modern societies (Benati and Guerriero, 2021a, b; Ferraro, Sanchirico and Smith, 2019).

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G. Benati: Conceptualization, Data curation, Investigation, Writing - Original draft. C. Guerriero: Conceptualization, Methodology, Formal analysis, Writing – Original draft, Visualization; F. Zaina: Investigation, Writing – Review & Editing, Visualization.

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