Did long distance-trade trigger Smithian growth in the Roman world? A comparative quantitative approach

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Introduction

Did long-distance trade in the Roman world operate on a scale sufficient to increase the overall size of markets in certain goods or commodities, enabling specialization and division of labor, and thus Smithian growth?

This work fits this strand of literature by studying **the impact of long-distance trade** on the **economic growth** of the Roman world, **applying a comparative quantitative approach**.

Economist and historians questioned about economic growth models in pre-industrial societies. Among the most important: Erdkamp (2020, 2016), Temin (2013), Scheidel (2009), Chilosi et al. (2013), Sylos Labini (1984), Finley (1973).
From a quantitative perspective: Scheidel and Frisien (2009), Maddison (2007), Milanovic (2007), Temin (2006), Goldsmith (1984)

Malthus vs Smith

Currently, the dominant theory on economic growth in Roman times is the **Malthusian model**, which assumes that economic growth will be halted by population growth in the long run. The Malthusian model is based on the postulate that the total supply of land is rigid, even if there is no unanimity regarding the direction of causality between population growth and agricultural production (Boserup, 1965). Same conclusion: **the pressure of the population pushes the farmers to intensify the labor factor to increase production**. (Clark 2007, Hansen and Prescott 2002, Allen 2003, Ashraf and Galor 2011, Voightländer and Voth 2013, Persson 2008).

Malthus vs Smith (2)

On the other hand, the **Adam Smith's "optimistic" view** about economic growth pattern is illustrated in the well know book *The Wealth of Nations* (1776).
The specialization can generate substantial increases in labor productivity, and that specialization is stimulated by increases in the size of domestic markets or the amount of trade.

"That the Division of Labour is Limited by the Extent of the Market"

For deeper discussions: Ortman and Lobo (2020), Erdkamp (2015), Valli (2005), Grantham (1993, 1999), Sylos Labini (1984).

Trade and Smithian growth

1) Trade activity improves the expansion and the integration of the markets, leading to productivity gains. (Ortmon and Lobo 2020, Valli 2005, Sylos Labini 1984)
2) The productivity gains in agriculture incentives the development of non-agricultural sectors, which in turn reduces hidden unemployment in the agricultural ones pushing to even higher productivity. (Erdkamp 2020, 2016, Grantham 1993, 1999, Lewis 1954)
3) The role of merchant activities affects the development of infrastructures - such as harbours - capable of mitigating uncertainty and transaction costs. This increases the trade activities (North 1989, 1991) .

How important was the long-distance trade in the Roman economy?

The main source of income for the Roman economy was land ownership.

However, in more recent times, many evidence (such as Ancient literary sources, Shipwreck, Institutional framework, Harbor infrastructures, Elite classes' investments, Financial capital and credit market, Technology and environmental conditions) suggests that **the merchants activity in the Roman world was an important and spread business**.

Ancient sources

Petronius mentions in the *Satyricon* (101) *Lichas* as a single owner and captain of a large ship, but adds that Lichas also owned several estates and many slaves engaged in business, stressing the diverse nature of Lichas' portfolio.
Lucian's Isis (*Navigum* 5), Hiero's Syracysia (*Atheaues* 5.40-54; Duncan Jones 1977; MacIntosh Turfa and Steinmeayer 1999) or Caligula's obelisk ship.

Shipwrecks findings

The recent archaeological findings about shipwrecks in the Mediterranean Sea are probably the most important evidence about Roman trade, but representing at the same time the heart of the debate about this topic.
Firstly, wrecks sites are usually located trough the great heaps of amphorae, implying that larger wrecks have a far better chance of being noted by drivers.
Secondly, the shipwrecks graph is partly a graph of amphora usage.

(Pomey and Tchernia 1978, Broekaert and Zuiderhoek 2020, Parker 2008, Wilson 2009)

Shipwrecks findings (2)

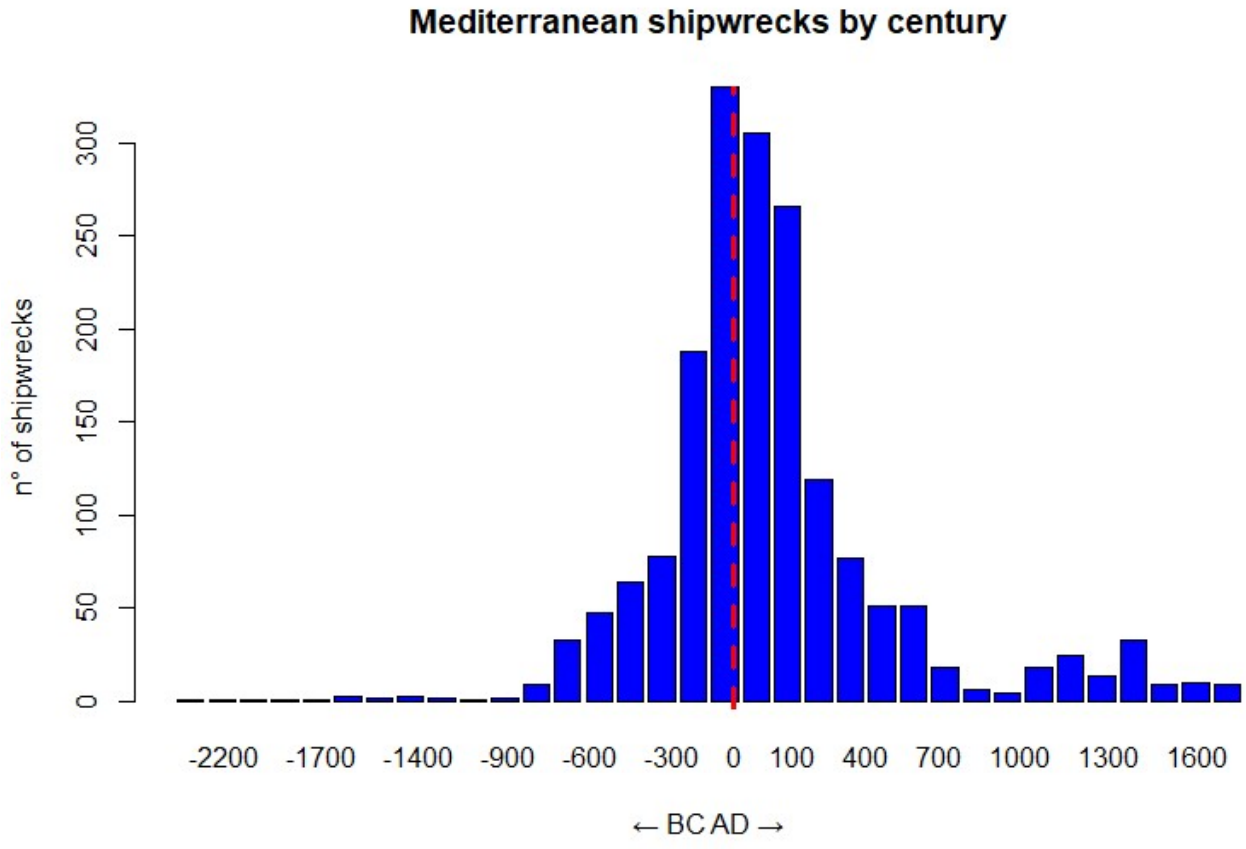

Figure 1: Oxford Roman Economy Project – own elaboration (28/09/2020).

Institutional framework

In the 218 B.C. the *plebiscitum Claudianum* forbidden senators and their sons to own a sea-going vessel of more than 24 tonnages.
During the reign of *Claudius* shippers gained special privileges for a ship of approximately 65 tonnages, while during the reign of *Traianus*, for a single ship of 330 tonnages or several ships of 65 tonnages.

Harbor infrastructures

The improvement of Rome's harbor facilities under the reign of *Claudius* and the building of the harbor of *Portus* (Ostia) under *Traianus* are proofs of the important role played by trade in the Roman economy.
The development of port infrastructures mitigates uncertainty and transaction costs, increasing trade activities.
The institutional framework should have encouraged the construction of larger ship (Wilson, 2009).

"Portus was the largest artificial harbour structure of the Mediterranean and could probably host some five hundred ships in its basins, and crucially, it had c. 13,900 m of wharfage space." (Schörle, 2011)

Financial capital and credit market

Verboven (2020) states that Roman credit markets provide maritime loans *faenus nauticus* to overseas merchants. The famous Muziris papyri indicates the presence of a bottomry loan for a ship returning from India with a cargo valued at around seven million sesterces. Malmendier (2009) contrary to widespread belief argues that the earliest predecessor of the modern business corporation was not the English East India Company nor the medieval *commenda*, but the Roman *societas publicanorum*.

Relevance of long-distance trade by sea in the Roman world: a quantitative approach for "convergences"

	Population (Income earners)	Tot. population (families)*	Per-capita income (sestertii)	Aggregate income per class per year (millions of sestertii)
Emperor	1	3	15,000,000	15 (0.09%)
Senators	600	1,629	150,000	90 (0.5%)
Knights	40,000	108,587	30,000	1,200 (7%)
Decurions	240,000	651,519	8,333	2,000 (12%)
"Other"	50,000	135,733	22,024	1,101 (6.6%)
Total elite	**330,601 (2%)**	**897,471 (2%)**		**4,406 (26%)**
Free workforce	14,220,000	38,602,529	790	11,234 (67%)
Enslaved	3,600,000	4,500,000	300	1,080 (6.5%)
Total non-elite	**17,820,000 (98%)**	**43,102,529 (98%)**		**12,314 (74%)**
Total	**18,150,601 (100%)**	**44,000,000 (100%)**	**380 (subsistence level)**	**16,720,000,000 (100%)**

Figure 2: population and income shares in the Roman Empire (14 A.D.). Source: Maddison (2007).

Relevance of long-distance trade by sea in the Roman world: a quantitative approach for "convergences" (2)

To quantify the total income share held by long-distance trade by sea, we applied a methodology based on a **two-step procedure**: The first one concerning the estimation of the merchant's per-capita income and the second one the estimation of population of the long-distance traders.

Step 1: we exploit the similarity between income distribution in the Roman era and in England and Wales in the late 17th century to estimate, by analogy, the hypothetical per-capita income of the Roman long-distance traders.

Step 2: In order to estimate the total population of long-distance trade class in the Roman world we exploit three different data sources.

The Model

Step 1

England and Wales 1688

$$\frac{r_T}{w_{MW}} = \beta_4 \qquad \frac{r_B}{w_{MW}} = \beta_5 \qquad \frac{w_{LDT}}{w_{MW}} = \beta_6 \tag{1}$$

Roman Empire 14 A.D.

$$\frac{r_S}{w_{FW}} = \beta_1 \qquad \frac{r_K}{w_{FW}} = \beta_2 \qquad \frac{x}{w_{FW}} = \beta_3 \tag{2}$$

Estimations

$$w_{opt} = \left(\frac{\beta_1\beta_6}{\beta_4}\right) w_{FW} \qquad w_{pes} = \left(\frac{\beta_2\beta_6}{\beta_5}\right) w_{FW} \tag{3}$$

Optimistic: 9,900 sestertii

Pessimistic: 8,000 sestertii

Sources: Maddison (2007), Lindert and Williamson (1982)

The Model: cost-side approach

Step 2

$$\begin{cases} C_{t1} = \frac{c_1 + c_{24}}{2} \\ C_{t2} = \frac{c_{25} + c_{74}}{2} \\ C_{t3} = \frac{c_{75} + c_{149}}{2} \\ C_{t4} = \frac{c_{150} + c_{199}}{2} \\ C_{t5} = \frac{c_{200} + c_{324}}{2} \\ C_{t6} = \frac{c_{325} + c_{400}}{2} \end{cases}$$

$$s.t$$

$$\begin{aligned} 10_{years} \quad \forall \quad C_{t1} \geq C \geq C_{t3} \\ 20_{years} \quad \forall \quad C_{t3} \geq C \geq C_{t6} (4) \end{aligned}$$

Source: French (1991), Broekaert and Zuiderhoek (2020)

The Model: cost-side approach (2)

Trader's Budget constraint

$$[(w_i - b_s)n_m]t_i \geq C_{ti} \tag{5}$$

$$\text{if } n_m > 3$$

$$I_E + [(w_i - b_s)n_m]t_i \geq C_{ti} \tag{6}$$

Sources: Goldsmith (1984), Maddison (2007), Krueger (2014)

The Model: cost-side approach (3)

Tonnage range	Total cost of single ship for years lifetime (sestertii)		Minimum number of owners required (optimistic scenario)	Minimum number of owners required (pessimistic scenario)	Share of the ship owned by merchants in optimistic scenario (%)	Share of the ship owned by merchants in pessimistic scenario (%)
	10 years					
$1 \leq t < 25$		49,114	0.6	0.7	100	100
$25 \leq t < 75$	115,609	172,745	1.6	2.2	100	100
$75 \leq t < 150$	220,186	286,021	2.9	3.8	100	79
	20 years					
$150 \leq t < 200$	488,486	584,374	3	4	100	74
$200 \leq t < 325$	583,392	792,545	3.9	5.2	77	58
$325 \leq t < 400$	869,068	1,002,727	5.3	7.1	57	43

Figure 3: Summary of capital investment and operating costs at ten- and twenty-years' lifetime. Source: Broekaert and Zuiderhoek (2020).

The Model: shipwrecks based estimation

Mediterranean ships distribution $\begin{cases} s_1 = S_{tot} N_{d1} \\ s_2 = S_{tot} N_{d2} \\ s_3 = S_{tot} N_{d3} \\ s_4 = S_{tot} N_{d4} \\ s_5 = S_{tot} N_{d5} \\ s_6 = S_{tot} N_{d6} \end{cases}$

with

$$1 \leq s_1, s_2, s_3 < 150$$
$$150 \leq s_4, s_5, s_6 < 400$$

to

$$s_1 + s_2 + s_3 = S_{t10}$$
$$s_4 + s_5 + s_6 = S_{t20} \quad (7)$$

Source: Poll (1996)

The Model: shipwrecks based estimation (2)

$$MS_{tot} = 2\left(\frac{S_{t10}\frac{1}{\alpha_1}}{t_1}\right) + \left(\frac{S_{t20}\frac{1}{\alpha_2}}{t_2}\right) \tag{8}$$

Assumption 1: at the end of each ship life cycle all ships were disused.
Assumption 2: the probability of sinking is constant for each life cycle of ship.

Sources: Tenenti (1959), Archivio storico del comune di Genova, Archivio di Stato di Genova.

The Model: shipwrecks based estimation (3)

$$\sum C_{ti} N_{di} MS_{tot} = \sum I_E + [(w_i - b_s) n_m] t_i N_{di} MS_{tot} \tag{9}$$

$$(r_s N_s + r_k N_k + r_d N_d + r_o N_o) - b_s \sum N = \sum [C_{ti} - (w_i - b_s) n_m t_i] N_{di} MS_{tot} \tag{10}$$

$$T_{tot} = \frac{\sum (C_{ti} - I_E) N_{di} MS_{tot}}{w_i - b_s} \tag{11}$$

The Model: shipwrecks based estimation (4)

(n=125)	Long-distance trade class population (members)	Share of merchants' investment in long-distance trade (%)	Share of elites' investment in total long-distance trade (%)	Share of total elites' income spent in long-distance trade (%)	Share of total long-distance trade income in Roman GDP
Optimistic scenario	2,747	87%	13%	0.1	0.16
Pessimistic scenario	3,041	72%	28%	0.2	0.14

Figure 4: Summary of estimations based on shipwrecks.

The Model:
England and Wales 1688 comparative estimation.

England and Wales 1688: 4.5 % of total GDP in long-distance trade activities.

$$MS_{EW} = \frac{\alpha_{4.5}}{\sum C_{ti} N_{di}} \tag{12}$$

Source: Lindert and Williamson (1982)

The Model:
England and Wales 1688 comparative estimation (2)

(n=3,354)	Long-distance trade class population (members)	Share of merchants' investment in long-distance trade (%)	Share of elites' investment in total long-distance trade (%)	Share of total elites' income spent in long-distance trade (%)	Share of total long-distance trade income in Roman GDP
Optimistic scenario	73,870	89	11	2.5	4.5
Pessimistic scenario	61,123	74	26	5.5	4.5

Figure 5: income distribution of long-trade activity using England and Wales 1688 comparison.

The Model: China 1880 comparative estimation.

(n=754)	Long-distance trade class population (members)	Share of merchants' investment in long-distance trade (%)	Share of elites' investment in total long-distance trade (%)	Share of total elites' income spent in long-distance trade (%)	Share of total long-distance trade income in Roman GDP (%)
Optimistic scenario	16,408	87	13	0.6	1
Pessimistic scenario	13,577	76	24	1	1

Figure 6: income distribution of long-trade activity using China 1880 comparison.

Source: Milanovic (2007)

The Model: Harbors based estimation.

(n=1,469)	Long-distance trade class population (members)	Share of merchants' investment in long-distance trade (%)	Share of elites' investment in total long-distance trade (%)	Share of total elites' income spent in long-distance trade (%)	Share of total long-distance trade income in Roman GDP (%)
Optimistic scenario	32,354	87	13	1.1	1.9
Pessimistic scenario	26,771	72	28	2.4	1.2

Figure 7: Income distribution of long-trade activity using Harbors based estimation. We assume a ratio ships/hectare= 2.14.

Source: Schörle (2011)

Comparative estimations

		Long-distance trade class population (members)	Share of merchants' investment in long-distance trade (%)	Share of elites' investment in total long-distance trade (%)	Share of total elites' income spent in long-distance trade (%)	Share of total long-distance trade income in Roman GDP
Shipwrecks (n=125)	**Optimistic scenario**	2,747	87	13	0.1	0.16
	Pessimistic scenario	3,041	72	28	0.2	0.14
England and Wales 1688 (n=3,354)	**Optimistic scenario**	73,870	89	11	2.5	4.5
	Pessimistic scenario	61,123	74	26	5.5	4.5
China 1880 (n=745)	**Optimistic scenario**	16,408	87	13	0.6	1
	Pessimistic scenario	13,577	76	24	1	1
Roman harbors (n=1,469)	**Optimistic scenario**	32,354	87	13	1.1	1.9
	Pessimistic scenario	26,771	72	28	2.4	1.2

Figure 8: Comparative estimations.

Conclusions

We have to reject the idea that trade was a marginal economic activity in the Roman world.
However, high levels of trade activity as experienced in early modern England, are neither very probable. The most plausible scenario is a society with good level of development in trade activities, which has nothing less to society of later periods.
To summarise, we cannot exclude that Smithian growth took place in the Roman world.

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