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

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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.


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).
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”

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.
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.
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 through 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.

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.
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)
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"

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

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

\[
\frac{r_T}{w_{MW}} = \beta_4 \quad \frac{r_B}{w_{MW}} = \beta_5 \quad \frac{w_{LD T}}{w_{MW}} = \beta_6
\]  

(1)

Roman Empire 14 A.D.

\[
\frac{r_S}{w_{FW}} = \beta_1 \quad \frac{r_K}{w_{FW}} = \beta_2 \quad \frac{x}{w_{FW}} = \beta_3
\]  

(2)

Estimations

\[
w_{opt} = \left( \frac{\beta_1 \beta_6}{\beta_4} \right) w_{FW} \quad w_{pes} = \left( \frac{\beta_2 \beta_6}{\beta_5} \right) w_{FW}
\]  

(3)

Optimistic: 9,900 sestertii

Pessimistic: 8,000 sestertii

Sources: Maddison (2007), Lindert and Williamson (1982)
The Model: cost-side approach

Step 2

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

s.t.

10_{\text{years}} \quad \forall \quad C_{t1} \geq C \geq C_{t3}

20_{\text{years}} \quad \forall \quad C_{t3} \geq C \geq C_{t6}(4)

Source: French (1991), Broekaert and Zuiderhoek (2020)
The Model: cost-side approach (2)

Trader’s Budget constraint

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

if \(n_m > 3\)

\[
l_E + [(w_i - b_s)n_m]t_i \geq C_{ti}
\]

Sources: Goldsmith (1984), Maddison (2007), Krueger (2014)
### The Model: cost-side approach (3)

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

<table>
<thead>
<tr>
<th>Tonnage range</th>
<th>Total cost of single ship for years lifetime (sestertii)</th>
<th>Minimum number of owners required (optimistic scenario)</th>
<th>Minimum number of owners required (pessimistic scenario)</th>
<th>Share of the ship owned by merchant in optimistic scenario (%)</th>
<th>Share of the ship owned by merchants in pessimistic scenario (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1 \leq t &lt; 25$</td>
<td>49,114</td>
<td>0.6</td>
<td>0.7</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>$25 \leq t &lt; 75$</td>
<td>115,609</td>
<td>1.6</td>
<td>2.2</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>$75 \leq t &lt; 150$</td>
<td>220,186</td>
<td>2.9</td>
<td>3.8</td>
<td>100</td>
<td>79</td>
</tr>
<tr>
<td>20 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$150 \leq t &lt; 200$</td>
<td>488,486</td>
<td>3</td>
<td>4</td>
<td>100</td>
<td>74</td>
</tr>
<tr>
<td>$200 \leq t &lt; 325$</td>
<td>583,392</td>
<td>3.9</td>
<td>5.2</td>
<td>77</td>
<td>58</td>
</tr>
<tr>
<td>$325 \leq t &lt; 400$</td>
<td>869,068</td>
<td>5.3</td>
<td>7.1</td>
<td>57</td>
<td>43</td>
</tr>
</tbody>
</table>
The Model: shipwrecks based estimation

Mediterranean ships distribution

\[
\begin{align*}
    s_1 &= S_{tot} N_{d1} \\
    s_2 &= S_{tot} N_{d2} \\
    s_3 &= S_{tot} N_{d3} \\
    s_4 &= S_{tot} N_{d4} \\
    s_5 &= S_{tot} N_{d5} \\
    s_6 &= S_{tot} N_{d6}
\end{align*}
\]

with

\[
\begin{align*}
    1 \leq s_1, s_2, s_3 &< 150 \\
    150 \leq s_4, s_5, s_6 &< 400
\end{align*}
\]

to

\[
\begin{align*}
    s_1 + s_2 + s_3 &= S_{t10} \\
    s_4 + s_5 + s_6 &= S_{t20}(7)
\end{align*}
\]

Source: Poll (1996)
The Model: shipwrecks based estimation (2)

\[ MS_{tot} = 2\left( S_{t10} \frac{1}{\alpha_1} \right) + \left( S_{t20} \frac{1}{\alpha_2} \right) \] (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)

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

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

\[ T_{tot} = \frac{\sum (C_{ti} - I_E) N_{di} MS_{tot}}{w_i - b_s} \quad (11) \]
The Model: shipwrecks based estimation (4)

<table>
<thead>
<tr>
<th>(n=125)</th>
<th>Long-distance trade class population (members)</th>
<th>Share of merchants’ investment in long-distance trade (%)</th>
<th>Share of elites’ investment in total long-distance trade (%)</th>
<th>Share of total elites’ income spent in long-distance trade (%)</th>
<th>Share of total long-distance trade income in Roman GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimistic scenario</td>
<td>2,747</td>
<td>87%</td>
<td>13%</td>
<td>0.1</td>
<td>0.16</td>
</tr>
<tr>
<td>Pessimistic scenario</td>
<td>3,041</td>
<td>72%</td>
<td>28%</td>
<td>0.2</td>
<td>0.14</td>
</tr>
</tbody>
</table>

**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.

\[ MS_{EW} = \frac{\alpha_{4.5}}{\sum C_{ti}N_{di}} \]  

(12)

Source: Lindert and Williamson (1982)
The Model: England and Wales 1688 comparative estimation (2)

<table>
<thead>
<tr>
<th>(n=3,354)</th>
<th>Long-distance trade class population (members)</th>
<th>Share of merchants’ investment in long-distance trade (%)</th>
<th>Share of elites’ investment in total long-distance trade (%)</th>
<th>Share of total elites’ income spent in long-distance trade (%)</th>
<th>Share of total long-distance trade income in Roman GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimistic scenario</td>
<td>73,870</td>
<td>89</td>
<td>11</td>
<td>2.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Pessimistic scenario</td>
<td>61,123</td>
<td>74</td>
<td>26</td>
<td>5.5</td>
<td>4.5</td>
</tr>
</tbody>
</table>

**Figure 5:** income distribution of long-trade activity using England and Wales 1688 comparison.
### The Model: China 1880 comparative estimation

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

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Long-distance trade class population (members)</th>
<th>Share of merchants' investment in long-distance trade (%)</th>
<th>Share of elites’ investment in total long-distance trade (%)</th>
<th>Share of total elites’ income spent in long-distance trade (%)</th>
<th>Share of total long-distance trade income in Roman GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimistic</td>
<td>16,408</td>
<td>87</td>
<td>13</td>
<td>0.6</td>
<td>1</td>
</tr>
<tr>
<td>Pessimistic</td>
<td>13,577</td>
<td>76</td>
<td>24</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Milanovic (2007)
### 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

<table>
<thead>
<tr>
<th></th>
<th>Long-distance trade class population (members)</th>
<th>Share of merchants’ investment in long-distance trade (%)</th>
<th>Share of elites’ investment in total long-distance trade (%)</th>
<th>Share of total elites’ income spent in long-distance trade (%)</th>
<th>Share of total long-distance trade income in Roman GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shipwrecks (n=125)</strong></td>
<td>Optimistic scenario</td>
<td>2,747</td>
<td>87</td>
<td>13</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>Pessimistic scenario</td>
<td>3,041</td>
<td>72</td>
<td>28</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>England and Wales 1688 (n=3,354)</strong></td>
<td>Optimistic scenario</td>
<td>73,870</td>
<td>89</td>
<td>11</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>Pessimistic scenario</td>
<td>61,123</td>
<td>74</td>
<td>26</td>
<td>5.5</td>
</tr>
<tr>
<td><strong>China 1880 (n=745)</strong></td>
<td>Optimistic scenario</td>
<td>16,408</td>
<td>87</td>
<td>13</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>Pessimistic scenario</td>
<td>13,577</td>
<td>76</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td><strong>Roman harbors (n=1,469)</strong></td>
<td>Optimistic scenario</td>
<td>32,354</td>
<td>87</td>
<td>13</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>Pessimistic scenario</td>
<td>26,771</td>
<td>72</td>
<td>28</td>
<td>2.4</td>
</tr>
</tbody>
</table>

**Figure 8:** Comparative estimations.
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.