TRADERS, INTERCONTINENTAL TRADE, AND GROWTH
BEFORE THE INDUSTRIAL REVOLUTION

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Abstract
This paper models how intercontinental trade profits could have encouraged growth in Early Modern Europe. Households produce and consume autarkic and market goods in an archipelago-like setting. A single trader monopolizes trade between them. He can accumulate capital to increase his trade capacities. This yields a gradual Smithian growth model with properties similar to a Cass-Koopmans model. By offering high profits, intercontinental trade encourages capital accumulation and growth. The predictions of the model are consistent with the growth experience of England, France and the Netherlands in the 17th and 18th century.

Keywords: Domestic trade, Early Modern Europe, Intercontinental trade, Growth model
JEL Codes: F43, N13, N73, O41
1. **Introduction**

Recent empirical work has shown that intercontinental trade was positively correlated with economic growth before the Industrial Revolution. The economic rise of the Netherlands and the United Kingdom was simultaneous to the increase of their Atlantic trade (Allen 2003, Acemoglu, Johnson, and Robinson 2005). This paper explores one mechanism that can explain this relation.

Theoretical works on unified growth theories has already explored the role of international trade in the divergence between industrial economies and non-industrial economies in the 19th century (Galor 2005, Galor and Mountford 2003). But they cannot explain the role of intercontinental trade before the Industrial Revolution, as the volume of trade was too small to have a sizeable effect on prices and on the reallocation of productive resources in Europe (O'Rourke and Williamson 2002, Acemoglu, Johnson, and Robinson 2005, p. 562), all the more so as a sizeable part of intercontinental trade was in goods neither produced nor consumed in the European trading economies.

However, the development of Atlantic trade was large enough to improve the economic and political position of specific groups, notably traders. This, according to Acemoglu, Johnson and Robinson was crucial for European development, because traders were a progressive political force able to coerce national governments into setting up institutions restricting the power of monarchy and securing broad-based property rights. However, it is not clear why these would be the objectives of traders (this difficulty is actually presented in Acemoglu, Johnson, and Robinson 2002, p. 27). They mainly clamoured for public protection and support to their own economic activities (e.g. Hirsch 1991). The improvement in the
political position of traders had as a its most direct consequence the improvement of their own accumulation prospects.

Of course, this did not happen in every European countries. Spain and Portugal tried to capture the benefits from intercontinental trade directly by setting up state monopolies rather than supporting the activity of their domestic traders. They were furthermore unsuccessful in checking the rising trade activity of their competitors. In contrast, England, the Netherlands and France implemented international policies partly devoted to supporting the activity of domestic traders. In a specific mercantilist European tradition started by Venice, these policies ranged from direct subsidies to military action against competitors (Curtin 1984, p. 116). They lead domestic traders to enjoy a higher rate of profits in intercontinental trade than in domestic activities, even when risk is taken into account (Daudin 2004). Intercontinental trade profits could be maintained at a high level both because the extension of individual country’s trade was often done at the expense of other countries and because European-controlled trade represented only part of world trade. For example intra-Asian trade was still a frontier for European mercantile expansion in the late 18th century.

One traditional view is that traders’ profits had an important role in Early modern accumulation of capital. The strongest form of this idea suggests this was at the root of the Industrial Revolution (Williams 1944 (1966), Wallerstein 1989). It is now discredited. A weaker form of this idea is that slave trade and plantation colonies played an important role in accumulation before the Industrial Revolution. This is still debated. Many economic historians would agree with O’Brien’s view that profits from the “periphery,” or, approximately, the non-European world, were simply too small to have played a major role in European growth even before the Industrial Revolution (O’Brien 1982, Eltis and Engerman
Furthermore, economic logic does not support the view that investors would remove capital from a high-profit sector to invest in the rest of the economy.

This paper does not dispute the importance of the role of traders in Europe’s institutional development. However, as a complement to the institutional mechanisms presented by Acemoglu, Johnson and Robinson, it suggests that intercontinental trade profits may have had a large role by themselves. In contrast to the traditional view of the importance of trading profits, it suggest that intercontinental trade profits were important because they encouraged the accumulation of trading capital rather than because they directly contributed to the capital stock. This is shown in a basic model of economic growth inspired from multi-sectoral “AK” endogenous growth models as presented by Rebelo (Rebelo 1991). In this setting, a small economic sector can play a decisive role in accumulation if it offers a way to escape declining returns to capital.

The paper is organized as follows. In the following section, the paper develops a model of the European domestic economies before the Industrial Revolution. In section 3, the paper shows how this model is modified by the introduction of intercontinental trade as a high-profit sector. Section 4 confronts the predictions of the model with the growth experience of the Netherlands, England and France in the 17th and 18th century. Section 5 concludes.

2. A model of domestic economies

2.1. A model of the industrious revolution and Smithian growth

One must have a plausible model of early modern growth giving a role to capital for profits from intercontinental trade to have any plausible role. The literature on unified growth theory (surveyed in Galor 2005) is mainly concerned with the transition from a pre-modern economy of little growth per capita to a post-Industrial Revolution economy of sustained
growth per capita. It does not study the logics of pre-modern growth. Historians have long suggested that early modern economies were able to grow through Smithian mechanisms of deepening market integration (e.g. Jones 1998 and Mokyr 1990, p. 5). One version of this idea is the notion of “industrious revolution”. This revolution did not explain the Industrial revolution, but was an important mechanism in explaining some Early modern growth episodes. The germ of this idea can be found in Smith’s “vent for surplus” theory of international trade (Oulton 1993). It suggests that one of the causes of growth was the integration of households in the domestic market economy through proto-industry and market agriculture (de Vries 1994). It manifested, for example, through the increase in the number of hours worked (Voth 2001). Traders played two roles in the deepening market integration and “industrious revolution”. First, they offered new consumption goods, which diffusion can be seen in probate inventories (Baulant 1989, Roche 1997). Second, they had an active role in the organization of production and in distribution, as suggested by the literature on proto-industry (Mendels 1972).

This paper takes up this idea by offering the first mathematical model of Smithian growth for Early modern European economies I am aware of (Yang and Ng 1998 presents a review of Smithian growth models. Kelly 1997 presents a Smithian growth model applied to Sung China). Capital in the model is not an input to production, but, under the form of circulating and trade capital, a support for traders’ activity.

The logic of the model can be easily summed up. Economies of specialization are modelled by the fact that “market goods” are easier to produce than “autarkic goods”. Yet, the use of the market to sell market production goods and buy market consumption goods has a cost. Hence, there is a trade-off between economies of specialization and trade costs. Industrious revolution comes from a larger participation in market production caused by the
reduction of trade costs. This reduction depends on the accumulation of trade capital by domestic traders.

2.2. Households

This model centres on the decisions of households regarding their participation to the market rather than on their consumption / saving trade-off. Changing participation is modelled as a transfer of productive capacities from the production of autarkic goods to the production of specialised market goods.

2.2.1. Markets and goods

The economy is an archipelago of I symmetrical local markets. Empirically, according to the central place theory by Christaller and Lösch, they can be identified with the influence area of fairs or market towns. Studies have shown that in France and England such areas had approximately a six-kilometre radius (Braudel 1979, t. 2, p. 33-37 & pp. 121-124). Their small size allowed anyone to walk to the market town, do business and be back within a day. Inside each local market, exchanges are free. Each local market can trade with other markets through a “national” market by paying trade costs.

The model builds on the study of rural households (Hymer and Resnick 1969). Households are both consumers and producers, akin to farmers: there are no firms. They only live for a single period. There are three categories of goods in local markets: Z-goods (autarkic), Y-goods (market production) and C-goods (market consumption). Their characteristics are presented in Table 1.

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1 I is used as a scaling factor, but the model is written in such a way that I plays no role in the dynamics or the steady state levels.
Table 1: Characteristics of goods

<table>
<thead>
<tr>
<th>Goods</th>
<th>Number of varieties</th>
<th>Production in local markets</th>
<th>Consumption in local markets</th>
<th>Trade outside local markets</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-goods</td>
<td>One</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Subsistence agriculture, handicraft, leisure…</td>
</tr>
<tr>
<td>Y-goods</td>
<td>One per local market ()</td>
<td>Yes</td>
<td>No</td>
<td>Sold to the national market</td>
<td>Agricultural or industrial market goods: textiles, wine, furniture, hardware, etc.</td>
</tr>
<tr>
<td>C-goods</td>
<td>One</td>
<td>No</td>
<td>Yes</td>
<td>Bought from the national market</td>
<td>Consumption basket of different market agricultural and industrial goods</td>
</tr>
</tbody>
</table>

C-goods can be thought as baskets of Y-goods that have been bundled on the national market. A piece of cloth produced by a weaver is a Y-good. The bundle of goods he consumes – some of the same cloth along with other textiles, hardware, wine… – is a C-good. The difference between Z-goods and in C/Y-goods is not sectoral: clothing, furniture, food products… are present in both categories of goods. The pertinent distinction is between high-quality or further processed goods that are sold on a larger market and mundane quality goods that are produced for local consumption by artisans and peasants (for the example of wheat, see Grantham 1989, p. 188 and Meuvret 1977). The autarkic good is an inferior good.

As household live only a single period, none of these goods can be hoarded. Selling Y-goods and buying C-goods can only be done on the national market. The relative importance of C/Y-goods and Z-goods in consumption and production is a measure of market integration.

2.2.2. Representative households

Usual rules of perfect competition apply inside local markets. Thus, one can simply examine the behaviour of a representative household. Each representative household $i$ has an production capacity written as:

$$y_i = Y(z_i)$$

(1)

Where $y_i$ is the production of specific Y-goods and $z_i$ the production of generic Z-goods. $Y$ is strictly decreasing in $z_i$. GDP is equal to the total number of Y-goods and Z-goods units
produced. \( Y \) is such that GDP increases when the production of \( Z \)-goods decreases, i.e. GDP increases when market integration increases.

\( Y \) does not change through time (this assumption is necessary for the existence of a steady state: see \textit{infra}). There is no technological growth. If there is population growth, the model makes the extreme Malthusian assumption that production capacities are strictly limited by natural resources availability and do not depend on the amount of labour in local markets. All the growth in production comes from growing market participation.

2.2.3. \textit{Households and the market}

As the \( Y \)-goods cannot be consumed or hoarded, each representative household sells its whole production of \( Y \)-goods (\( y_i \)) to the national market. It buys a quantity \( c_i \) of \( C \)-goods. Its budget equation is:

\[
p_{i,Y}y_i = p_Cc_i
\]

Where \( p_C \) is the price of \( C \)-goods and \( p_{i,Y} \) the price of \( Y \)-goods produced by household \( i \). \( p_{i,Y} \) is always smaller than \( p_C \).

We can define a mark-up \( \mu_i \), varying between zero and one.

\[
\mu_i = 1 - \frac{p_{i,Y}}{p_C} = \frac{y_i - c_i}{y_i}
\]

This mark-up is a measure of trade costs. If it is equal to zero, the household can exchange \( Y \)-goods for \( C \)-goods on a one-to-one basis. If it is equal to one, the household cannot get any \( C \)-goods whatever is its offer of \( Y \)-goods; hence, it cannot use the market.

Neither \( Z \)-goods nor \( C \)-goods can be hoarded. They have to be consumed immediately. Each representative household consumes all its production of \( Z \)-goods and all its purchases of \( C \)-goods. Its utility is:
\[ u_i = U(z_i, c_i) \]  

(4)

2.2.4. Household’s choice

The production behaviour of each household given a level of trade costs can be summed up in a reaction function \( R \). Each household \( i \) chooses its optimal level of production \( y_i^* \) by solving the following program:

\[
\begin{align*}
\max_{y_i} & \quad U(z_i, c_i) \\
y_i &= Y(z_i) \\
c_i &= (1 - \mu_i)y_i
\end{align*}
\]  

(5)

If there are multiple solutions, households select the smallest Y-goods production possible. Hence \( y_i^* \) is unique. It can be written as a function \( R \) of \( \mu_i \):

\[ y_i^* = R(\mu_i) \]  

(6)

When \( \mu_i \) is equal to 1, households cannot use the market. Hence they do not produce any Y-goods: \( R(1) = 0 \). Depending on the specific production and utility functions of households, their Y-goods production reach zero for \( \mu_{\text{max}} \leq 1 \). Because the autarkic good is inferior, \( R \) is decreasing in \( \mu_i \) : following a decline of the relative price of market goods, both the substitution effect and the income effect encourage households to increase their participation to the market. With reasonable assumptions, \( R' < 0 \) and \( R'' < 0 \) in the domain \([0, \mu_{\text{max}}]\). \( R^{-1} \) can be defined from \( R \) restricted to that domain.

\( R \) plays a very important role in the model. The higher the relative price of market production goods (Y-goods) relative to the price of market consumption goods (C-goods), the more households contribute to the national market. This increases GDP and is at the core of the mechanism of growth this model studies.
2.2.5. Application to a specific functional form

To get tractable results, one needs to specify $Y$ and $U$. The symmetry of local markets allows to drop the $i$ subscript.

$Y$ is a simple linear trade-off function.

$$y = A(Z - z)$$  \hspace{1cm} (7)$$

Where $A$ is a set of techniques and $Z$ is the maximum level of $Z$-goods production. Both are scalars, and $A$ is strictly superior to one.

$U$ is a simple separable utility function in which only $Z$-goods have a decreasing marginal utility:

$$U(z, c) = B \ln z + c \text{ with } 0 < B < A.Z$$  \hspace{1cm} (8)$$

Where $B$ is a parameter that measures the desirability of $Z$-goods compared to $C$-goods.

The program of the household can be written as:

$$\text{Max}_y U\left(Z - \frac{y}{A}, (1 - \mu)y\right) \Leftrightarrow \text{Max}_y B.\ln\left(Z - \frac{y}{A}\right) + y.(1 - \mu)$$  \hspace{1cm} (9)$$

If $y^*$ is an interior solution of the household’s program, it verifies:

$$\frac{dU}{dy}(y^*) = 0 \Leftrightarrow y^* = A.Z - \frac{B}{1 - \mu}$$  \hspace{1cm} (10)$$

Hence $R$ can be defined as:

$$R(\mu) = \begin{cases} 
\text{if } \mu < 1 - \frac{B}{AZ} \Rightarrow R(\mu) = A.Z - \frac{B}{1 - \mu} \\
\text{if } \mu \geq 1 - \frac{B}{AZ} \Rightarrow R(\mu) = 0
\end{cases}$$  \hspace{1cm} (11)$$

As expected, $R'(\mu)$ and $R''(\mu)$ are strictly negative for $\mu < 1 - \frac{B}{AZ}$.
2.3. Domestic Trade

2.3.1. Traders and trade function

Modelling the activity of domestic traders allows to endogenize market participation costs. Traders form the link between different local markets. They buy all the Y-goods produced by households and sell them C-goods. For simplification, traders are represented in the model by a single monopolist. Assuming Cournot-competition or Bertrand-competition with capacity constraints, competition between traders yields similar results.

The trader is infinitely lived. At each period, he consumes $I_c M, t$ units of C-goods.

The trader has a constant inter-temporal elasticity function:

\[
U_M \left( I_c M, t \right) = \frac{C_{M, t}^{(1-\theta)} - 1}{1 - \theta} \quad \text{with } \theta > 0 \text{ and } \theta \neq 1
\] (12)

His inter-temporal utility function is:

\[
\sum_{t=1}^{T} \frac{1}{(1 + \rho)^{t-1}} U_M \left( I_c M, t \right)
\] (13)

Where $\rho$ is his preference for the present.

In the same way a production function defines the activity of a firm, a trade function defines the activity of a trader. Traders have to pay the logistic and marketing transaction costs (Coase 1937). Some are \textit{ex ante} costs: finding information on the market in general and finding a particular exchange partner. Some are “instantaneous” costs: determining the goods to be exchanged, bargaining their price and the contract. Some are \textit{ex post} costs: the mutual monitoring of exchange partners to insure respect of the spirit and letter of a contract by preventing late payment or delivery and preventing deceit on the quality of goods (Casson 1987 and Furubotn and Richter 2000, p. 44-45). The level of costs depends on the institutional framework.
There are many possible means of transaction: human capital (accumulating information on markets), social capital (exchanging bonds to prevent misbehaviour), financial capital, etc. For the benefit of this paper, all this will be summed up as “trade capital”. It is obtained by the trader by saving C-goods on a I-to-one basis. The trader holds at each period $t$ a quantity of trade capital $k_t$. He can keep capital from period to period.

The trader uses trade capital to transform Y-goods into C-good according to a “trade function” $T$. $T$ is constant through time (this assumption is necessary for the existence of a steady state: see infra). This function is akin to a production function, but with the significant difference that trade capital cannot physically produce any new goods. Hence trade capital and Y-goods inputs are strict complements in $T$. This is very different from the usual “iceberg” trade costs.

As all local markets are symmetrical, to “produce” one unit of the C-good, the trader needs $1/I$ unit of every Y-good. Assuming that there are $y_i$ inputs of each Y-good and a quantity of capital $k$, that restricts the form of the trade function $T$ to the following:

$$T(y_1, y_2, \ldots, y_I, k) = \min \left[ I.y_1, I.y_2, \ldots, I.y_I, T_k(k) \right] \quad (14)$$

Where $T_k(k)$ is the maximum amount of C-good that can be traded with $k$ units of trade capital. This function $T_k$ has the usual characteristics of a production function: $T_k' > 0$ and $T_k'' \leq 0$.

2.3.2. Chronology of decisions

The economy goes through discrete time periods. At each period $t$:

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2 One way of thinking about the trade function, if one accepts nominal rigidities, is to assimilate trade capital to money and the trade function to a cash-in-advance constraint. In that case, “savings” represent exports of C-goods in exchange for money. However, this neglects the specific nature of social capital. This paper does not deal with these issues and treats the trade function as a black box.
The trader chooses a mark-up $\mu_t$ and announces it to the households. Each household produces $y_t$, Y-goods of its particular variety. The trader chooses $\mu_t$ so that he has enough capital to trade all Y-goods.

- He gathers all the Y-goods produced by households.
- He transforms them into $I, y_t$ C-goods according to his trade function $T$.
- He gives to the households as a group a share $(1-\mu_t)$ of the total available C-goods.
- He consumes $I, c_{M,t}$, taken either from his share of the C-goods produced in that period or from his stock of capital (on a one-to-I basis).
- He saves the rest to increase his stock of capital: $k_{t+1} = k_t + \frac{\mu_t I, y_t - I, c_{M,t}}{I}$.

2.3.3. **Trader’s instantaneous choice**

The strategic variable of the trader is the mark-up $\mu_t$. The trader uses it to maximise the share of C-goods he keeps for himself: $\mu_t, I, y_t$. In each period, this is equal to:

$$\mu_t, I, y_t = \mu_t, \text{Min}\left[I, R(\mu_t), I, R(\mu_t), \ldots, I, R(\mu_t), T_k(k_t)\right] = \mu_t, \text{Min}\left[I, R(\mu_t), T_k(k_t)\right]$$

(15)

If there is no capital constraint, that boils down to maximising $\mu_t, I, R(\mu_t)$. Let $\mu^*$ be the level of the mark-up that corresponds to this maximisation. It verifies:

$$\frac{d(\mu^* I, R(\mu^*))}{d\mu^*} = 0 \Leftrightarrow R'(\mu^*)\mu^* + R(\mu^*) = 0$$

(16)

To trade all the Y-goods implied by this optimal mark-up, the trader needs a quantity of capital equal to $k^*$ defined as:

$$k^* = \left(T_k\right)^{-1}\left(R(\mu^*)\right)$$

(17)
If he does not have enough capital, he increases the mark-up so as to reduce the production of Y-goods down to a manageable level while increasing the share of C-goods he keeps for himself.

It is possible to define a function $P$ that gives the amount of C-goods the trader keeps from himself when he uses a certain quantity of capital in domestic trade. $P$ is defined as:

$$
\begin{align*}
\text{• if } k < k^*: & \quad P(k) = \mu R(\mu) \text{ such as } \mu = R^{-1}(T_k(k)) \\
\text{i.e. } P(k) & = R^{-1}(T_k(k)).T'_k(k) \\
\text{• if } k \geq k^*: & \quad P(k) = \mu^* R(\mu^*)
\end{align*}
$$

(18)

**Proposition 1:** $P' \leq 0$ and $P'' \geq 0$.

**Proof in appendix.**

$P$ is similar to a standard production function, except that it is bounded. It would be better to have $P$ changing through time, depending on the techniques for trade and production and on the population in local markets. This evolution would find its origin in the evolutions of $Y$ or $T$. However, I could not introduce the effect of technological, institutional or demographic change in a plausible way such that their effect on $P$ is something equivalent to Harrod-neutral technical progress, which is necessary for a steady state equilibrium to exist (Uzawa 1961).

It is also possible to write the relation between GDP per canton and the amount of trade capital used by the trader in domestic trade:

$$
GDP(k) = \frac{T'_k(k)}{I} + Y^{-1}\left(\frac{T_k(k)}{I}\right)
$$

(19)

2.3.4. **Dynamic optimisation**

As the number of local markets does not make any difference in the model, $I$ is normalized to 1 in what follows.
The trader’s program can be written as:

\[
\begin{align*}
\max_{\mu, k_1, \ldots, k_T} & \sum_{t=1}^{T+\infty} \frac{1}{(1+\rho)^{t-1}} U_M(c_{M,t}) \\
\text{subject to} & \quad k_{t+1} = k_t + P(k_t) - c_{M,t} \\
\text{and} & \quad k_1 \text{ fixed}
\end{align*}
\]

Proposition 2: The stock of capital will converge toward a fixed point \(k^f\) that verifies:

\[
\rho = P'(k^f)
\]

The program is similar to the canonical Cass-Koopmans model (Cass 1965, Koopmans 1965, Barro 1995) and is solved in the same way. The fact that \(P\) is bounded is not an issue as production is also bounded in the Cass-Koopmans model.

\(k^f\) does not depend on the parameters of \(U_M\). Depending on parameters of \(P\), this fixed point might exist or not. If it does not, the trader is better off consuming all his capital in the first period.

2.3.5. Application to a specific functional form

These results can be verified for the household’s utility function selected in equation (8).

In that case, \(\mu R(\mu)\) and \(\mu^*\) can be written explicitly:

\[
\begin{align*}
\mu R(\mu) &= \mu \frac{B + AZ(\mu - 1)}{\mu - 1} \\
\frac{\partial (\mu R(\mu))}{\partial \mu} &= -B + AZ(1 + B)(\mu - 1)^2 \\
\frac{\partial (\mu^* R(\mu^*))}{\partial \mu} &= 0 \Rightarrow \mu^* = 1 - \frac{B}{\sqrt{AZ}}
\end{align*}
\]

(The other solution is excluded by \(\mu < 1\))
With the further assumption that $T_k(k) = T.I.k$ ($T$ being a scalar measuring the state of the transaction technology and institutions), it is possible to write $k^*$:

$$k^* = \frac{1}{T} \sqrt{AZ} \left( \sqrt{AZ} - B \right)$$  \hspace{1cm} (23)

It is also possible to write $P(k)$:

$$P(k) = \begin{cases} 
\text{if } k < k^*, & P(k) = k.T \left( 1 - \frac{B}{AZ - k.T} \right) \\
\text{if } k \geq k^*, & P(k) = \left( \sqrt{AZ} - B \right)^2 
\end{cases}$$  \hspace{1cm} (24)

One can verify that $P' > 0$ and $P'' < 0$ if $k < k^*$.

GDP can be written down as:

$$GDP(k) = k.T + Z - \left( \frac{k.T}{A} \right)$$  \hspace{1cm} (25)

$k^f$ exists if:

$$P'(0) > \rho \iff T \left( \frac{AZ - B}{AZ} \right) > \rho$$  \hspace{1cm} (26)

If it does, it is possible to write $k^f$ and the associated GDP:

$$k^f = \frac{A.T.Z(T - \rho) - \sqrt{A.B.T.Z.(T - \rho)}}{T(T - \rho)}$$

$$GDP(k^f) = Z + \frac{(A - 1)(A.Z.(T - \rho) - \sqrt{A.B.T.Z.(T - \rho)})}{A.(T - \rho)}$$  \hspace{1cm} (27)

As expected, the level of the GDP at the fixed point is increasing with $A$ and $T$.

2.3.6. Consequences of technical and institutional progress

Solow growth was not the exclusive force of growth in Early modern Europe. New technologies were invented and put in use. New institutional settings facilitated trading as legislation better protected property rights, etc. In the framework offered by this model, these
would translate respectively in changes in $Y$ and in $T_k$. It is not possible to explicitly integrate a gradual change of these parameters, but some static comparative work is possible.

In the short term, technical progress in market goods production encourages the household to produce and consume more market goods at a given mark-up. It does not change the amount of market production because of the trade capital constraint implied by the trade function. Technical progress is “absorbed” by an increase of the mark-up $\mu$. However, it also increases $P(\mu)$, the optimal mark-up $\mu^*$, the long run level of market goods production and the long-run level of GDP.

In the short term, institutional or technical progress that increases $T_k$ is similar to an increase in the capital stock of the trader. It increases $Y$-goods production and reduces the mark-up $\mu$. Yet, it has no effect on the optimal mark-up or the optimal level of production for the trader. It simply changes the amount of trading capital necessary for this optimal level. Yet, because it eases the constraints on accumulation, it will narrow the gap between the fixed-point of the trader’s accumulation of capital $k^f$ and the optimum stock of capital $k^*$. Hence a favourable change in $T_k$ increases the level of $Y$-goods production and GDP in the long run.

3. **The role of international entrepot trade in Smithian growth**

In the preceding section, this paper has presented a mechanism of Smithian growth or industrious revolution brought about by the accumulation of transaction means. What is the effect of introducing intercontinental trade as a high-profit sector in this mechanism?

3.1. **Setting up the model**

Intercontinental trade is defined as an alternative investment opportunity for traders which provides constant returns to trade capital equal to $r$, with $r > \rho$.  

- 17 -
Furthermore, the model also assumes that the rest of the word provides a specific consumption good to domestic traders. One unit of this consumption good can be bought in exchange for 1 unit of trade capital. Domestic and foreign consumption goods are associated in a Cobb-Douglas way in the trader’s utility function: they are not perfectly substitutable. Let $I, x_t$ be the trader’s consumption of these goods in period $t$. The trader’s new instantaneous utility function is:

$$U_M(I, c_{M,t}, I, x_t) = \left(\frac{c_{M,t}^{1-\alpha} x_t^{\alpha}}{1-\theta} \right) - 1$$

with $\theta > 0, \theta \neq 1$ and $0 < \alpha < 1$  \hspace{1cm} (28)

The quantity of trade capital invested in intercontinental trade at period $t$ is called $k_{d,t}$. The quantity of trade capital invested in domestic trade at the same period is called $k_{d,t}$. $I$ is normalized to 1. There no technique to transform capital into domestic consumption goods.

The trader’s program becomes:

$$\begin{aligned}
\max_{k_{d,t}, k_{x,t}} & \sum_{t=1}^{\infty} \frac{1}{(1+\rho)^{t-1}} U_M(c_{M,t}, x_t) \\
\text{subject to} & \quad c_{M,t} \leq P(k_{d,t}) \\
\quad & \quad k_t = k_{d,t} + k_{x,t} \\
\quad & \quad k_{t+1} = k_t + P(k_{d,t}) - c_{M,t} - x_t + r k_{x,t}
\end{aligned}$$

$$\begin{aligned}
\max_{k_{d,t}, k_{x,t}} & \sum_{t=1}^{\infty} \frac{1}{(1+\rho)^{t-1}} U_M(c_{M,t}, x_t) \\
\text{subject to} & \quad P(k_{d,t}) - c_{M,t} \geq 0 \\
\quad & \quad k_{t+1} = k_t + P(k_{d,t}) - c_{M,t} - x_t + r k_{x,t}
\end{aligned}$$

$$\Leftrightarrow \begin{aligned}
\max_{k_{d,t}, k_{x,t}} & \sum_{t=1}^{\infty} \frac{1}{(1+\rho)^{t-1}} U_M(c_{M,t}, x_t) \\
\text{subject to} & \quad P(k_{d,t}) - c_{M,t} \geq 0 \\
\quad & \quad k_t \geq k_{d,t}, k_{d,t} \geq 0 \\
\quad & \quad k_{x,t} \geq 0; k_t \text{ fixed}
\end{aligned}$$

There are three control variables ($k_{d,t}, c_{M,t}, x_t$) and a state variable ($k_t$).

The transversality condition requires that the discounted capital stock valued at its shadow price converges toward 0. This can be written as:

$$\lim_{t \to \infty} \frac{k_t \lambda_t}{(1+\rho)^{t-1}} = 0$$

(30)
3.2. Dynamics

It is useful to define $k^D$:

$$k^D \text{ either verifies } P'(k^D) = r \text{ or is equal to 0 if } P'(k) < r \text{ for all } k$$  \hspace{1cm} (31)

Proposition 3: The stock of domestic capital converges toward $k^*$ as defined in equation (17).

The dynamics of this model and the proof of this proposition are in the appendix. The intuition follows.

Suppose the trader starts with a sufficiently small capital stock that returns to capital in the domestic economy are higher than in intercontinental trade: $k_0 < k^D$. The dynamic starts in the first regime (see Table 2). The trader accumulates capital in the domestic economy only and gradually increases its consumption. His increase in consumption (given by the decrease of $\lambda$ at a rate greater than $1 - \frac{1 + \rho}{1 + r}$) is faster than if there was no possibility of investment in intercontinental trade. At some point, his stock of capital reaches $k^D$, bringing him to the second regime.

In the second regime, the returns to the domestic capital stock are equal to the returns to capital invested in intercontinental trade. The domestic trade capital stock stops growing and savings are channelled into intercontinental trade. In this regime, the domestic economy stagnates. But the trader’s consumption and capital stock both increase. As $\lambda$ decreases at a constant rate, at some point his domestic consumption level reaches the maximum level possible with only $k^D$ invested in domestic trade. The dynamic then moves to the third regime.

In the third regime, the trader consumes all his domestic income. In order to keep on increasing his domestic consumption, the trader has to invest more capital in domestic trade than $k^D$, despite the lower returns compared to intercontinental trade. His domestic capital is
bounded by $k^*$ which maximises his domestic income. As $k^* > k^f$, domestic GDP increases further in the long-run than in the model without intercontinental trade. Notice that, once his stock of domestic capital is close enough to its long-term value $k^*$, it can be considered as constant. With this approximation, the model takes the usual AK form, which dynamics are well known: the stock of capital invested in intercontinental trade grows without bound. Table 2 sums up the characteristics of each regime.

**Table 2: Characteristics of the regimes**

<table>
<thead>
<tr>
<th>Regimes</th>
<th>Domestic trade capital</th>
<th>Intercontinental trade capital</th>
<th>Domestic consumption constraint</th>
<th>Returns to domestic capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Accumulation, $&lt; k_D$</td>
<td>No accumulation</td>
<td>Is not active</td>
<td>$&gt; r$</td>
</tr>
<tr>
<td>Second</td>
<td>No accumulation, $= k_D$</td>
<td>Accumulation</td>
<td>Is not active</td>
<td>$= r$</td>
</tr>
<tr>
<td>Third</td>
<td>Accumulation, $k_D &lt; k &lt; k^*$</td>
<td>Accumulation without bound</td>
<td>Is active</td>
<td>$&lt; r$</td>
</tr>
<tr>
<td>Fourth</td>
<td>No accumulation</td>
<td>No accumulation</td>
<td>Is active</td>
<td>$\geq r$</td>
</tr>
</tbody>
</table>

The important result of this model is that intercontinental trade, through higher profits, pushes trade capital accumulation and, hence market participation, to higher levels than what would happen in an economy without intercontinental trade investment. Furthermore, the promises of riches to be made in intercontinental trade also increase the speed of capital accumulation (For more details on the plausibility of these dynamics in the case of France, see Daudin 2006). This is mitigated early in the dynamic by the necessity of investing part of the capital stock in intercontinental trade. In the long run, however, the domestic capital stock predicted by the model with intercontinental trade is greater than the domestic capital stock predicted by the model without intercontinental trade. This result would not hold if capital could be transformed into a consumption good exactly similar to the domestically produced one. As long as the trader has a direct interest in the increase of domestic production, his accumulation will be followed by the rise of domestic production.
4. The European experience

To verify the plausibility of the model, it is calibrated on the experience of Europe. As noted in the introduction, one expects that this model only applies to European states which had both the power and the willingness to help domestic traders. If they had a predatory behaviour against traders, as it was the case in Spain, they discouraged accumulation. Furthermore, if they were not powerful enough to insure high profits to their traders, they could not benefit from the mechanisms presented in this model. That was the case of the Austrian Hapsburgs, who could not fully support the Ostend Company; of Portugal as it became subordinated to British trade interests after the treaty of Methuen; of most non-European states during that period and even of Spain in the 18th century, despite the Bourbons’ reforms. These restrictions leave us with three potential illustrations of the mechanisms of the model: England (associated with Wales in this paper), France and the Netherlands.

Second, the model needs large states for the full advantages of intercontinental trade to exist. If domestic sources of consumption are not important enough – or foreign sources of consumption can substitute for them – capital accumulation will be encouraged, but the centres of international trade would become simply enclaves of growth consuming foreign goods. England and France certainly satisfy this condition. It is not certain it was the case for the Netherlands.

4.1. Collecting data

Data has been gathered for England, France and the Netherlands around four years: 1655, 1716, 1753 and 1790. There is no way to determine exact values for each of these years, but approximations of the mean value of each variable around each year can be constructed. Each year was chosen both for data availability and chronological reasons.
1655 is the earliest date for which there is reliable trade data for the Netherlands. Furthermore, it represents a turning point in European history: after solving internal problems, England’s Navigation Acts of 1651 and the nomination of Colbert as France’s contrôleur général in 1661 symbolize the will of both these countries to counter Dutch trade supremacy.

1716 is the earliest for which there is reliable trade data for France. The long-lasting European wars associated with Louis XIV had just finished with the treaties of Utrecht (1713) and Rastatt (1714) and the following period was relatively peaceful – at least between the three countries under study – up to the War of Austrian Succession (1740-1748: the direct conflict between France, Great-Britain and the Netherlands only started in 1744).

1753 is the least satisfying of our four dates, as it is simply between the War of Austrian Succession and the Seven Year War (1756-1762). Yet, it cuts the period between 1716 and 1790 neatly in two sub-periods of 37 years.

Finally, 1790 does not need much justification. Political and economic events in the late 18th and early 19th century marked the beginning of the domination of England on its economic and political rivals and the beginning of a new economic era.

Data on real GDP and intercontinental trade estimated in silver were collected. There are no sources that would allow to deflate trade in order to compute “real” trade — but that should not trouble the inter-country comparison. The details of data collection and price treatment are presented in the data appendix.

Many current studies on Early modern Europe development are based on the examination of real wages rather than GDP (this is the case for example of Allen 2003). It is certain that estimates of real wages are of higher quality than estimates of GDP, especially since the recent new wave of price data collection (see Maddison 2003, pp. 251-3 for a discussion). However, Europe-wide comparable wages concern mainly urban unskilled workers. Most
workers in cities were already integrated in the regional or national market economy at the beginning of the period. The Smithian growth of the market economy was mainly a rural phenomenon. Furthermore, real wages are mainly computed relative to food prices. Food was certainly a very important budget item, but the “industrious revolution” is based on the diffusion of new consumer goods: using real wages would miss the relative price decrease of new consumer goods or even their apparition (de Vries 1992, Clark 2005). For these reasons, GDP is a better proxy of development.

4.2. The numerical exercise

The functional forms used in the numerical exercise were the ones presented in the preceding sections. Table 3 explains how parameters values were chosen.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z$, the maximum level of production of autarkic goods per local market (in thousands of 1990 U.S. $)</td>
<td>350. Based on Maddison’s data on GDP in 1000. He assumes the GDP per capita in Europe to be uniformly 400$. It comes down to a question of population density. As the surface of the Netherlands is not well known for this period and Southern France probably had some urban life (which is, by definition, non autarkic) I use England in 1000 as a benchmark, for a production per local market of 336,000 $</td>
</tr>
<tr>
<td>$\mu^*$, the optimal mark-up</td>
<td>15 %. This number was often used as a benchmark for the “just” trade profit in transaction, as in the Maximum French legislation (Le Roux 1996, p. 33).</td>
</tr>
<tr>
<td>$A$, the set of techniques that enables market goods production</td>
<td>A: 375 ; B: 95 000. The maximum level of pre-industrial development is assumed to be 25% higher than the GDP of the Netherlands in 1655</td>
</tr>
<tr>
<td>$B$, the parameter that determines the relative utility of autarkic goods compared to market goods</td>
<td></td>
</tr>
<tr>
<td>$\rho$, the trader’s internal discount rate</td>
<td>5%</td>
</tr>
<tr>
<td>$r$, the rate of return of investment in intercontinental trade</td>
<td>6% (see text)</td>
</tr>
<tr>
<td>$T$, the set of domestic exchange techniques</td>
<td>0.256. This assumes that France in 1655 was on the verge of developing its investment in intercontinental trade.</td>
</tr>
<tr>
<td>$\alpha$, the share of domestic goods in the trader’s consumption</td>
<td>95%. Arbitrary, as there are no budget data for these social categories</td>
</tr>
<tr>
<td>$\theta$, elasticity of marginal utility (1/$\theta$ is the inter-temporal elasticity of substitution)</td>
<td>Difficult to estimate (See for example Beaudry and van Wincoop 1996). Fixed at 1.5</td>
</tr>
<tr>
<td>Starting capital stocks</td>
<td>Chosen so that 1655 GDP is right</td>
</tr>
</tbody>
</table>

Figure 1 compares the simulated and actual evolution of growth and intercontinental trade in Western Europe.
Figure 1: Actual and simulated Western Europe, 1655-1790

This simulation cannot be over-interpreted. Early modern European growth was influenced by many phenomena that are not taken into account by the model. For example, it is probable that the Netherlands and England had a better trade and production technology than France. The model does not take into account the improvement in institutions in England following the Glorious Revolution, the beginning of the Industrial Revolution in England during the second half of the eighteenth century, nor the fact that the Netherlands were unable to extend their share of world trade in the 18\textsuperscript{th} century due to a small central state that could not muster domestic resources at a level comparable to the French or the English. That was due to military and political factors (O'Brien 2000), but also to the fact that the stagnation of their GDP did not give them the means to secure the very large levels of intercontinental trade predicted by the model.
This being said, the model and the data on England and France are compatible with the idea that first England and then France went into a catch-up phase compared to the Netherlands by capturing a larger and larger share of world trade. Yet, the model explains only 50 per cent of English growth and over-predicts French growth by 10 per cent. This could be explained by the Industrial Revolution, but its macroeconomic impact was small in the 18th century. It cannot be attributed to institutional differences in the organisation of domestic trade, as $T$ has no effect on the dynamics in the third regime (even if it intervenes in the level of GDP). However, it could come from a difference in the respective efficiency of the English and French States in defending national traders in the international economy. It could be that, as a result, the proper profit rate on intercontinental trade for English traders is higher than in France. Simply increasing the rate of return in the intercontinental sector from 6 to 6.5% in England helps explain more than 2/3 of the unexplained growth.

Without investment opportunities in external trade, the model predicts that equilibrium GDP level of the French and the English economies would have been 60 1990 US $ per square km. From their 1655 starting level, the French economy could have grown to 49 1990 US $ and the English economy to 54 1990 US $ in 1790. Hence, the introduction of intercontinental trade explains approximately one third of the predicted French growth and two-thirds of the predicted English growth.

5. **Conclusion**

This paper has presented three new and complementary ideas. First, it has built a formal model of gradual industrious revolution. Second, it has shown that growth in this model could be boosted by the introduction of high-profit investment in intercontinental trade. Hence, it provides an alternative explanation for the positive role of intercontinental trade and the improvement of traders’ position on European pre-industrial growth. Finally, it has
confronted this model to the European experience of the 17th and 18th century. Development of intercontinental trade was correlated with accelerated economic growth and increased long-term GDP. This gives plausibility to the pertinence of the growth mechanisms highlighted in the model.

The next step is to build an empirical test to discriminate between the institutional explanation of the consequences of the increase of intercontinental trade and the explanation given here. In the model, the only indicator of institutional quality is the “trading technology” ($T_k$). Its improvement has equivalent effects in the short term than a further accumulation of trading capital. Hence, the role of each cannot be explained directly. This is not very surprising. The exact same difficulty arises when one tries to differentiate between the accumulation of capital and technical progress in an industrial economy. Growth accounting offers a way to solve this difficulty for the modern world: it should probably be tried for the pre-industrial world as well, focusing on trading capital rather than fixed productive capital.

6. Mathematical Appendix

6.1. Proof of Proposition 1

Trivially, $P\prime(k) = P\prime\prime(k) = 0$ if $k \geq k^*$. Notice that, according to equation (16) and equation (17), $k^*$ is the unique $k$ that verifies:

$$R\prime\left(R^{-1}\left(T\left(k^*\right)\right)\right)R^{-1}\left(T\left(k^*\right)\right) + T\left(k^*\right) = 0$$

(32)

Because of this relation and $T' > 0$: 

- 26 -
\[ P'(k) = 0 \]
\[ \Rightarrow \frac{d}{dk} \left[ R^{-1}(T_k(k), T_k(k)) \right] = 0 \]
\[ \Rightarrow T_k'(k) \left[ R^{-1}(T_k(k)) + \frac{T_k(k)}{R' \circ R^{-1}(T_k(k))} \right] = 0 \]
\[ \Rightarrow R' \circ R^{-1}(T_k(k), R^{-1}(T_k(k)) + T_k(k) = 0 \]
\[ \Rightarrow k = k^* \]

As \( P'(0) = T_k'(k) \mu_{\text{max}} \) — which is superior to 0 — and \( P' \) is continuous, \( P' > 0 \) over the domain \([0,k^*]\).

For \( P'' \), we have assumed that \( R'' \) was < 0. Hence:

\[ P''(k) = \left( T_k'(k) \left[ R^{-1}(T_k(k)) + \frac{T_k(k)}{R' \circ R^{-1} \circ T_k(k)} \right] \right)' \]
\[ = T_k''(k) \left[ R^{-1} \circ T_k(k) + \frac{T_k(k)}{R' \circ R^{-1} \circ T_k(k)} \right] \]

\[
\begin{pmatrix}
T_k'(k) \\
R' \circ R^{-1} \circ T_k(k)
\end{pmatrix}
+ \begin{pmatrix}
T_k'(k) \\
R' \circ R^{-1} \circ T_k(k)
\end{pmatrix}
- T(k) \begin{pmatrix}
T_k'(k) \left( R^{-1} \right)' \circ T_k(k) \circ R'' \circ R^{-1} \circ T_k(k) \\
(R' \circ R^{-1} \circ T_k(k))^2
\end{pmatrix}
+ \begin{pmatrix}
T_k'(k) \\
R' \circ R^{-1} \circ T_k(k)
\end{pmatrix}
\]

Hence \( P'' < 0 \) over the domain \([0,k^*]\).
6.2. Proof of Proposition 3

6.2.1. *Lagrangian*

To simplify notations, the “M” subscript is dropped. The Lagrangian associated to this dynamic optimization problem is:

\[
L = \sum_{t=1}^{\infty} \frac{1}{(1+\rho)^{t-1}} \left[ U(c_t, x_t) + \lambda_t \left( k_t + P(k_{d,t}) - c_t - x_t + r(k_t - k_{d,t}) - k_{t+1} \right) \\
+ \gamma_t \left( k_t - k_{d,t} \right) + \beta_t \left( P(k_{d,t}) - c_t \right) \right]
\]  

(35)

First order conditions are:

\[
\frac{\partial L}{\partial c_t} = 0 \quad \Leftrightarrow \quad \lambda_t = U'_1(c_t, x_t) - \beta_t
\]

\[
\frac{\partial L}{\partial x_t} = 0 \quad \Leftrightarrow \quad \lambda_t = U'_2(c_t, x_t)
\]

\[
\frac{\partial L}{\partial k_{d,t}} = 0 \quad \Leftrightarrow \quad \lambda_t \left[ P'(k_{d,t}) - r \right] - \gamma_t + \beta_t P'(k_{d,t}) = 0
\]  

(36)

\[
\Leftrightarrow \quad \lambda_t = \frac{1}{r} \left( U'_1(c_t, x_t) P'(k_{d,t}) - \gamma_t \right)
\]

\[
\frac{\partial L}{\partial k_t} = 0 \quad \Leftrightarrow \quad \lambda_t = \frac{(1+\rho)\lambda_{t-1} - \gamma_t}{1 + r}
\]

6.2.2. *Regimes*

- First regime: \( k_t = k_{d,t}; \ c_t < P(k_{d,t}), \ \gamma_t > 0, \ \beta_t = 0. \) In this regime, there is no investment in intercontinental trade as the returns to capital are higher in the domestic economy.

- Second regime: \( k_t > k_{d,t}; \ c_t < P(k_{d,t}), \ \gamma_t = 0, \ \beta_t = 0. \) In this regime, the trader invests his capital in both intercontinental trade and the domestic economy. The returns to capital are equal in both the domestic economy and intercontinental trade. Hence, the stock of domestic capital is not increasing.
Third regime: $k_t > k_{d,t}$; $c_t = P(k_{d,t})$, $\gamma = 0$, $\beta_k > 0$. In this regime, the trader invests his capital in both intercontinental trade and the domestic economy. But all the domestic consumption is now consumed. Because this constraint is binding, the trade-off between investment in the domestic economy and in intercontinental trade is akin to a trade-off between consumption and savings. The returns to capital in the domestic economy are smaller than in intercontinental trade. Both capital stocks are increasing.

Fourth regime: $k_t = k_{d,t}$; $c_{M,t} = P(k_{d,t})$, $\gamma > 0$, $\beta_k > 0$. In this regime, the whole capital is invested in the domestic economy and all of it is consumed. The dynamic path is trivial, as there is no capital accumulation.

6.2.3 Borders

We study the dynamic in the $(k, \lambda)$ space.

The border between the first and the fourth regime is defined by: $c_{M,t} = P(k_{d,t})$. That implies:

$$
\begin{align*}
\begin{cases}
\lambda_t = U_1'(P(k_t), x_t) \\
U_1'(P(k_t), x_t) = U_2'(P(k_t), x_t)
\end{cases}
\end{align*}
$$

(37)

The border between the first and the second regime is defined by:

$$
P'(k_t) = r \iff k_t = k^D
$$

(38)

The border between the second and the third regime is defined by:

$$
P(k_{d,t}) - c_t = 0 \iff P(k^D) = c_t \iff \lambda_t = \lambda^D
$$

(39)

Where $\lambda^D$ is either equal to $+\infty$ if $k^D = 0$ or defined such as:

$$
\begin{align*}
\begin{cases}
\lambda_t = U_1'(P(k_t), x_t) \\
U_1'(P(k_t), x_t) = U_2'(P(k_t), x_t)
\end{cases}
\end{align*}
$$

(40)
The border between the third and the fourth regime is defined as:

\[
k_t = k_{d,t} \iff \begin{cases} 
U_2'(P(k_t), x_t) = U_2'(P(k_{d,t}), x_t) \\
\frac{U_1'(P(k_t), x_t) P'(k_t)}{r} = U_2'(P(k_t), x_t)
\end{cases}
\]  

(41)

6.2.4. Dynamics

The dynamics of capital are defined as:

\[
k_{t+1} = k_t + r(k_t - k_{t,d}) + P(k_{t,d}) - c_t
\]

The dynamics of \( \lambda \) are defined in the first regime as:

\[
\lambda_{t+1} = \frac{1 + \rho}{1 + P'(k_t)} \lambda_t
\]

(42)

And in the second and third regime as:

\[
\lambda_{t+1} = \frac{1 + \rho}{1 + r} \lambda_t
\]

(43)

The transversality condition in the second and third regimes implies that the total capital stock can not increase by more than \( r \) percent per period.

6.2.5. Phase diagram

Here is a possible phase diagram that corresponds to this model:\(^3\)

---

\(^3\) It is built from the same parameters as the paper’s simulation, except that \( r \) is equal to 0.04 so that \( k^D \) and \( \lambda^D \) exist along with the first and second regime.
7. **Data Appendix.**

<table>
<thead>
<tr>
<th>Real GDP</th>
<th>England and Wales</th>
<th>Netherlands</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on: Maddison 2001, p. 247 for 1600, 1700 and 1801. For 1655, I assume a constant growth rate between 1600 and 1700. For 1716 and 1753, I extrapolate from 1700 using the growth rate provided by Crafts 1985, p. 45. For 1790, I retropolate from 1801 using the growth rate in Crafts and Harley 1992, p. 715.</td>
<td>I use the mid-range estimate of de Vries and van der Woude’s estimate of the GDP per capita of the Netherlands at 1720-1744 prices: de Vries and Woude 1997, p. 707. I convert the unit from 1720-1744 guilders to 1990 international dollars by comparing their estimate for 1700 and Maddison’s estimate for 1700: Maddison 2003, p. 46.</td>
<td>Based on Maddison 2003, p. 46 for 1700 and 1820. For 1655 and 1716 I assume stagnation of real GDP income from 1655 to 1716 because of hunger crisis and warfare. This is Maddison’s hypothesis based on Vauban and Boisguilbert: Maddison 2003, p. 20-22 and 27. For 1790, I retropolate from Maddison’s number for 1820 using the growth rate from Toutain’s growth rate of real GDP between 1785 and 1820 (Toutain 1997, p. 19). For 1753, I assume a constant growth rate between 1716 and 1790.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal trade – 1655: France and England</th>
<th>England and Wales</th>
<th>Netherlands</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>Léon estimates that in 1660 there were 3,000 Dutch trading ships, 600 French ones and slightly more English ones (here 650) (Léon and Carrière 1970 (1993), p. 187.). Dutch nominal trade in silver is known (see infra). English (and French) trade are assumed to be proportional to their number of trading ships. This yields a higher level of trade for England than if we retropolate King’s numbers for 1688 with the growth rate of English trade from 1688 to 1700 as given by duty sources. I assume no re-exports from England and France.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal trade (All exchange rates to silver are taken at par from McCusker 1978, p. 9 and p. 95)</th>
<th>England and Wales</th>
<th>Netherlands</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>For 1716, 1753 and 1790: I use numbers from Davis and Deane &amp; Cole for 1789-1790 (Davis 1969, p. 94, 102 and Deane and Cole 1962 (1969), p. 87) and assume constant growth rates between estimates to compute trade in early 18th century prices For 1784-6 numbers, I convert them from British trade to English trade by using the ratios based on 1772-3 numbers as given by Dean and Cole. Iden for re-exports. I then assume these data are in 1700 prices and use Officer 2001 to deflate them.</td>
<td>estimates for 1650s, 1720s and 1770s by de Vries and Woude 1997, p. 499 and assumes constant growth rates between estimates. 1790: estimated by de Vries and Woude 1997, p. 495. I assume that the growth rate of the share of re-exports from the 1770s to 1790 is equal to the growth rate from the 1720s to the 1770s.</td>
<td>1716 and 1790: from Arnould 1791, table 2 (for 1790, extrapolated from 1787 numbers using the 1753-1787 growth rate). It provides re-exports as well (table 2-F) 1753: from Arnould, table 10, using as a modifier the mean between the ratio between his numbers and the Bureau’s in 1790 and 1716: +168% (See Daudin 2005, p. 201). Re-export share extrapolated from 1716 and 1790.</td>
<td></td>
</tr>
</tbody>
</table>
Bibliography


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