

The character of growth before ‘modern economic growth’

The GDP of Holland between 1347 and 1807

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Abstract

On the basis of a newly constructed dataset of the national accounts of the province of Holland in the period between 1347 and 1800, we analyze the pattern of growth in this region, which was one of the most prosperous and dynamic parts of the pre modern European economy. We demonstrate that this economy was characterized by almost continuous but highly unstable economic growth caused mainly by exogenous shocks related to international trade and shipping, and harvest fluctuations. The causes of this growth vary over time. Yet, the start of the Golden Age was characterized by the increase of total factor productivity. TFP-growth was an important factor behind growth in the period until the 1620s, was negative during the middle decades of the 17th century, and became positive again after the 1660s. This suggests a surge of technological change during the 1540-1620 period, followed by much more incremental changes in the next two centuries.

Keywords: GDP, national accounts, Holland, economic growth, historical development

JEL Codes: E01, E24, N13, N53, N63, N73

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INTRODUCTION

The debate about the character of economic growth before the Industrial Revolution of the late eighteenth century has gone through a number of stages. In the 1960s and 1970s the early modern economy of Europe was considered to be basically stagnant, a view that was most clearly expressed by Wilhelm Abel¹ and by the representatives of the French Annales school.² In the 1980s and 1990s this picture came under attack from several sides. Economic historians of the early modern period began to point out that the industrialization of the late eighteenth and early nineteenth centuries was made possible by structural changes that took place during preceding centuries. The development of urbanization and international trade networks,³ agricultural productivity,⁴ proto-industry,⁵ national patterns of specialization⁶ and labor markets,⁷ the ‘consumer revolution’ and the ‘industrious revolution’,⁸ all demonstrated that this was a dynamic period, when the basis was laid for the industrialization of Western Europe after c. 1780. This ‘revolt of the early modernists’, as Jan de Vries has called it⁹, has resulted in a much more optimistic interpretation of economic growth during the centuries before the Industrial Revolution.¹⁰ In their book on ‘The First Modern Economy. Success, Failure, and Perseverance of the Dutch Economy, 1500-1815’, Jan de Vries and Ad van der Woude have carried this ‘revolt of the early modernists’ to its logical conclusion. Their thesis is not only that The

¹ Abel, *Agrarkrisen und Agrarkonjunktur*.

² Le Roy Ladurie, “L’histoire immobile”, pp. 673-92.

³ De Vries, *European urbanization*.

⁴ De Vries, *The Rural Economy*; Hoffman, *Growth*.

⁵ Mendels, “Proto-industrialization”, pp. 241-61.

⁶ Kussmaul, *A general view*.

⁷ Lucassen, *Migrant Labour*.

⁸ De Vries, “The industrious revolution”.

⁹ Idem, p. 253.

¹⁰ An early example for Holland is Riley, “The Dutch economy after 1650,” who claims that even in the 18th century, which generally was considered a period of stagnation, there was growth.

Netherlands in this period can be characterized as 'the first modern economy', but also that it went through a process (or rather a cycle) of 'modern economic growth' between 1500 and 1815.¹¹

This re-assessment of the early modern period has not gone unchallenged, however. The old orthodoxy that the pre 1800 world was basically a Malthusian one in which the welfare of the population was stagnant in the long run, has returned to the scene with the appearance of Greg Clark's 'A Farewell to Alms', and the heated debate to which it gave rise.¹² Clark mainly focused on English data and estimates – most importantly (and controversially)¹³ estimates of real wages – and did not pay a lot of attention to what was happening in the rest of Europe, however.

So far, the answering of the questions about the growth trajectory of the European economy before industrialization has thus been severely constrained by data problems. The optimism of De Vries and Van der Woude is based on a few scattered data points concerning possible levels of income in the Dutch Republic (or Holland),¹⁴ whereas the pessimism by Clark is largely based on his real wage series for England.¹⁵ What is missing, in our opinion, is a consistent set of estimates of the national accounts of the European countries in the pre-1800 period, making it possible to study the process of

¹¹ De Vries and Van der Woude, *First Modern Economy*, p. 721.

¹² Taken from a long list of reviews for example: Pomeranz, "Gregory Clark, Farewell to Alms"; Harley, "Gregory Clark, Farewell to Alms."

¹³ Broadberry, Campbell, and Van Leeuwen, "The sectoral distribution of the labour force."

¹⁴ Jan de Vries already in his study of the system of inland transport in the 17th and 18th century developed an innovative way to estimate income changes in this period, but also these results were tentative: De Vries, *Barges and capitalism*, pp. 241-270.

¹⁵ His GDP estimates are also largely based on the real wage series and the assumption of a constant per capita days worked between 1200 and 1850. Furthermore, his main claim is, contrary to Shaw-Taylor and Jones, "An industrializing region" and Shaw Taylor and Wrigely, "The occupational structure of England", that the release of labor from agriculture only started after the mid-18th century, which again suggest a stagnationist view until around 1800. Estimates of faster economic growth between 1270 and 1800 in which agricultural labor was released already since the 17th century is brought forward is discussed by Broadberry, Campbell and Van Leeuwen, "The sectoral distribution of the labour force."

economic growth in detail. A research project with the aim to put together these sets of estimates of long-term economic growth in Western Europe before the Industrial Revolution already started in the 1990s (initiated by Herman van der Wee and Angus Maddison)¹⁶, and is now reaching a stage in which detailed and annual estimates of GDP per capita for key regions in Western Europe are being put together such as for England, Italy, and Spain.¹⁷ This paper presents the results of such a project for Holland, the most populous and wealthy province of the Netherlands, for which relatively rich historical sources are available making it possible to construct annual estimates of GDP and its components.

The case of Holland is of obvious importance for the debate sketched in the introduction. It was undoubtedly one of the most dynamic parts of Europe in the centuries before 1800 and had, as demonstrated by De Vries and Van der Woude, already a relatively modern institutional framework.¹⁸ Their hypothesis of ‘a first round of modern economic growth’ is largely based on the case of this province. A reconstruction of the national accounts of the province should make it possible to answer the question if (and when) this region generated such a process. Or was its development a typical example of ‘Smithian’ growth, driven by the expansion of international trade and resulting from increased specialization and improved allocation of resources?¹⁹ Was it another example of the wave-like character of an ‘efflorescence’, typical of the pre industrial economy,

¹⁶ E.g. Blomme and Van der Wee, ‘the Belgian economy’; Malanima, ‘Italian economic performance’; Yun, ‘Proposals to Quantify Long Term Performance in the Kingdom of Castile’; Van Zanden, ‘Early modern economic growth.’ This work has been completely ignored by Clark, however

¹⁷ See for example Broadberry et al, “British Economic Growth,” Prados de la Escosura and Alvarez Nogal, “The rise and decline of Spain,” and Malanima, “Italian GDP.”

¹⁸ De Vries and Van der Woude, *The First Modern Economy*, pp. 693-699.

¹⁹ See Mokyr, *The Enlightened Economy*, p.5.

which in the long run did not lead to a (much) higher level of GDP per capita?²⁰ How important were ‘modern’ drivers of economic growth such as technological change and the accumulation of human and physical capital? And, assuming that De Vries and Van der Woude are correct that institutions in this part of the world were indeed remarkably modern already in the 16th and 17th century, why did this ‘first modern economy’ cease to generate growth and structural change after 1650 or 1670? Or did it continue to grow after 1670?

The focus on the province of Holland has big advantages: it was the most urbanized, dynamic and richest province of the Dutch Republic, and is therefore typical for the pattern of change that can be found in the most developed parts of Western Europe in this period.²¹ Studying this case inform us about the growth processes that were possible in this part of the European economy, which were not limited by the decreasing returns of the agricultural sector (because this sector was so small in this region). Moreover, we were also able to reconstruct the basic outlines of the growth trajectory of the Holland economy in the late Medieval period (between 1347 and 1500), which makes it possible to study a period in which structural transformation was dramatic and an important source of economic growth. By adding these 150 years to the growth record, we can also put the experience of this economy during its ‘Golden Age’ in perspective.

²⁰ Goldstone, ‘Efflorescences’.

²¹ Growth in Holland was probably faster between 1500 and 1650, but after 1650 the ‘periphery’ of the country started to catch up, and it was probably more dynamic in the late 17th and 18th century, as a result of which the overall performance between 1500 and 1800 may have been very similar; it requires another research project to reconstruct and analyze these patterns in detail; see also the discussion about these issues in; De Vries and Van der Woude, *First Modern Economy*, 172-179.

Finally, our intention is to chart the most important features of long term growth in Holland in this paper, focusing on its ‘proximate causes’; we do not intend to test ideas about its ‘ultimate causes’ from new institutional economics or unified growth theory.

THE DATASET

We think we are now closer to answering above questions, because we have built a detailed dataset of the national accounts of Holland between 1510 and 1807, and also developed a likely ‘scenario’ for the pace and character of economic growth during the late Medieval period. As a result, we can present estimates of the development of GDP per capita for the whole 1347-1807 period; this also includes estimates of the structure of the economy (the share of agriculture in GDP, for example). In the appendices we give the details about this project; it describes the way in which the estimates of the national income for Holland before 1807 have been put together. The aim of the project was, for the period between 1510 and 1807, to produce annual estimates of gross value added of the main industries of the Holland economy in both current and constant prices, which could then be used to produce estimates of total GDP (and GDP per capita). The starting point consisted of two benchmark estimates, for 1510/14 and for 1807, the result of previous research into the structure of the Holland economy at the beginning of the 16th century,²² and into the national accounts of the Netherlands in the 19th century.²³ Moreover, we used previous research into the development of Holland in the late medieval period, to produce tentative estimates of the growth performance of that period

²² Van Zanden, “Taking the measure of the early modern economy.”

²³ Smits, Horlings, and Van Zanden. *Dutch GNP and its components, 1800-1913*. The two studies by Horlings, *The Economic Development of the Dutch Service Sector* on the services sector and by Jansen, *De industriële ontwikkeling in Nederland* on the industrial sector in the first half of the 19th century were important as models for estimating output and value added in different parts of the economy.

as well, but these pre 1510 estimates are due to data constraints based on a much smaller body of evidence. We applied the standard System of National Accounts (SNA) methodology, concentrating on - as in previous work - the output side of the economy.

We will first briefly explain the estimates concerning the 1510-1807 period. The challenge of this part of the project was to find sources that reflect the annual variation in output or value added in different industries between 1510 and 1807 in order to ‘interpolate’ between the two benchmark estimates for 1510/14 and 1807. In the process of working with the data, we sometimes were able to improve on the estimates made for 1510/14 and for the 1807-1913 period, as a result of which the resulting estimates of GDP growth between these two benchmarks is slightly higher than we previously estimated (these, relatively small, discrepancies between earlier studies and the estimates presented here are discussed in appendix 1)²⁴. Moreover, the 1807 estimates related to the Netherlands as a whole, and in order to link the Holland estimates to those of the Netherlands, we had to estimate its share in Dutch GDP, which also lead to a number of (generally small) modifications of the original estimates (appendix 1).

The economy has been broken down into three sectors (primary, secondary and tertiary). The primary sector includes agriculture and fishing (herring fishing and whaling); the main branch we miss here is fresh water fisheries which were quite important in the 16th century, but declined afterwards.²⁵ The secondary sector consists of textiles (wool and linen), clothing, construction, peat digging, food (bakeries, brewing, gin – *jenever* – distilling, and other foodstuffs), paper, shipbuilding, printing, soap

²⁴ The appendices are provided in the working paper version to be downloaded at: http://www.cgeh.nl/sites/default/files/WorkingPapers/CGEH.WP_No4_vanZandenvanLeeuwen.mar2011.pdf

²⁵ See De Vries and Van der Woude, *The First Modern Economy*, pp. 237-239.

production and sugar refining. The tertiary sector was covered by international shipping, international trade, domestic trade, inland transport (via inland waterways), banking, education, government services (military sector and the rest), housing, domestic services, and professional services, which were approximated by notaries and book traders. In sum, we have annual estimates of the value added (in current and constant prices) of 27 branches of national income, many of which are constructed on the basis of several underlying time series; for example, the output of shipping sector is based on data on shipping to the Baltic, Asia, the Americas (including the slave trade), and ‘the rest’, the other trades which had to be estimated on the basis of the number of ships entering the Netherlands in these years. A lot of the underlying data relate to yields of various taxes, such as the famous Soundtoll registers and the many indirect excises levied by the government.²⁶ In addition, the detailed accounts of the Dutch East Indies Company, the central government of Holland, the Amsterdam Exchange Bank (Wisselbank) and the University of Leiden have also been used for the project.²⁷ Moreover, thanks to the work by Posthumus, Noordegraaf, De Vries and others, there is a wealth of information on the development of prices and wages, which is also of fundamental importance for reconstructing the national accounts.²⁸ The weakest part of the project are the estimates of technical coefficients and cost structures, for which we often have only very tentative estimates, related to one or two years (for the soap industry, for example, we know for only one year, 1699, what the share of value added is in gross output). We were mainly

²⁶ Bang and Korst, *Tabeller over Skibsvart og Varetransport*, and Fritschy and Liesker, *Gewestelijke Financiën*.

²⁷ De Korte, *De Jaarlijkse financiële verantwoording in de VOC*; Fritschy and Liesker, *Gewestelijke Financiën*; Van Dillen, *Mensen en achtergronden*; Sluijter, ‘*Tot ciræt, vermeerderinge ende heerlyckmækinge der universiteyt*’.

²⁸ Posthumus, *Nederlandsche prijsgeschiedenis*; Noordegraaf, *Daglonen in Alkmaar*; De Vries and Van der Woude, *The First Modern Economy*, pp. 609-614; for a recent overview see Van Zanden, “What happened to the standard of living before the Industrial Revolution?”

interested in the long term changes in the economy of Holland; for lack of sources, gaps in series sometimes had to be interpolated, but this probably does not affect the long term picture that we get. The *Informacie*, the very extensive and detailed census of 1514, which is probably the richest source for the study of the national accounts in the pre 1800 period, to some extent compensates for the data problems of the 16th century. From the 1580s onwards, when the newly independent Dutch Republic expands and starts to raise many new taxes, the data flow increases steadily, and the quality of our estimates increases as well.

These estimates show, as has been pointed out before, that already at the beginning of the 16th century the structure of the economy of Holland was very modern, with, for example, almost half the population living in cities and less than a quarter of the labour force active in the agricultural sector.²⁹ This of course raises the question whether the roots of ‘modern economic growth’ should not be sought in the period before 1500.³⁰ To address this question, we have also tried to chart the development of GDP per capita for the late medieval period, going back to the 1347, or just before the population decline caused by the Black Death. Unfortunately, we only have relatively good information on the performance of the agricultural sector (mainly arable agriculture), via the availability of a number of more or less representative series of the yields of tithes, and on the development of the urban population (and in particular the population of Leiden) in this

²⁹ See Van Zanden, “Taking the measure of the early modern economy”, p. 134, 148.

³⁰ See the discussion in Van Zanden, “The revolt of the early modernists: an assessment.”

period. This was used to develop a tentative scenario of what happened to GDP between 1347 and 1510 (the details are explained in appendix 2).³¹

The estimates of the national accounts of Holland are, in our view, the best summary of the information that is available about the long term development of the economy of this region in that period. The beauty of the system of national accounts is that it allows for a consolidation of all available information, from many different sources and studies, which individually all have their limitations and are subject to certain margins of error, into one consistent framework, the SNA, which ‘takes care’ of the selection and the weighting of all the data. The result is a set of estimates of GDP and its components that is, in our view, the state of the art summary of our knowledge about this topic.

The estimated series obviously have their weaknesses. One weakness mentioned already is that in particular for the 16th century we often do not have annual observations of the variables measured. This can be quantified: for the first period (1510-1580) we have annual observations for only 35% of the economy (the rest is therefore based on intrapolarations); after 1580 (when the Dutch republic emerges as an independent state and starts to produce large amount of data), this rises to almost 60% (59.1% in 1580-1650 and 59.5% in 1650-1750), to decline a bit (to 54.6%) in the 1750-1807 period.

It is also possible to address the issue of the degree of reliability of our estimates. In order to assess this it is necessary to estimate error margins. We applied a method to do this, developed by Feinstein and Thomas, who take as their starting point subjective estimates of the margins of error of the underlying series, made by the authors of the

³¹ The appendices are provided in the working paper version to be downloaded at: http://www.cgeh.nl/sites/default/files/WorkingPapers/CGEH.WP_No4_vanZandenvanLeeuwen.mar2011.pdf

series. Their argument for doing this is that '[h]owever problematical such subjective assessments of unknown errors may be, they are much more informative than general statements formed from some favoured permutation of stock phrases (these estimates are very: 'approximate', 'imperfect', 'unreliable', 'tentative', 'uncertain', 'fragile'; they are: 'a best guess', 'a rough guide', 'an order of magnitude', 'a crude indication'; or, very occasionally, they are: 'reasonably reliable', 'broadly acceptable'; and so on).' In calculating the error margins of the estimated series, they follow Chapman and attach margins of error to each component series, where four categories of error margins are distinguished: 3% for "firm estimates", 10% for "good estimates", 20% for "rough estimates", and 35% for conjectures.³² Since these error margins were based on 95% probability, they are equivalent with two standard errors.

We attached these error margins to all series and time periods in our estimates; give the quality of the underlying data, we think that the estimates for the agricultural sector are weakest, and that those of the services sector have on average the lowest margins of error. The next step is to aggregate into an error margin for the total national income. Since some errors will be above, and other below the true value of the component series, it follows that, as long as the series are derived independently, the errors may offset each other. Therefore, Feinstein and Thomas (2001, 17) proposed the following equation:

$$\sigma_v = \sqrt{\sigma_x^2 + \sigma_y^2 + 2r_{xy}\sigma_x\sigma_y}$$

³² Chapman, *Wages and Salaries in the United Kingdom 1920–1938*; ; her categories have been adopted by Feinstein and Thomas 2001 (and by Smits, Horlings and Van Zanden 2000)

, where the standard error of the over-all series (σ_y) is equal to the square root of the sum of the variances of series X and Y, as well as the interdependence component of the two series r_{xy} , i.e the correlation coefficient of the two series. Following a multiplicative procedure of doing this for all 27 series in our dataset and all time periods, we arrived at estimates for the error margins as given in below Table 1. The estimated error margins are considerable (10-12% for the period before 1650), but decline over time (until the middle of the 18th century). We did not apply the same method to the pre 1510 estimates, because the number of underlying series is very limited, estimates are based on indirect evidence and therefore the margins of error are even much higher for that period – our subjective estimate is that those margins for the total GDP series for 1347-1510 are at least two to four times the level of the post 1510 period (and therefore vary between 20 and 40%). However, as shown in Figure 1, these error margins do not change the trend in the data.

Table 1

Margin of error in GDP and its components (95% probability)								
	Agriculture		Industry		Services		GDP	
	Mean GDP	% margin of error (95%)	Mean GDP	% margin of error (95%)	Mean GDP	% margin of error (95%)	Mean GDP	% margin of error (95%)
1510-1580	16,226.4	30.2%	17,907.3	15.1%	44,631.0	9.7%	78,764.7	11.6%
1580-1650	23,105.0	27.8%	39,362.4	17.2%	102,173.8	7.3%	164,641.2	10.8%
1650-1750	29,954.4	21.2%	58,754.7	6.3%	120,201.3	5.0%	208,910.3	4.1%
1750-1807	35,286.8	31.4%	60,809.4	8.4%	128,160.1	3.7%	224,256.3	7.0%

Figure 1.
PER CAPITA GDP (1800 CONSTANT GUILDERS, INCLUDING ERROR MARGINS)

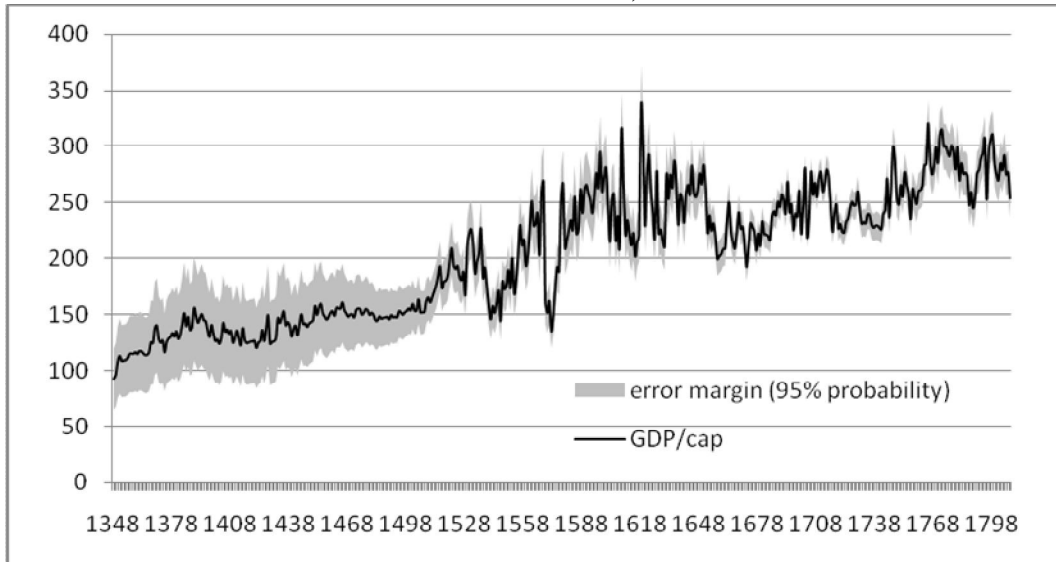
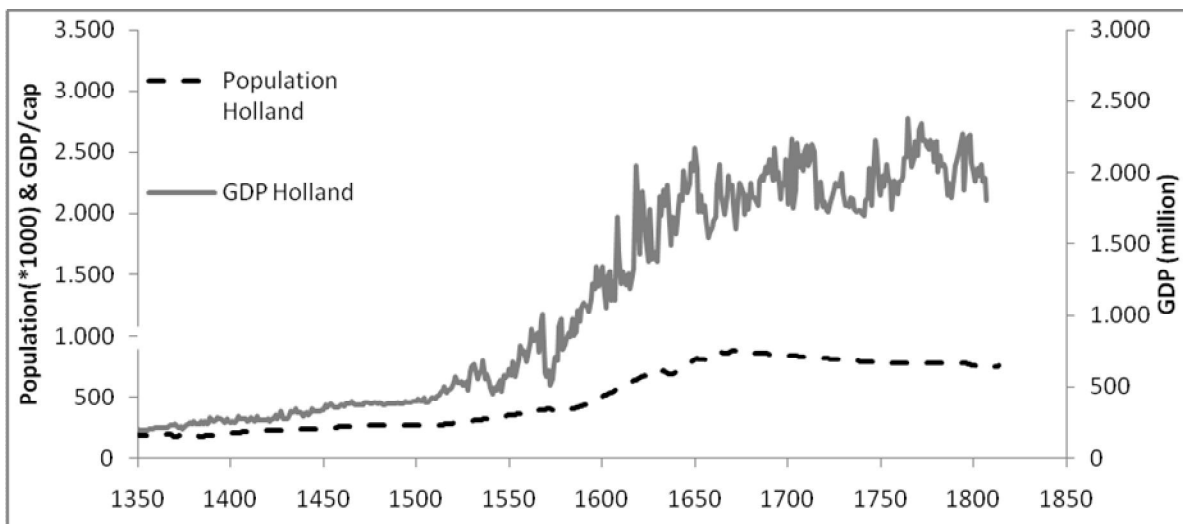


Figure 2

GDP (million 1990 GK dollars), POPULATION (*1000) IN HOLLAND, 1347-1807



Source: Appendix 1 and 2.

The ‘big picture’ that emerges from putting together the estimates for population and GDP for the late medieval and early modern period is presented in Figures 1 and 2. Three periods can be distinguished. During the late Medieval period GDP growth and population growth was rather slow; there was a strong increase in GDP per capita in the decades after the Black Death of 1348, stability or even some decline between the 1370s and the 1420s, a resumption of growth in the middle decades of the 15th century, and stability or even some decline towards the end of that century).³³ More importantly, the underlying trend was clearly upward, in spite of the fact (for example) that already during the middle decades of the 15th century population levels surpassed the pre-1348 peak, implying that per capita growth was not simply a due to population decline. Margins of error are large for this period, however, so we cannot be too confident about the exact rate of economic growth.

The second period – of rapid GDP combined with rapid population growth – starts during the first decades of the 16th century and ends during the middle decades of the 17th century (Figure 2). This is the classical ‘first round of economic growth’ as analysed by De Vries and Van der Woude. It is after about 1670 followed by a third period of stable population levels (or even a slight decline), combined with a slow increase in total GDP. The picture of per capita growth is more nuanced, however. Again the trend is clearly upward between 1500 and 1620, but per capita growth is only marginally more rapid than before 1500, and appears to end already in the 1620s, when the per capita series shows a number of strong peaks. The 1620-1670 period is one of rapid GDP growth, but stability – perhaps even some decline – in the per capita series (because population growth is so rapid in these years, partially due to massive immigration from the neighbouring

³³ De Boer, *Graaf*, 211-333; Van Bavel and Van Zanden, ‘Jump-start’.

countries). The eighteenth century performance of the Holland economy is better than expected on the basis of current literature: GDP per capita recovers to the level of the peak years before 1650, and income levels in the 1760s and 1770s are even higher than ever before (and even the 1790s are in terms of GDP per capita not bad at all).

Perhaps the most striking result is the almost continuous growth of GDP per capita at on average 0.19 percent per year during the 1347-1807 period. Growth is already quite strong in the late medieval period, when during the second half of the 15th century per capita GDP increased at a slightly higher rate of 0.25 percent per year. Surprisingly, between 1500 and 1800 the familiar pattern of growth before ca 1670 and stagnation or even decline afterwards, is not that obvious in the per capita estimates. What is perhaps most striking of the estimates presented in Figures 1 and 2 is the continued increase in GDP per capita in the 18th century, in particular in its second half. Seen in the very long run, per capita growth in the 18th century is not very dissimilar, and not (much) lower, than in the preceding three centuries. This is in sharp contrast with the usual view that growth came to a complete standstill, or was even negative, in the century and a half after 1670.³⁴

It appears that trend growth of per capita GDP was remarkably stable in the very long run; in all periods - during the late Middle Ages, the period of expansion between 1500 and 1670 and the period of relative stagnation after 1670 - we witness an ongoing

³⁴ There are reasons to be even more optimistic about the growth performance during the 18th century. The Netherlands exported a lot of capital during this period, which led to strongly increasing flows of income to Dutch citizens. This means that the growth of real income was faster than the development of real product, measured here. On the basis what is known about these investments and income flows, it can be estimated that at the end of the 18th century Dutch GNP was perhaps five percent higher than GDP, a difference which was close to zero at the start of the century (Van Zanden and Van Riel, *The Strictures of Inheritance*, p. 21). Holland was contributing disproportionately to this, and may have received about 70 to 80 percent of the income from abroad, increasing its income by 6-8%. Real incomes therefore grew more than the GDP estimates suggest, and much of this increase was concentrated in the second half of the 18th century.

growth of per capita income. Between 1510/14 and 1807/08 GDP per capita increased by about 60%, somewhat more than was expected on the basis of the comparison of the two benchmark (1510/14 and 1806/7), which pointed to an increase of about 50%.³⁵ During the period of more than 450 years (1347-1807) per capita GDP more or less doubled.

Another, equally striking feature of the reconstructed series is the high instability of the economy. The second striking feature of the estimated national accounts is the instability of the pre-1800 economy. From the middle decades of the 16th century onwards (when the number of series with annual observations increases), trend growth is almost overshadowed by enormous swings in all sectors of the economy. There is rapid growth during the middle decades of the 16th century (when Holland is closely linked to the Antwerp economy), followed by almost complete collapse during the first years of Revolt against Philip II (between 1566 and 1573), when, from peak to trough, income per capita almost halved. It was probably the worst depression in early modern Dutch history. The period between the mid 1570s and 1620 was one of very rapid growth, initially in spite of the war with Spain, but the Truce with Spain between 1609-1621 led to a further acceleration of economic expansion. The next phase, the renewed war between 1621 and 1648, is again a period of continued growth (although the peak of the early 1620s is not surpassed). The peace with Spain in 1648 was followed by a sharp contraction of the economy, however, partially the result of the 'peace dividend', because expenditure on the army and the navy contracted sharply in these years (Figure 4). The rest of the economy also did not fare very well in these years. The sharp decline after 1713 has the same explanation: a massive reduction of public spending on defense. If we

³⁵ Van Zanden, "Early modern economic growth"; Van Zanden, "Taking the measure of the early modern economy", pp. 153-154; the explanation is that our estimates differ sometimes from the benchmarks established for 1510/1514 and 1807; see the detailed discussion in appendix 1, Table 1.

ignore the expenditure on navy and army the growth of GDP per capita becomes smoother, but the growth retardation of the second half of the 17th century still seems to be there.³⁶

What are the causes of these huge swings in the level of GDP? We can start the decomposition of the variance by, for simplicity sake, assuming that we have the variance of two series:

$$X \sim (\mu_X, \sigma_X^2)$$

$$Y \sim (\mu_Y, \sigma_Y^2)$$

, where μ and σ^2 denote the mean and the variance of the series X and Y respectively and s and z are their variances. Now, if add the total of the two variables together, we get:

$$Z = X + Y$$

Where the new series Z has a mean $\mu_X + \mu_Y$ and, if they are uncorrelated, the variance is simply the sum of their individual variances. In case the series are correlated Z still has the same mean as before but the variance becomes:

$$\sigma_Z^2 = \sigma_X^2 + \sigma_Y^2 + 2 \cdot \sigma_{XY}$$

, where σ_{XY} is the covariance of X and Y . In other words, if the series are positively correlated, the variance of the sum of the series will go up. We can generalize this equation for N variables as follows:

$$\text{Var}(Z) = \sum_{i=1}^N \text{Var}(X_i) + 2 \sum_{i < j} \text{Cov}(X_i, X_j)$$

³⁶ In the submitted version of the paper this section is summarized as follows: In the working paper version of this paper we have analyzed the causes of high instability in detail and compare it with the much more stable growth path of the Netherlands after 1815. It could be demonstrated that the sector of international services was the main cause of high instability – industrial and agricultural output was fluctuating much less violently.

The results of the decomposition of the variance are presented in Table 2. It appears that the services sector is the main cause of volatility; especially (international) trade fluctuates enormously, largely due to exogenous shocks such as wars (Jonathan Israel gives a detailed overview of these developments).³⁷ The openness of the Dutch Republic therefore contributed significantly to the instability of its economic development, a factor that declined after 1670.

The same method can be used to analyse why the variance of GDP and its components was so much smaller during the 19th century (Table 3). We concentrate on the three main sectors here. The services sector is still the most important source of instability although declining after 1807. However, one has to keep in mind that after 1807 the data refer to the Netherlands instead of Holland. More interesting is a relative decline in volatility in industry. Even though we are again confronted with a change to the Netherlands in 1807, the decline in industrial volatility is still part of a trend that already started after 1670 and picks up again only after ca 1850 (see Table 3). This suggests that the decline in growth in the Holland/Netherlands economy was largely caused by a decline in dynamism of the industrial sector and, to a smaller extent of the trade sector. It is noteworthy that not only the effect of industry on volatility declined between 1670 and 1850, but also that also the general coefficient of variance declined between 1670 and 1850, possibly caused by the slower GDP growth during this period, which reduced the variance and decreased the CV.³⁸

³⁷ Israel, *Dutch Primacy in World Trade, 1585-1740*.

³⁸ For a description of the effect of the presence of a trend on the coefficient of variance see Földvári and Van Leeuwen, "What can price volatility tell us about market related institutions?"

Table 2

. DECOMPOSITION OF THE VARIANCE OF GDP PER SUBSECTOR IN
HOLLAND, 1510-1807

	1510-1670	1670-1807	1510-1807
Agriculture	9.40%	6.48%	11.04%
Agriculture	6.14%	7.15%	8.55%
Fisheries	3.26%	-0.66%	2.49%
Industry	26.17%	-0.43%	27.03%
building	6.82%	2.01%	6.01%
textiles	7.36%	2.14%	8.92%
food	11.20%	-4.33%	10.96%
Other industry	0.79%	-0.25%	1.14%
Services	64.43%	93.95%	61.94%
trade	30.75%	82.14%	27.80%
transport	15.90%	1.07%	12.15%
government	0.07%	2.68%	2.15%
army	8.30%	6.91%	9.11%
Other services	9.41%	1.14%	10.73%
GDP	100.00%	100.00%	100.00%

Table 3

DECOMPOSITION OF THE VARIANCE IN GDP, 1510-1913

	Holland		Netherlands	
	1510-1670	1670-1807	1815-1850	1850-1913
Agriculture	9.40%	6.48%	24.72%	7.71%
Industry	26.17%	-0.43%	30.16%	38.87%
Services	64.43%	93.95%	45.12%	53.42%
GDP	100.00%	100.00%	100.00%	100.00%
Coefficient of Variation	0.42	0.11	0.18	0.37

We can test whether growth is continues over the entire period between 1347 and 1800.

Since we do not want to impose breakpoints in the model, we use the Quandt Andrews

unknown breakpoint test.³⁹ The model takes the first and last 15% of observations in the sample and then tests for all in-between years whether including a breakpoint improves the fit of the model. The 0-hypothesis is that no breakpoints exist. The results are reported in Table 4. This shows the possible F-statistics which indicate if the 0-hypothesis is rejected. As one can see, in all cases the p-value is 1, indicating that the hypothesis of no breakpoints cannot be rejected.

Table 4

QUANDT-ANDREWS UNKNOWN BREAKPOINT TEST FOR PER CAPITA GDP
GROWTH

Quandt-Andrews unknown breakpoint test
Null Hypothesis: No breakpoints within trimmed data
Equation Sample: 1357 1850
Test Sample: 1429 1763
Number of breaks compared: 335

Statistic	Coefficient (without smoother)	Coefficient (with Baxter- King smoother)
Maximum LR F-statistic (without smoother: 1579) (with smoother: 1635)	5.124096 (0.9226)	6.014991 (0.1597)
Exp LR F-statistic	0.757583 (0.9964)	1.070419 (0.1775)
Ave LR F-statistic	1.145506 (1.0000)	1.549063 (0.1806)

Note: probabilities (in parentheses) calculated using Hansen's (1997) method
Warning: estimation sample is non-continuous (probabilities calculated assuming a continuous sample)

One might argue that above results have low power because either more breakpoints are present, or because of strong volatility in the series caused by wars and

³⁹ Quandt, "Tests of the hypothesis that a linear regression system obeys two separate regimes." and Andrews, "Tests for Parameter Instability."

plagues making the breakpoints turn out insignificant. However, we tried this test also on sub periods which did not alter the results. Furthermore, the volatility present in the data consists largely of changes in the level of GDP per capita, while during the inbetween periods growth seems to have continued. This is a finding that has also been found for present day developing economies: countries with good institutions know long periods of stable growth while countries with sub-optimal institutions experience relatively fast growth inbetween periods of stagnation.⁴⁰ Since this seems to apply to Holland as well, we presented in the second regression in Table 4 the same coefficient after using a Baxter-King filter to remove volatility. In the smoothed and non-smoothed series the coefficients are insignificant, suggesting that no breakpoint can be determined. Table 4, however, does show that, if a breakpoint is present, it should be around either 1579 (acceleration) or 1635 (slowing down).⁴¹

STRUCTURAL CHANGE AND GROWTH BETWEEN 1347 AND 1510

Although per capita growth seemed to have taken place almost during the whole period, this does not imply that the character and sources of per capita growth remained the same over the entire period. Before we analyze the ‘proximate causes’ of growth in the period after 1500 in some detail, first a few words about the late Medieval period. This was without doubt a period of very rapid structural change. In the 1340s, between 50 and 55% of GDP originated in agriculture, and probably an even larger share of the labor force was employed in the primary sector. This changed in the following 150 years. At about 1490

⁴⁰ Pritchett, “Understanding patterns,” Jerzmanowski, “Empirics of hills, Mountains, plateaus and plains.”

⁴¹ We checked these results also via the CUSUM test, a graph showing the one-step recursive forecast errors. If the model at the start of the period remains the same for the entire period, e.g. a constant per capita growth rate, the recursive forecast error must not be significantly different from 0; such a graph also shows no breakpoints during the 1347-1807 period, confirming the results of table 2.

the share of agriculture had already declined to less than 20%, after which the process of structural change proceeded much more slowly (Figure 3). At the same time the share of the population living in urban areas increased from 23% just before the Black Death to 45% in 1514, making Holland the most urbanized region in Europe.⁴² This dramatic restructuring of Holland's economy was induced by exogenous shocks that undermined the agricultural basis of the region; a rising water level, storm surges (such as the St. Elisabeth flood of 1421) and the gradual subsidence of the peat lands on which most of the arable farming was taking place sharply reduced arable output from the 1370s onwards.⁴³

In the long run, the economy of Holland was able to respond well to this crisis, however. Within the agricultural sector there was a switch towards livestock farming; exports of cheese, butter and livestock increased, which was accompanied by a rapid commercialization of this sector. On the countryside new 'proto-industrial' activities also spread quickly: spinning for the urban wool industry, for example. During part of the year the rural population became active as wage workers on the herring fleet and on the merchant fleet, in dike building and maintenance and in peat digging.⁴⁴ Finally, the urban sector also expanded in this same period, stimulated perhaps by immigration from the countryside.⁴⁵ Two major export industries, woolen textiles and brewing, developed rapidly, and Holland also acquired a strong international position in international shipping (long distance trade was still concentrated in the southern Netherlands).

⁴² Van Bavel and Van Zanden, "The jump start of the Holland economy", p. 505.

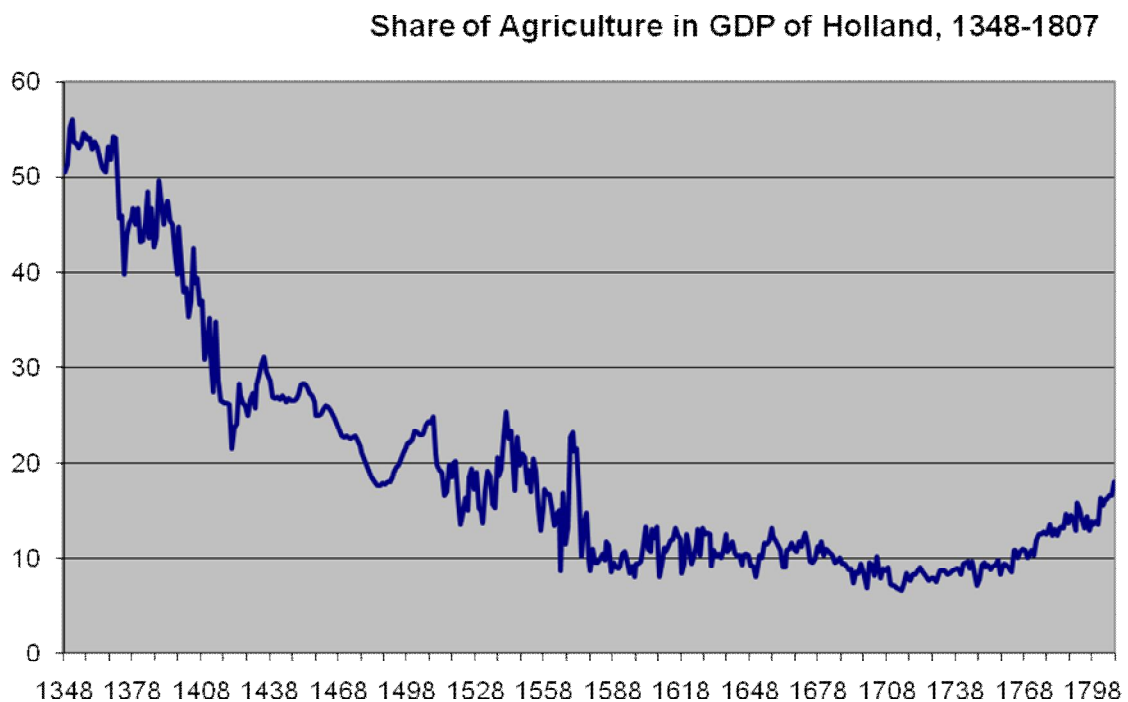
⁴³ De Boer, *Graaf en Grafiek*, pp. 218-224.

⁴⁴ Van Bavel, "Early proto-industrialization in the low countries?"

⁴⁵ De Boer, *Graaf en Grafiek*, pp. 142-164.

In short, the crisis in agriculture led to a rise of market-oriented activities in which the Holland economy specialized. This was, however, made possible by the relatively efficient market institutions that had emerged in preceding centuries. As a result of these changes, in 1514 only about half the rural population was active in agriculture – other rural activities had become equally important.

Figure 3
THE SHARE OF AGRICULTURE IN TOTAL GDP IN HOLLAND, 1348-1807



Sources: see Appendix 2.

Structural change obviously was a very important source of growth in the late medieval period. The benchmark estimates for 1510 (Table 5) demonstrate that the level of labor productivity in industry and in services was much higher than in the primary

sector. Switching 30-40% percent of the labor force from low productive agriculture to high productivity activities in the secondary and tertiary sector could therefore easily account for an increase of 15-20% of GDP per capita. Total growth was much more, however, almost 60% in per capita terms. A first per capita growth spurt is related to the effect of the sudden decline of the population after 1347. The return to pre-Plague population levels does not result, however, in a decline in income levels; growth in fact continues in the 15th century, when population growth also picks up again. During a period of high nominal and real wages, the Holland economy was able to acquire a strong international position in the production of textiles (woolens and linen), beer, herring, peat, and shipping.⁴⁶ This suggests that growth was to a large extent also driven by technological change making possible increases in total factor productivity, which were probably also linked to the economies of scale that resulted from urbanization and specialization.

Table 5
STRUCTURE OF THE ECONOMY AND RELATIVE LABOR PRODUCTIVITY,
1510 AND 1807

		Primary*	Industry	Services
1510	GDP	27.2%	35.1%	39.7%
	Occupational structure	39.4%	38.4%	22.2%
	Labor productivity	0.64	0.91	1.79
1807	GDP	18.2%	31,3%	50.5%
	Occupational structure	23.0%	42.0%	35.0%
	Labor productivity	0.79	0.74	1.45

* includes agriculture, fisheries, and peat digging
Source: see Appendix 1.

⁴⁶ Van Bavel and Van Zanden, "The Jump-Start", pp. 511-526.

THE PROXIMATE CAUSES OF GROWTH BETWEEN 1510 AND 1807

As a result of the dramatic decline of agriculture in the late medieval period, structural change in the next three centuries was rather limited. What happened between 1510 and 1807 – to make a long story short – was that the share of services in the labor force and in GDP increased strongly, which is what may be expected during economic development. Moreover, its relative productivity remained higher than in industry and agriculture, implying that this shift contributed to income growth. At the same time, the share of the primary sector in GDP (and employment) declined (from 27% to 18%); the share of industry in employment increased somewhat, but in GDP it fell, indicating a relative fall in its productivity (but the 1800-1812 period was exceptional, with very high agricultural prices, inflating the relative productivity of agriculture).

Consistent with these changes in relative share of sectors, the services sector was indeed growing relatively rapidly, as Table 6 demonstrates, but this was almost matched by industrial growth (0.53 percent annually of industrial value added, compared with 0.56 percent of services); agriculture was in fact the least dynamic from this point of view (0.28% annually). Within industry, textiles is the most dynamic industry, while within services, banking, government (including army), and transport are the three fastest growing sectors.

Table 6
ANNUAL GROWTH RATES BY ECONOMIC SECTOR(%)

Growth rates by economic sector (%)												
	Agriculture	Industry	Of which				Services	Of which				
			<i>Food & Drink</i>	<i>Textiles</i>	<i>Building</i>	<i>Other Industry</i>		<i>Transport</i>	<i>Trade</i>	<i>Government</i>	<i>Banking</i>	<i>Other Services</i>
1512-1565	0.37	0.88	0.80	0.05	1.60	0.88	2.07	2.19	2.46	0.66		0.84
1665-1620	0.86	1.48	1.42	2.46	1.33	0.55	1.11	1.77	0.79	3.17		1.15
1620-1665	-0.02	0.50	0.65	0.79	0.16	-0.18	-0.45	0.21	-1.18	-0.10	2.22	0.85
1665-1720	-0.11	0.02	0.18	-0.09	-0.33	0.27	0.06	-0.47	0.38	-0.25	1.77	-0.07
1720-1800	0.28	0.00	-0.40	0.64	-0.03	-0.44	0.14	0.11	-0.13	1.15	1.40	-0.07
1512-1800	0.28	0.53	0.44	0.76	0.50	0.16	0.56	0.71	0.44	0.98		0.47
Average share of sector in GDP (%)	0.17	0.27	0.12	0.07	0.04	0.04	0.56	0.09	0.31	0.07	0.003	0.1

Source: see Appendix 1.

NB 1512 is the average of 1510/14, 1565 is 1563/67, etcetera

For the period after 1540 it is possible to do an exercise in growth accounting and analyze the sources of economic growth: increased inputs of labor, capital and human capital, and total productivity growth. Because the output of the capital goods sector consisting of shipbuilding and the construction industry is known, it is possible to make tentative estimates of the capital stock from 1540 onwards using the Perpetual Inventory Model (to turn estimates of the flow of capital goods into stock estimates we assumed a asset life of ships of 10 years, and of other capital goods – mainly buildings - of 20 years). In addition, we have estimates of the population, of the annual years of schooling of the population (via the ‘output’ of the education system), and of the cultivated land used in agriculture. Their weights, derived from very tentative estimates of the income side of the economy, are assumed to be 40% for labor (where the share of the labor force in total population is assumed constant over time), 30% (capital stock), 20% (human

capital stock) and 10% (land) (for a further description, see appendix 1).⁴⁷ For example, in the base period 1540, agriculture has a share of about 20% in GDP (Figure 3), about half of which is the rent of the land used, which brings the share of land in GDP to 10%. The share of human capital (measured as the average years of education of the labor force)⁴⁸ to GDP can only be estimated in a very tentative way (on the basis of data on the skill premium and the salaries earned by skilled employees); therefore also estimates excluding human capital (and raising the share of the labor force to 60%) have been presented.

Table 7

THE ESTIMATED SOURCES OF ECONOMIC GROWTH, 1540-1800

	Population	Human Capital	Capital Stock	Land	Weighted Inputs	GDP	TFP (1)	TFP (2)
1540-1620	1.05	1.17	1.56	0.17	1.14	1.92	0.65	0.81
1620-1665	0.68	1.28	0.75	0.17	0.77	-0.18	-1.00	-0.83
1665-1720	-0.04	0.56	-0.26	0.03	0.02	0.08	0.08	0.18
1720-1800	-0.30	-0.10	0.22	0.07	-0.07	0.04	0.09	0.15

Note:

TFP (1) shares of inputs: population 40%, capital stock 30%, land 10%, human capital 20%;

TFP (2) shares of inputs: population 60%, capital stock 30%, land 10%

1540 is 1538/1542, etc.

Human capital is population corrected for changes in the average years of education.

The results, presented in Table 7, show that TFP growth was contributing significantly to growth between 1540 and 1620 and again – but at a lower rate of change – between 1665 and 1800. TFP-growth was strongest in the final decades of the 16th century, when in a way the economic basis for the ensuing ‘Golden Age’ was laid. It then

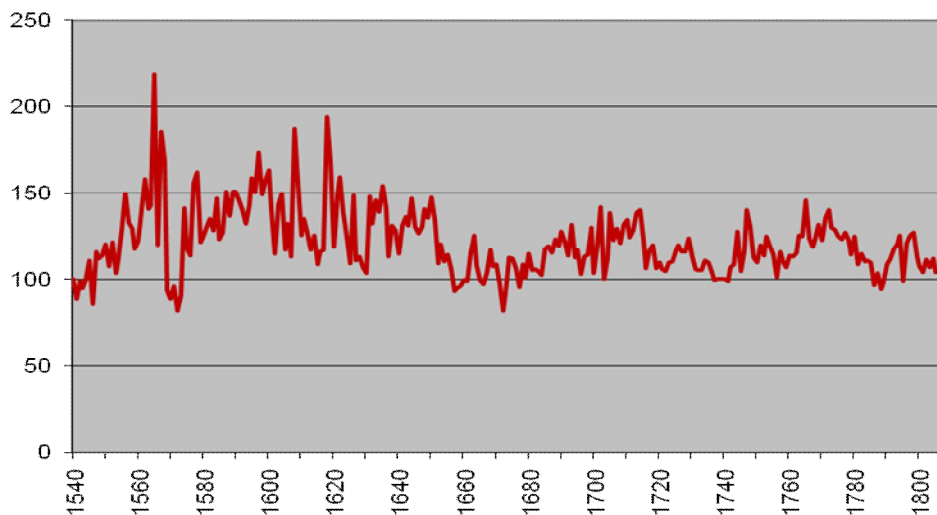
⁴⁷ The appendices are provided in the working paper version to be downloaded at:

http://www.cgeh.nl/sites/default/files/WorkingPapers/CGEH.WP_No4_vanZandenvanLeeuwen.mar2011.pdf

⁴⁸ See Figure 4 of Appendix 1; average years of education increases from about one in the 1550s to about 2 in the 1790s.

slowed down during the first half of the 17th century, and even declined from the 1620s onwards. For the 1660s onwards, however, it stabilized and even began to play a now much more modest role in economic growth. The wave-like character of technological development during the ‘long’ Golden Age is confirmed by studies of the number of patents granted by Dutch authorities, which peak in the 1620s and 1630s, and slowly decline afterwards⁴⁹, and by the qualitative information on the rise and decline of Dutch technological leadership collected and analyzed by Davids.⁵⁰ There clearly was an ‘explosion’ of innovation in the 1540-1620 period, followed by a long period in which technological change continued, albeit at a much slower pace. Moreover, the development of TFP of the economy as a whole is also almost identical to the estimates of the growth of TFP in the shipping sector, presented by Van Zanden and Van Tielhof,⁵¹ which show a strong increase in TFP until the 1620s, and decline afterwards.

Figure 5
 THE DEVELOPMENT OF TFP BETWEEN 1540 AND 1807 (1540=100)
 The development of TFP between 1540 and 1807 (1540=100)



⁴⁹ Van Zanden and Van Riel, *The Strictures of Inheritance*, p. 27.

⁵⁰ Davids, *The rise and decline of Dutch technological leadership*.

⁵¹ Van Zanden and Tielhof, “Roots of Growth and Productivity Change.”

The Medieval phase of growth was dominated by structural transformation and a perhaps rather slow process of technological change, which together resulted in substantial TFP-growth. After 1540 technological change probably accelerated, and TFP-growth contributed a lot to per capita increase in GDP. A third phase of continuing per capita growth, after the 1660s, was largely based on factor substitution and a modest increase in TFP. After 1720 the physical capital stock increased in per capita terms (Table 7). As Adam Smith already noticed, interest rates in the Netherlands were very low in these years, which contributed to international competitiveness, and must also, in combination with high wages, have furthered capital deepening. In shipping, for example, the labor input was reduced relative to the capital input, as a result of which the tonnage per sailor increased strongly, a process analyzed by Lucassen and Unger.⁵²

Structural change was a rather limited source of growth in this period, because this economy was already strikingly modern from the start of the period. The most significant change in this respect was probably the increase of the banking industry – based on the low interest rates, the excellent financial infrastructure, and the availability of large domestic savings surpluses which were exported abroad.⁵³ But even the banking industry contributed only a few percent to GDP during its best years in the 1770s, 1780s and 1790s.

A source of per capita growth that was becoming increasingly important was human capital formation. Already in the 16th century levels of human capital in Holland were relatively high, as was remarked by contemporary visitors, who found that not only

⁵² Lucassen and Unger, “Labour productivity in ocean shipping.”

⁵³ Riley, *International Government Finance*.

men but also women could usually read and write, and that these skills were not only concentrated in the cities, but also spread over the countryside. We estimated the development of the average years of education of the Holland population at (not more than, but also not less than) about 1 year in the middle of the 16th century, increasing to about 2 years in the second half of the 18th century when 84 percent of the males and 64 percent of the females did sign a marriage certificate. Levels of literacy were very high by international standards – much higher, for example, than in England or Belgium.⁵⁴

Summing up, we can distinguish three phases in the process of economic growth: the first one, between 1347 and 1500, is characterized by rapid structural transformation and (modest) technological change; the second one, from the middle of the 16th century to the middle of the 17th century, was based on relatively rapid technological development, and is combined with relatively fast growth of population; during the third phase, which begins in the 1660s, population growth comes to an end, technological change slows down, but changes in relative factor proportions and human capital formation allow for a further increase in per capita incomes during the 18th century.

CONCLUSION

The central question of this article was about the character of economic growth before the Industrial Revolution: was there some kind of ‘first round of modern economic growth’, a

⁵⁴ Buringh and Van Zanden, “Charting the Rise of the West.” Human capital is measured in the usual way in studies based on national accounts, as the average years of education of the population; we acknowledge that for the pre 1800 period in particular other forms of human capital – such as on the job training by apprentices as part of the guild system – were perhaps more important, we cannot measure this part of human capital (which is, however, often ignored in studies on the effects of human capital on growth – see the discussion in Van Leeuwen, *Human capital and economic growth*.)

sustained increase in income per capita accompanied by structural change? Or should we interpret the Dutch Golden Age as an example of the cyclical nature of growth in this period, of a brief efflorescence of the economy, inevitably followed by stagnation or even decline?

The answer to these questions was based on a detailed reconstruction of the national accounts of Holland in the period between 1510 and 1807, linking these series to the available estimates of GDP and its components for the Netherlands (for the 1807-1913 period). Moreover, we also were able to produce highly tentative estimates for long-run growth in the late Medieval period (1347-1510), to analyse in more detail the growth process during the Dutch Golden Age. On this basis we could establish the following features of economic growth before the Industrial Revolution.

1. Growth was relatively slow (by post 1800 standards) but it is difficult to find an economy which was growing as rapidly as Holland in the 450 years between the Black Death and the Napoleonic Wars. For example growth in England only matched the 0.19 per cent per annum growth of Holland from 1650 onwards.⁵⁵ The trend rate of growth of per capita GDP of 0.19 per cent per annum led to a total increase of real incomes by more than 100% in the 450 years under study, and made Holland into one of the wealthiest parts of the world economy by the end of the 16th century.
2. Growth was persistent: the Holland economy shows remarkable resilience in this respect; it goes through a number of crises, due to harvest failures and dramatic decline of arable yields between 1370 and 1440, the Revolt and the following civil war between 1572 and 1609, and the increased competition by

⁵⁵ Broadberry, Campbell, Klein, Overton, and Van Leeuwen, "British Economic Growth," Table 19.

its neighbours (from 1650s onwards), but it manages to adapt its economic structure and to resume its growth path after each successive crisis.

3. GDP was highly unstable – much more unstable than after 1820; this was mainly due to the importance of international services in the economy, which showed enormous fluctuations in output and income, in rare cases doubling or halving over the course of a year. This is linked to fact that this economy was first of all dominated by its large services sector, by international shipping and -trade in particular (contributing around 31% to GDP), which made Holland an open economy affected by the booms and busts of world trade;
4. The Holland economy went through a phase of intense technological change, between the middle of the 16th and the middle of the 17th century, which was an important factor behind the rapid growth of GDP in this period; before and after this ‘big wave’, technological change was much slower, but it continued to contribute to growth after the 1660s;
5. The relationship between structural change and GDP was growth was different before 1800 than afterwards; there are broad similarities with what Crafts⁵⁶ found for the English economy, that structural change of the labour force and of GDP tended to be much more radical in the pre 1800 period than per capita growth. Or, in terms of the relationship between structural change and GDP growth, one percent of ‘decline of agriculture’ was accompanied by a much smaller increase in real income than in the 19th century. According to Crafts this was a peculiar feature of the British economy, but we find a similar pattern in Holland, suggesting that this was a more general characteristic of

⁵⁶ Crafts, *British economic growth*, 61-62.

the process of pre modern economic growth. Interestingly, comparing the 19th century patterns for Europe as discussed by Crafts with the post 1950 patterns found in Chenery and Syrquin points to a further change in this relationship.⁵⁷

6. International trade and shipping were the most dynamic sectors of the economy, and its expansion went together with rapid structural change that must have contributed a lot to GDP growth. In that sense, growth was typically ‘Smithian’, but at the same time modern drivers of growth – technological change, the increase of human and physical capital – also contributed a lot to the increase of real incomes. The growth accounting exercise presented here does not allow us to carefully make a distinction between these two sources of growth, however, because they both result in an increase in total factor productivity.

Growth was, in sum, episodic, unstable, dependent on world markets, driven by a mixture of ‘Smithian’ and ‘Schumpeterian’ forces, but resilient, and in the very long term more or less constant – after each crisis the economy found new ways to increase output and productivity. This, in our view, neatly solves the problem, implicit in the interpretation by De Vries and Van der Woude, that Holland had a (more or less) modern set of institutions and was a (more or less) modern market economy, but, after being successful during the Golden Age, failed to generate continuous growth after 1670.⁵⁸ De Vries and Van der

⁵⁷ Whereas a halving of the labor force in agriculture (from 66 to 33%) before 1820 correlates with an increase of GDP per capita of about 90%, during the 19th century such a change would be consistent with an increase of 165%; in 1950-1970 the growth of GDP would be even larger: 369%; Crafts, *British economic growth*, 61-62; Chenery and Syrquin, *Patterns of development*.

⁵⁸ De Vries and Van der Woude, *The First Modern Economy*.

Woude underestimated performance after 1670 – because trend growth did continue after a break – which points to even greater resilience of this economy than they had expected.

It is, however, also quite clear that growth before 1800 was different from growth after that date. It was much slower than after the Industrial Revolution: it took more than 350 years to double real income in Holland, but ‘only’ one century to double real income of the Netherlands after 1807. Whereas after 1807 every generation could count on the fact that it was by and large better off than the previous one, this was not the case in the pre 1800 period; it not only took more time to increase real income, but annual fluctuations in output and income were also much larger than in the 19th century. Part of the explanation of the acceleration of growth is, perhaps, that growth after about 1820 was a pan-European process, which profited from positive feedbacks between countries and regions. In contrast, before 1800 growth was concentrated in only a few regions, which also heavily competed with each other. The slowing down of the Holland economy in the second half of the 17th century was linked to increased competition from other European countries, which resulted in strong protectionism on their part. Both Cromwell’s Navigation Acts of the 1650s, and Colbert’s protectionistic policies of the 1660s and 1670s aimed at undermining Dutch supremacy on the high seas and international markets, and both had very serious consequences for Dutch trade and shipping (for good reasons, it led to major wars between the countries involved).⁵⁹ The greater stability of growth after 1820 may also be related to the fact that the 19th century knew a long period of relative peace, whereas the almost continuous warfare of the early modern period was a very important cause of instability, especially of the international

⁵⁹ Israel, *Dutch Primacy*, pp. 207-236, 282-291.

sector of the economy, on which Holland depended so much. Obviously, the underlying rate of technological change also accelerated during the Industrial Revolution.

Economic growth therefore, did indeed exist in the pre-1800 period, but its rate was much slower and its instability much higher than in the period after the Industrial Revolution. We have demonstrated that this process of ‘pre modern economic growth’ – of slow, and very unstable increases in per capita income - already began in the late Medieval period, which is consistent with much of the new literature on the topic, which is however to a large extent based on the evidence of the development of real wages in this period.⁶⁰ Apparently, this economy was able to adapt successfully to the situation of labor scarcity that emerged after 1348, and developed the right institutions and incentives to transform itself in a highly successful ‘high wage economy’, capable of generating positive trend growth.

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⁶⁰ E.g. Allen, “The great divergence in European wages and prices”; Van Bavel and Van Zanden, “The Jump Start of the Holland economy”; Pamuk, “The Black Death and the origins of the ‘Great Divergence.’”

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