Ship Traffic and the Economy of the Cape Colony: 1652-1793

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Abstract

Most historians regard the Cape Colony of the seventeenth and eighteenth centuries as an impoverished and destitute settlement, primarily because of the many restrictions and prohibitions enforced by the Dutch East India Company, who founded the Cape settlement as a refreshment station for its ships. The mercantilist thinking of the time ensured that the free burghers in the Cape were to comply with the demands of the Company, dependent on the number of passing ships, for a market, and with little economic incentive to expand production. This assumption of poor economic performance only came to be challenged in the late 1980s. Using new data collected from the so-called *opgaaf* rolls (tax return records) in The Hague, Van Duin and Ross (1987) argue that, in fact, the Cape economy grew significantly throughout the eighteenth century. However, these authors emphasise that local demand played the dominant role in the development of the economy and dismiss the traditional argument that passing ships were essential to the welfare of the Cape Colony. Using new empirical evidence on the number of ships in Table Bay combined with techniques from business cycle theory, this paper tests whether ship traffic had any significant relationship with agricultural production in the Cape Colony and, if so, the direction and size of association. The results suggest a strong systematic co-movement between wheat and ship traffic in Table Bay, with less evidence for wine production and stock herding activities.

KEYWORDS: Band-pass filter, Medium-term fluctuations, Dutch East India, Cape, Business Cycle, South Africa, Cliometrics, Ships, Harvest Cycles, Colonial Economy.

1 Introduction

Most historians regard the Cape Colony of the seventeenth and eighteenth centuries as an impoverished and destitute settlement. This interpretation is ascribed to the multitude of restrictions on economic activity enforced by the Dutch East India Company (*Vereenigde Oostindische Compagnie*, or VOC), which founded the Cape settlement as a refreshment station for its ships. However, Van Duin and Ross ...(1987) challenge the view of the Cape as a subsistence economy. Using new data based on the *opgaaf* rolls (tax return records) obtained from Dutch archives, these authors argue that the early Cape economy was a competitive market economy, exhibiting strong growth throughout the eighteenth century. In contrast to the traditional argument that passing ships were essential to the welfare of the Cape Colony, Van Duin and Ross emphasise the dominant role of *local* demand in driving economic growth at the time. This is quite surprising, given that historical descriptions of the early Cape Colony contain many references to the economic importance of ships anchored in

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Table Bay. While Van Duin and Ross consider ship traffic, their qualitative approach prevents a more systematic analysis. This paper attempts such a study, using a time series smoothing technique borrowed from the business cycle literature to deal with problems in the historic economic time series and employing an econometric procedure to test for long-run relationships.

The paper is structured as follows: the first section presents a review of the literature on early Cape economic activity in relation to ship traffic, and the hypotheses to be tested. The second section introduces the econometric methodology, while the third section presents the data. The fourth section describes the time series smoothing process and the fifth section presents the results of the econometric tests for long-run relationships. The final section concludes.

2 Economic Activity in the early Cape Colony in relation to ship traffic

The first Europeans to settle in South Africa arrived in 1652 to establish a halfway station for ships sailing between Europe and the East Indies under the command of the VOC. The economic history literature contains ample references to the relationship between ship traffic and economic activity in the early Cape economy of the seventeenth century, with Giliomee .(2003) noting that Jan Van Riebeeck, the first VOC-appointed governor, wanted to introduce a European farming model that would provide food supplies to both the station and passing ships. Intensive crop farming, though, did not materialise, partly due to the Colony's initial enforcement of low prices. Consequently, while the VOC did not intend initially to develop the Cape station into a colony for European settlement, the abundance of free land and resultant extensive farming methods accelerated the expansion of the Colony. This process of expansion was facilitated by the VOC, with land grants to time-expired soldiers, sailors, and other servants of the Company. Nevertheless, historians note that, by the end of the seventeenth century, agricultural production (notably, cereals) appears to have been insufficient for the subsistence of the local population (De Kock, 1924, Sleigh, 1993). Production only appears to have started meeting local demand by the early 1700s, after more land had been awarded to French immigrants in 1699 (Fairbridge, 1931).

The gradual expansion of the Cape Colony resulted in the formation of three distinct population classes: firstly, the citizens of Cape Town consisting of VOC servants, soldiers and artisans; secondly, the rural wheat and viticulture farmers in the fertile area along the first mountain ranges, and thirdly, the pastoral stock farmers of the interior (De Kock, 1924:28). The history literature contains references to the relationship between ship traffic and each of these economic activities. De Kock (1924) suggests that wheat farmers frequently complained about their precarious financial position, with travellers noting that many of these farmers lived in poverty. Specifically, the authors note the farmers' concern about instability in the demand for their produce and the VOC constraints on free trade with passing ships. The relationship between stock farming and ship traffic receives explicit attention from Van Duin and Ross (1987), who note the response of foreign ships to high meat prices towards the latter part of the eighteenth century. The relationship between wine production and ship traffic is evident from research concerning exports as well as the salience of liquor as an attraction to Cape Town (Fairbridge, 1931). The allowance and even support of wine exports may appear to contradict the mercantilist policy of the Company, given the severe restrictions placed on the export of other agricultural products, particularly meat and wheat. Yet, the support of wine exports probably was a consequence of the mercantilist policy, as wine exports to the East substituted French wines (De Kock, 1924:50).

Agricultural production by no means constituted the whole of the Cape's economic activities. As the only port and physical market of the Cape Colony, Cape Town housed a variety of secondary and tertiary sector activities. Table 1 presents a survey conducted in 1732 by then Cape Governor Jan de la Fontaine, revealing the relative distribution of occupations for free burghers over the three districts of the Colony. In the final row, the total number of survey candidates is compared to the total population as suggested by an alternative source. This indicates that the survey, in fact, covered the entire population (or, at least, the total number of white and free black people in the Cape Colony).

Table 1 suggests that at least 40% of those living in the district of Cape Town were involved in secondary and tertiary activities. Furthermore, the survey excludes VOC officials, who totalled 1016 at the time – many of whom performed services in Cape Town or were part of the private and illegal trade.

The relationship between ship traffic and tertiary sector activity receive attention from Van Duin and Ross as well as some other works. Van Duin and Ross (1987:15) agree that "the money the ships and their crews brought into Cape Town, and spent on lodging, food, drink and the minor trade. . . , may indeed have contributed, through the multiplier effect, to the prosperity of [the] colony in ways we have been unable to measure". In fact, historians suggest that Cape Town was known as the "Tavern of the Seas", and offered many public houses and inns to weary travellers (Giliomee, 2003:28, Schutte, 1980:189). Van Duin and Ross argue that an average of between 9 700 and 11 600 men left either Europe or Asia every year between 1720 and 1780 on the ships of the VOC. Almost all of these men, except those who had died on the way, would have come into Cape Town where they would have spent several weeks recuperating from the long voyage (Van Duin and Ross, 1987:13).

The preceding subsections briefly review evidence concerning economic activity in the early Cape Colony. In particular, the work by Van Duin and Ross receives significant attention, by virtue of the importance of their research in altering economic historians' view of the early Cape economy – changing it from a subsistence-based to a market-based view. However, Van Duin and Ross emphasise local consumer demand in driving agricultural production growth, although these authors acknowledge that economic activities in Cape Town may have been more closely related to ship traffic. The secondary position accorded to ship traffic as a source of demand for agricultural produce is in contrast to various historical sources, as outlined above. In particular, the literature appears to suggest that ships arriving in Table Bay had three important demand-generating impacts. First, the ships required replenishing of food, water and fuel supplies for the journey ahead. This was the original purpose of the halfway station at the Cape. Second, and especially after production in the local economy had increased to above subsistence levels, some products were bought for export, especially wine and brandy destined for the East Indies. In addition, especially for the first few decades of the Colony's existence, most manufactured items had to be imported from Europe. Third, Cape Town offered crews arriving on ships after several months at sea the opportunity to heal, relax and enjoy themselves. Furthermore, from a methodological viewpoint, Van Duin and Ross rely on a predominantly descriptive analysis based on a particular source of shipping data. Therefore, it is appropriate to reconsider the relationship between ship traffic and economic activity by employing statistical techniques that enable a more systematic analysis. Formally, therefore, the null hypothesis to be considered is:

H_0: Economic activity in the Cape Colony of the eighteenth century was systematically related to the demand from passing ships.

It is important to note, from the outset, that a finding in favour of H_0 does *not* indicate that economic activity was driven solely by ship-related demand. Instead, this study is intended as a complement to the Van Duin and Ross analysis by considering an additional source of demand to that of local consumption.

If H_0 is not rejected, it may be informative to consider specific features of the relationship, apart from simply establishing its existence. Firstly, it is important to quantify the size of the correlation between ship traffic and different forms of economic activity. This is important, as the study is aimed at establishing the relative importance of different sources of demand and is intended to complement the Van Duin and Ross analysis. Of course, the expectation, even *a priori*, is not that economic activity was driven solely by ship-related demand, but that it would have been a significant source of economic growth. Therefore, it is necessary to obtain estimates of the long-run correlation coefficient. Secondly, it may also be useful to establish the direction of the relationship. That is, did economic activity in the Cape generally respond to exogenous variations in ship traffic or did ship traffic also respond to the availability of produce and services in the Cape Colony? This is an important question, as it concerns the nature of the relationship between the Cape Colony and passing ships: if both supply and demand adjust to establish equilibrium, market power may have been much more symmetrically distributed between foreign ships and economic actors in the Cape. The nature of the analysis, of course, is insufficient to qualify as a complete causal analysis, but it may, nevertheless, shed light on these issues.

3 Methodology

Pesaran, Shin and Smith (2006) suggest an econometric method to test for the existence of long-run relationships based on the first step of the autoregressive distributed lag (ARDL) approach to co-integration. The advantage of their method over conventional co-integration tests (such as the Johansen, 1988, system approach) is that it overcomes the need for unit root pre-testing – i.e. that it is not necessary to know whether the time series contain stochastic trends in order to apply the technique. The method is based on the following ARDL(p) specification:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1,i} \Delta y_{t-i} + \sum_{i=1}^{p} \alpha_{2,i} \Delta x_{t-i} + \beta_1 y_{t-1} + \beta_2 x_{t-1} + \varepsilon_t \quad (1)$$

$$\Delta x_t = \phi_0 + \sum_{i=1}^{p} \phi_{1,i} \Delta y_{t-i} + \sum_{i=1}^{p} \phi_{2,i} \Delta x_{t-i} + \beta_3 y_{t-1} + \beta_4 x_{t-1} + \varepsilon_t \quad (2)$$

where y is a measure of economic activity (such as wheat production), x is a measure of ship traffic and all variables are in logarithmic form. The method consists of a bounds-testing approach to testing the null hypotheses $\beta_1 = \beta_2 = 0$ and $\beta_3 = \beta_4 = 0$ against two-sided alternatives. The intuition of the test lies with its close analogy with tests of weak exogeneity in co-integrated systems. The equations above can be seen as representing a co-integrated system, with the β coefficients representing the long-run adjustment parameters. For example, if the hypothesis $\beta_1 = \beta_2 = 0$ is rejected, this is akin to suggesting that the variable y_t is weakly exogenous and does not contribute towards re-establishing a long-run equilibrium between y_t and x_t. Therefore, the two null hypotheses $\beta_1 = \beta_2 = 0$ and $\beta_3 = \beta_4 = 0$ serve to establish, firstly, whether a long-run co-integration relationship exists between y_t and x_t and, secondly, whether one of the two variables is long-run forcing (i.e. whether the relationship is unidirectional).

The critical values for the upper and lower bounds of the F-statistic are reported in Pesaran, Shin and Smith (2006). Values falling below the lower boundary indicate the absence of a systematic relationship, while values exceeding the upper boundary confirm such a relationship. Where the test statistics fall between the two critical values, it is necessary to test for unit roots in the individual series. If both series are integrated, the upper bound is the critical value. Where both series are stationary, the lower bound is the critical value. For one integrated and one stationary variable the test is inconclusive if the test statistic falls between the boundary values.

The estimated coefficients in equations (E1) and (E2) above can be used to estimate the long-run relationship. Under the null hypothesis $\beta_1 = \beta_2 = 0$ for equation (E1), the stable long-run relationship can be represented by:

$$y_t = \pi_0 + \pi_1 x_t + \nu_t \quad (3)$$

Similarly, under the null hypothesis $\beta_3 = \beta_4 = 0$ for equation (E2), the long-run relationship is:

$$x_t = \lambda_0 + \lambda_1 y_t + \nu_t \quad (4)$$

where $\pi_0 = -\alpha_0/\beta_1$ and $\pi_1 = \beta_2/\beta_1$ and, similarly, $\lambda_0 = -\phi_0/\beta_3$ and $\lambda_1 = \beta_4/\beta_3$ and ν_t are zero-mean stationary (Atkins and Coe, 2002).

4 Data

The intended study described above requires consistent time series data on various forms of economic activity as well as on ship traffic. The following subsections describe the agricultural production data for wheat, wine and cattle as well as data on secondary and tertiary sector activities, while the final subsection presents the ship traffic data used in this paper.

4.1 3.1 Wheat production

Traditionally, literature on the economic history of the Cape Colony has argued that wheat production did not increase significantly during the eighteenth century. De Kock argues that restrictions on trade with passing ships and, more generally, on exports from the Cape Colony frequently generated cereal shortages: "This continued throughout the eighteenth century and led to a repetition of famines in bad years. Many farmers, having found by experience that they could not dispose of their surplus produce at satisfactory prices or even at all, adopted the custom of sowing only sufficient grain to meet the needs of their own family. If the crops turned out to be a failure in some districts on account of unfavourable weather conditions, a deficiency in the supply of grain might easily result, as such farmers had not allowed for a surplus" (1924: 48). De Kock offers only anecdotal evidence, citing a shortage in 1786 and a report from De Mist in 1792, stating that the Cape had only eighteen days' supply of cereals and attributing this to the "ill-conceived intentions and bad statesmanship of the Directors of the Dutch East India Company" (De Kock, 1924:48). These have led economic historians to argue that the supply of wheat in the Cape Colony only equalled demand by the turn of the eighteenth century.

Van Duin and Ross, however, challenge the view of persistent wheat shortages.[1] These authors argue that the official *opgaaf* data on which historians rely is inaccurate and that production growth was much higher. Given that *opgaaf* records were the basis on which taxes on grains were calculated, Van Duin and Ross argue that there was an incentive to under-report grain production levels. Arguably, the level of under-reporting is significant. For example, Van Duin and Ross (1987) note the bizarre situation of grain exports generally exceeding official production figures for the period 1769–1783. These authors then use corrective coefficients to adjust the official figures and also to test the plausibility of the adjustment via a comparison with other relevant information. The corrective coefficients are based on the demand for wheat in the Cape, which is the total of local consumption, consumption by ships and their crew, and exports. A comprehensive explanation of the size and construction of the corrective coefficients is provided in Van Duin and Ross (1987:21–31). The corrections have not been discussed in the literature, though Armstrong (1988:718) notes that the correction coefficients appear to be plausible: "[H]igher figures will merely strengthen the ... thesis, while lower figures seem unlikely". Figure 1 reports the corrected wheat production *opgaaf* figures, showing that the correction significantly alters the general pattern of the original series.

The quantitative evidence suggests that wheat production did not increase significantly during the first two decades of the eighteenth century. This is consistent with other historical accounts that report a number of poor harvests, especially in the Stellenbosch district, over this period (Sleigh, 1993:15). However, the second half of the 1720s and the early 1730s saw a rapid increase in production. The 1740s was a period of dissatisfaction, according to Van Duin and Ross (1987:30). Between 1743 and 1745, following a reduction in the official price of wheat, there were numerous complaints from farmers about their precarious financial position. Travellers in the interior of the

[1] The *opgaafrollen* were the rolls on which the annual returns of population and production were recorded by the Company.

country note that many of these farmers lived in poverty and complained of the unstable demand for their produce (Thunberg, 1986: 94). The farmers requested a revision of the price, a reduction in taxes and free trade of their goods (Van Duin and Ross, 1987:30). Yet, by the end of the 1740s, even though the VOC colony did not respond to these requests, wheat production had picked up again, showing rapid growth until the early 1750s. Until the mid-1760s, wheat production fluctuated, with serious harvest failures in the Cape district in 1764–65. Wheat production then increased at a dramatic pace until the early 1780s, after which it declined sharply. According to Van Duin and Ross, harvests were generally poor between 1782 and 1787, with 1786 being particularly disastrous to the extent that wheat had to be imported from the United States (Van Duin and Ross, 1987:31). Thereafter (1789–1793), production returned to and exceeded former levels, with 1793, the last year for which data is available, recording the highest volume of wheat production.

4.2 Wine production

Van Riebeeck introduced the first vines in 1655 (Van Zyl, 1974). By 1659, the first Cape wine was produced (De Kock, 1924). Van Riebeeck's successors were also interested in viticulture. The settlement of French immigrants from France, especially in the district of Drakenstein, gave particular impetus to viticulture, so that winemaking soon became an important branch of Cape agriculture. According to official statistics, the colonists and officials had planted 400 000 vines by 1688 (De Kock, 1924:50).

Until 1743, a tax was charged on the basis of the *opgaaf* records generated from information submitted by farmers. Thereafter, taxes were levied at the moment wine was brought into Cape Town (Van Duin and Ross, 1987: 43). This measure was an attempt to reduce suspected evasion, as all traffic had to travel along the same road between Devil's Peak and the sea on entry into Cape Town. However, Van Duin and Ross argue that, contrary to the data on wheat production, there is no evidence that these figures underreport actual production to a significant extent (Van Duin and Ross, 1987). However, they do suggest that the number of vines, rather than actual wine production, may be a more appropriate variable, as the former was probably not as sensitive to bad weather conditions as the latter. Van Duin and Ross (1987) provide data for total wine production and the number of vines planted for the period 1700 to 1793 on the basis of *opgaaf* figures. Figure 2 suggests that wine production was generally stagnant for the first four decades, followed by rapid expansion. At first glance both wine production and the number of vines appear to have a common outlier towards the end of the sample period. Clearly, the value is implausible – especially as far as vines are concerned. However, it can be argued that, although the amplitude is probably overstated, the general upward movement is not.

Wine production grew strongly for most of the eighteenth century. Long periods of expansion were interspersed with short periods of decline, notably in the early 1760s and again in the 1770s and 1780s. According to Van Duin and Ross (1987:45), these slowdowns were due to harvest failures and not disinvestment. In evidence, they highlight the series concerning number of vines showing no real periods of decline other than during the 1730s. The production of brandy was also encouraged, although no data are available (De Kock, 1924).

4.3 Stock farming

With the Colony expanding into the interior, cattle farming became more important, as it represented the sole means of subsistence and the only means of transport. The stock farmers of the interior, many of whom lived a nomadic life on the frontier, had little incentive to settle down for long periods of time .(Schutte, 1980). Land was available relatively freely, and as soon as the pasture became depleted the farmer decided to move on. In this way, the farmer was limited in his accumulation of capital to only those goods that could be transported by ox back or wagon. Sheep farming was also important, but data problems prevent a further analysis here. Using data from Van Duin and Ross, the cattle stock in the Cape Colony between 1700 and 1793 is shown in Figure 3.

Clearly, there are some problems with the time series data, similar to the ones mentioned for viticulture. For example, the figure above suggests that the number of cattle grew exponentially during the 1770s and again in the late 1780s. These problems will receive attention in a later section.

4.4 Ship traffic data

The only reliable estimate of the number of ships that arrived in the Cape Colony was published by Beyers in 1929. Figure 4 shows the arrival of ships in Table Bay by nationality between 1700 and 1793. The category "Other" includes ships from Denmark, Portugal, Austria, Prussia, Sweden, Spain, Hamburg, Italy, Russia and America.

A new electronic data source that includes records of all Dutch ships to anchor in Table Bay since the founding of the Dutch East India Company has made it possible to extend the period of analysis to 1652 (see Figure 5). Furthermore, the data allows estimates of the number of days ships anchored in Table Bay. Boshoff and Fourie (2008) have used this to compile a unique data set of ship traffic demand in Table Bay between 1652 and 1793. The original data was compiled by Bruijn, Gaastra and Schöffer (1987) in three volumes. The data set requires some cleanup prior to analysis – the final version of the data is available from the authors on request. A combination of the Bruijn, Gaastra and Schöffer (1987) and Beyers (1929) data sets are used in the econometric analysis of this paper.

5 Time Series Smoothing

The literature review has highlighted that the economic time series (the wine and cattle-related series in particular) appears to exhibit significant variation, either due to the incentive to under-report or the incomplete and inaccurate data collection efforts of the VOC. However, a time series data set of this type, spanning nearly a century and covering diverse aspects of economic activity, rarely comes available to economic historians. The challenge, therefore, is how to extract the useful information from this incomplete data set, while minimising the possible bias. The work by Van Duin and Ross has contributed significantly to this end, by substantially improving the quality and representativeness of the original data. However, even these authors advise against using the annual data, given the potential inaccuracy of any given data point. This problem led Van Duin and Ross (1987:31) to suggest relying on five-year averages, rather than the actual annual figures – given the danger of identifying spurious relationships. However, the resulting descriptive analysis loses much of the tractability of a systematic time series evaluation. Consequently, this paper proposes a smoothing method, which reduces the impact of year-to-year data problems, while retaining the explanatory power of the time series.

Economists have developed a range of time series smoothing techniques allowing them to extract specific information from time series data. This has been particularly useful in the business cycle literature, where the aim has been to separate short-run, business cycle information from the long-run growth trend in the economy (Harding and Pagan, 2002). One approach is the band-pass filter method, which entails decomposing time series into different frequency components – that is, different components containing information on different time horizons (Baxter and King, 1999). In the current context, this smoothing method may be quite useful in solving the problem at hand. Clearly, the challenge is to remove the short-run information in the data, while retaining the longer-run information.

As mentioned, the focus on specific frequency ranges requires the decomposition of time series into different frequency bands. Theoretically, such decomposition is possible by virtue of the spectral decomposition theorem (Christiano and Fitzgerald, 2003). This theorem provides the theoretical basis for the extraction of a specific frequency range via a time series filter called the band-pass filter. The band-pass filter is so named as it "passes" only the specified frequency range – removing other frequency components. The spectral decomposition theorem requires an infinitely long time series. Consequently, in practice, econometricians use approximations to these "ideal" filters. Two approximations have become popular: the Baxter-King (1999) and the Christiano-Fitzgerald (2003) approximations. Zarnowitz and Ozyildirim (2006) note that if the focus is on high-frequency components only, the Baxter-King approximation does not outperform the popular Hodrick-Prescott (1997) filter (the filter most frequently used in business cycle analysis). However, these authors argue that the Baxter-King filter is useful where the focus is on broader frequency ranges. Everts (2006) notes further that the Christiano-Fitzgerald approximation is more suitable for identifying longer-term fluctuations. This paper employs the Christiano-Fitzgerald approximation.

It may be argued that time series smoothing can be achieved using much simpler methods, such as a moving average filter. The choice of smoothing method is quite important, as it embodies a particular assumption about the role of different frequencies in the smoothing process. Estrella (2007) notes that time series filters can either be focused on signal extraction or frequency extraction. Moving averages, for example, are signal extraction filters where a signal can be obtained by calculating an average of a selected number of original series values. Simply taking a moving average of the original series implies that the resultant smoothed series still relies, in part, on the short-run information. This is problematic, given that some individual data points appear to be incorrect. Alternatively, band-pass filters can be used. These are frequency extraction filters where the smoothing is achieved by removing a particular frequency component of the time series. In the case of historic agricultural data, the latter approach is to be preferred – given that it is likely that the longer-term information is accurate, but that the year-on-year fluctuations are not. Consequently, a band-pass filter is the preferred filtering method.

5.1 Smoothing results

The smoothing procedure described in the previous section can now be applied to the original economic and ship traffic series to extract short- and medium-term fluctuations. Before proceeding to the results, however, it is necessary to define short- and medium-term fluctuations in order to avoid *ad hoc* concepts. However, such definitions in themselves, involve judgment. It is the same type of challenge that Burns and Mitchell (1946: 469) encountered during their pioneering business cycle research: "Seldom can the interrelated species of social ... phenomena be marked off from one another with such precision as to leave no doubtful cases". Nonetheless, in their study of US business cycles (which can be considered short-term fluctuations) from 1885 to 1931, Burns and Mitchell found cycles to last between one-and-a-half and eight years. Of course, Burns and Mitchell explicitly warned that the range appears to shift over time (Everts, 2006) – although many contemporary studies of the business cycle continue to employ the one-and-a-half to eight year range. Consequently, in the context of the present study, it might be useful to consider some comparable figures concerning the South African experience.

Research by Schumann (1938) on the properties of South African business cycles from 1806 to 1936 offers some guidance concerning the duration of South African business cycles, indicating that business cycle fluctuations lasted between two and twelve years in the period before diamonds were discovered, that is, up to the 1870s. Arguably, the economic fluctuations of this period are closest in nature to those of the eighteenth century Cape Colony, as the economy was still largely agrarian-based (Schumann, 1938:112–13). On the other hand, there are significant differences between the Cape Colony of the eighteenth and nineteenth centuries, the least of which is not the difference in government. Despite these problems, this paper defines short-term (or high-frequency) fluctuations as those cyclical components in the historic time series with a period of between two and twelve years (Comin and Gertler, 2006). Sensitivity tests based on a period of two to eight years do not yield significantly different results.

Medium-term fluctuations can be defined in similar fashion. Unfortunately, less guidance is available concerning the upper bound for the medium-frequency range. This is not necessarily problematic, as Comin and Gertler argue that "[e]ven though [their] measure of the cycle includes frequencies up to 50 years . . . its representation in the time domain leads to cycles in the order of a decade" ...(2006:526). These authors argue that this result is an outcome of the spectral density. The frequency definition for medium-term fluctuations appears to be consistent with the findings in Schumann (1938), who identifies three medium-term cycles in the predominantly agricultural period from 1806 to 1869, with respective duration 30 years, 13 years and 20 years. Again, although these durations are not necessarily comparable to the eighteenth century, they do indicate that the South African economy in its agrarian phase *did* experience medium-term fluctuations. Equally important, the dubious quality of the time series data (as discussed above) necessitates a broad view of fluctuations. Therefore, this paper defines medium-term (or medium-frequency) fluctuations as those movements in the historic time series lasting between 12 and 40 years (Baxter and King, 1999). As the upper bound is a subject of debate, sensitivity tests were performed for narrower frequency ranges of 12 to 20 years. Results again do not appear to be significantly different.

Figure 6 presents short- and medium-term fluctuations for the number of ships in Cape Town harbour:

The line containing circles represents the short- and medium-term fluctuations combined. Put differently, this particular line can be interpreted as the de-trended series, representing the deviations of the actual series from the long-run trend (defined as those "fluctuations" with a period in excess of 40 years). The solid line represents the medium-term fluctuations (defined previously as that component of the time series with a period of between 12 and 40 years). The short-term fluctuations can be found in the difference between the two lines. Clearly, a substantial amount of short-run noise is present. Lowering the upper bound for the medium frequency from 40 to 20 years does not produce significantly different outcomes.

This smoothing methodology can also be applied to economic time series. As discussed previously, the extracted short- and medium-term fluctuations in the economic and ship traffic data can then be used to test for a relationship. The following section performs the PSS test to study the relationship between ship traffic and economic activity in the early Cape economy.

6 Results

Given the methodology and data adjustment discussed above, this section presents the results of the empirical analysis. The first subsection presents results based on, firstly, the *un*smoothed data series and secondly, data series smoothed with a moving average filter, to emphasise the importance of the frequency filtering procedure described above. Subsequent subsections then present the results based on various forms of band-pass filtered data.

6.1 Results for agricultural series in unadjusted or moving average form

An index of the original *unadjusted* ship traffic and the various agricultural time series is shown in Figure 7 (the base value is 100 in 1701). Visual inspection suggests little correlation between any of the economic output variables and ship traffic.

These visual impressions can now be verified econometrically. In addition to considering the unsmoothed series, it may also be useful to include smoothed time series using a five-year moving average filter (as opposed to the frequency filters) in the econometric analysis. As discussed in the section on methodology, the analysis is based on the ARDL method developed by Pesaran, Shin and Smith (2006). For this and subsequent applications of the econometric procedure, a lag of four years is used, as this generally removes serial correlation in the errors. The accompanying 10% critical values for an ARDL with a lag order of four years with an unrestricted intercept and no deterministic trend is [2.45; 3.52] (Pesaran et al., 2006:300). Table 2 presents the results:

As predicted by the visual inspection, Table 2 reports no statistically significant results for the unsmoothed series. Furthermore, the analysis finds no stable long-run relationship between ship traffic and economic activity based on moving average filtered series, except for some evidence of a long-run forcing relationship from ships to wheat production. Nevertheless, as argued earlier, the general absence of significant statistical relationships appears to be fundamentally at odds with the qualitative discussion in the literature. However, as the following subsections show, important information is contained in specific frequency ranges of the time series. Focusing on specific frequency components when assessing relationships may, therefore, alter the preliminary findings.

6.2 Results for agricultural time series adjusted for high-frequency fluctuations

This subsection considers similar tests on time series data from which the short-term fluctuations have been removed, using the band-pass filter. Table 3 reports the PSS results for this data set:

The results clearly differ from those obtained based on the unadjusted data set. They suggest that significant long-run relationships exist between ship traffic and all three agricultural time series and that the direction of causality appears to run both ways for wine and wheat production activities. As noted when suggesting the hypotheses, this is not unexpected. If ship traffic represented demand for agricultural produce in the Cape, one would expect economic activity to respond to changes in ship traffic. In some ways, this direction of causality appears to be particularly strong, given the relative size of the test statistics for this direction. However, it may also be argued that increased availability of local produce may have incentivised ships to visit Cape Town. Interestingly, as was the case for the previous set of results, the test results for cattle differ – suggesting that ship traffic was the long-run forcing variable. In general, however, the results suggest that the short-run aberrations in the data *did* hide a systematic relationship between (at least some) agricultural production activities and ship traffic over longer time horizons.

6.3 Results for agricultural time series adjusted for both high-frequency and low-frequency fluctuations (i.e. medium-term fluctuations)

Table 3 involves analysing time series data adjusted for short-term “fluctuations”. However, it may be worthwhile to focus on medium-term *fluctuations* rather than the entire time series. As mentioned in the data section, these fluctuations can be removed in a similar fashion to that employed to extract short-term fluctuations. Figure 8 plots the medium-term fluctuations in agricultural production series, extracted earlier, against similar fluctuations in ship traffic. A visual inspection suggests that some of these fluctuations are correlated. Consequently, a similar econometric analysis is conducted on these medium-term components.

Table 4 presents the results:

The results differ somewhat from those reported in Table 3. The finding of a statistically significant, bi-directional causal association between wheat production activities and ship traffic is maintained. However, much less support is obtained for wine production activities, with some evidence that medium-term fluctuations in ship traffic may be forcing medium-term fluctuations in wine production. Similar results, however, are not obtained when using the number of vines. The pattern of generally weaker results for cattle also continues. In fact, with short-run data problems (such as the spikes in cattle numbers in the 1770s and 1780s) removed and long-run information also excluded, it seems that medium-term fluctuations in stock farming activities were *not* related to ship traffic fluctuations.

Given the findings concerning the existence of a strong bi-directional long-run association between wheat production and ship traffic, the econometric methodology described earlier can now be employed to calculate the size of the long-run coefficients. Table 5 present these estimates:

The claim for a two-way forcing relationship between ship traffic and wheat production should be interpreted with care. Clearly, the fact that statistically, both variables appear to adjust to restore equilibrium is not an indication that the relationship was equally strong in both ways. In fact, closer inspection reveals that the impact of gyrations in wheat production had a very uncertain effect on ship traffic fluctuations. This is consistent with other work, showing that ship traffic was influenced by several other factors. Firstly, as shown in Boshoff and Fourie (2008), ship traffic to the Cape was strongly related to war periods in Western Europe and secondly, Dutch ships were required to anchor in Table Bay on their way to the East. And, while non-Dutch ships were free to bypass the Cape Colony, the lack of substitute ports nearby to provide the level and extent of products and services available in Cape Town is likely to have mitigated the impact of fluctuations in agricultural production on ships' decisions to visit the Cape. On the other hand, medium-term fluctuations in ship traffic fluctuations appear to have had an economically and statistically significant effect on medium-term fluctuations in wheat production. In essence, then, the emphasis on statistical fit leads to the identification of a bi-directional relationship, although the relationship is clearly more unidirectional in terms of size. This result is conditional, given the bivariate nature of the analysis, but it nevertheless suggests that while ship traffic appears to have mattered less to in-land activities such as cattle, it was certainly an important force as far as economic activity closer to Cape Town, such as wheat production (and, perhaps, wine production as well), is concerned.

7 Conclusion

The first general conclusion from the preceding empirical results is that data problems do influence the analysis. Unadjusted agricultural data do not appear to have any relationship to ship traffic. Furthermore, attempts at signal extraction through moving average smoothing do not appear to address the problem. However, once specific frequency ranges are removed, more supportive evidence emerges. In fact, the second general conclusion from this section is that H_0 is supported for wheat and, to a lesser extent, for wine production. There is strong statistical evidence of a bi-directional long-run relationship between wheat production and ship traffic. However, calculation of the size of the correlation reveals that ships are significant in their impact on wheat and not *vice versa*. The evidence for wine production is less convincing and there is some evidence that ship traffic may have been the stimulating force for viticulture. On the other hand, when also controlling for information in the "ultra long run" (the time horizon exceeding 40 years), stock herding fluctuations appear to have been unrelated to ship traffic fluctuations. A third general conclusion, therefore, is that agricultural activity closer to Cape Town, in the form of wheat and wine production, appears to have been strongly related to ship traffic, while the relative isolation of the *trekboere* from more developed Cape Town and its surrounding regions may have contributed to a weaker relationship with ship traffic.

More generally, this paper illustrates that techniques developed for the analysis of business cycles can also be applied to the study of fluctuations in a pre-industrial economy. In particular, the band-pass filter can be applied to extract longer-term fluctuations in time series where poor data quality can result in the identification of spurious short-term fluctuations.

Thus, while fluctuations in ship traffic appears to have had a significant impact on wheat production over the long run, the results are less convincing for wine and generally absent for cattle. These findings provide empirical proof to support the claims of historians that ship traffic was an important component of economic activity in the Cape Colony, at least as far as wheat production and (to a lesser extent) viticulture is concerned. These findings are consistent with the claim that agricultural production in the Cape Colony was market-related, not subsistence-based, except for cattle farming in the interior. Nevertheless, Van Duin and Ross's hypothesis concerning the salience of local demand sources for agricultural production is not contradicted for stock-farming, where ship traffic appeared to have played a minor role.

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Table 1: Survey of occupations in Cape Colony, 1732

Economic sector	**Cape Town**		**Stellenbosch**		**Drakenstein**	
	Number	*Proportion*	*Number*	*Proportion*	*Number*	*Proportion*
Primary	70	16.83%	48	34.04%	193	67.01%
Production	97	23.32%	12	8.51%	5	1.74%
Services	83	19.95%	9	6.38%	1	0.35%
Uncertain	166	39.90%	72	51.06%	88	30.56%
Total population according to this survey	416	100.00%	141	100.00%	287	100.00%
Total population according to Van Duin and Ross (1987)	397		145		284	

Source: Schutte (1980: 189)

Table 2: ARDL bounds test results for agricultural production and ship traffic time series

Relationship	**Unsmoothed F-statistic**	**5-year moving average F-statistic**
Ships → wheat sown	0.73	0.56
Wheat sown → ships	1.17	1.23
Ships → wheat reaped	1.18	11.34*
Wheat reaped → ships	1.03	0.70
Ships → vines	0.29	0.63
Vines → ships	1.88	2.68
Ships → wine	0.40	0.06
Wine → ships	1.70	1.43
Ships → cattle	2.76	0.80
Cattle → ships	0.42	0.87

** Statistically significant at 10%*

Table 3: ARDL bounds test results for adjusted agricultural production and ship traffic time series (high-frequency fluctuations removed)

Relationship	F-statistic
Ships → wheat sown	4.34*
Wheat sown → ships	4.81*
Ships → wheat reaped	17.88*
Wheat reaped → ships	24.00*
Ships → vines	22.32*
Vines → ships	7.65*
Ships → wine	23.35*
Wine → ships	15.56*
Ships → cattle	83.07*
Cattle → ships	0.51

** Statistically significant at 10%*

Table 4: ARDL bounds test results for medium-term fluctuations in agricultural production and ship traffic time series

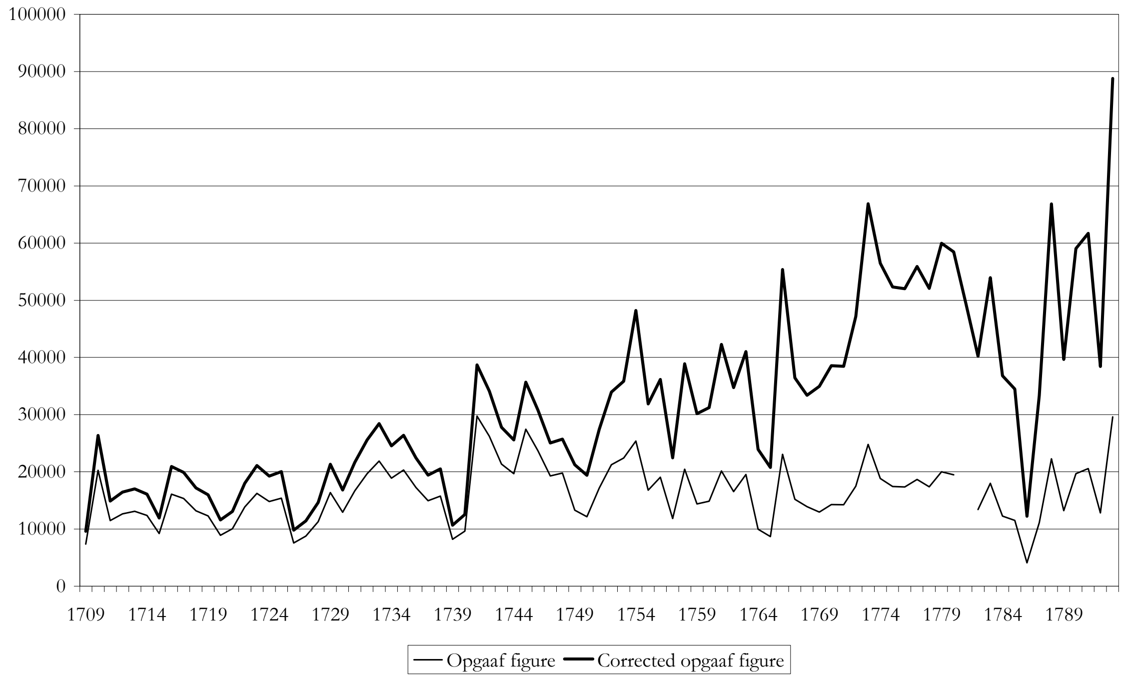
Relationship	F-statistic
Ships → wheat sown	5.04*
Wheat sown → ships	3.85*
Ships → wheat reaped	54.37*
Wheat reaped → ships	82.13*
Ships → vines	2.64
Vines → ships	2.29
Ships → wine	5.86*
Wine → ships	2.47
Ships → cattle	1.69
Cattle → ships	1.38

** Statistically significant at 10%*

Table 5: Estimate of long-run correlation between medium-term fluctuations in agricultural production and ship traffic time series

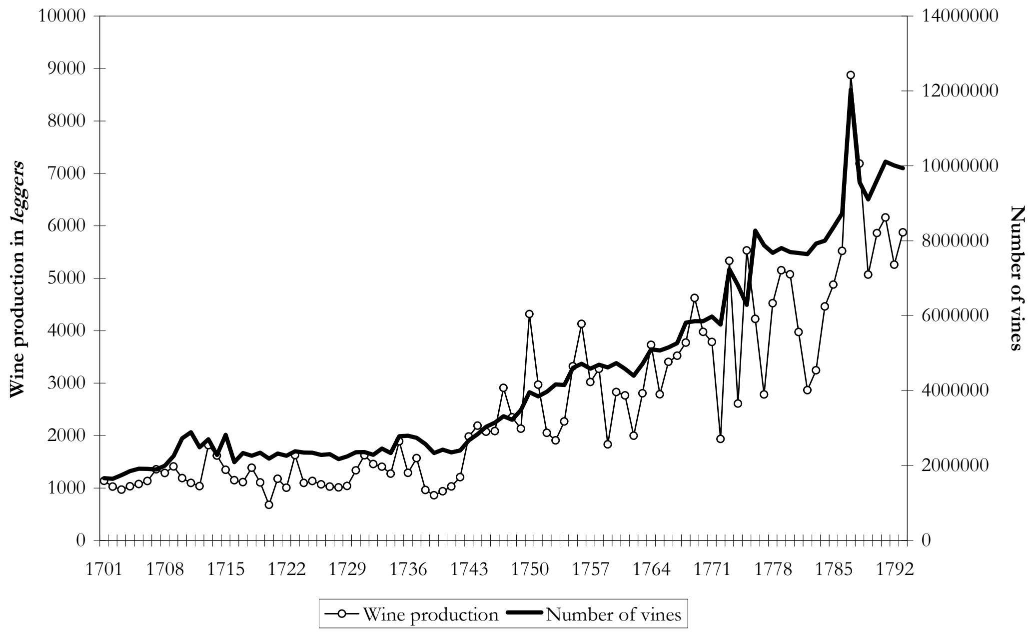
Relationship	Long-run coefficient	Standard error
Ships → wheat sown	0.30	0.002
Wheat sown → ships	0.06	12.698
Ships → wheat reaped	0.53	0.000
Wheat reaped → ships	-0.06	0.628

Figure 1: Actual and corrected wheat production figures, 1709-1793



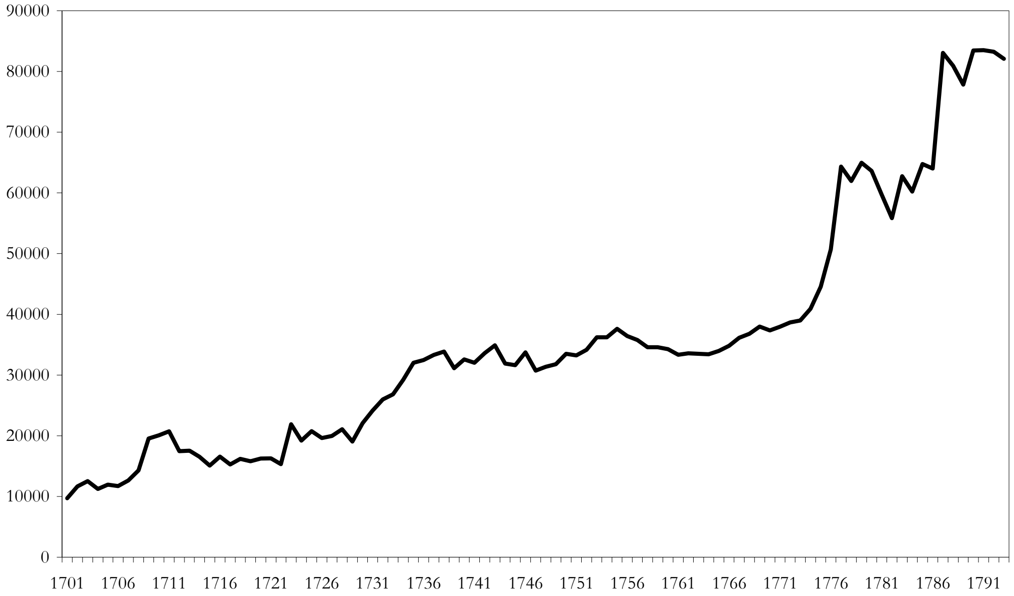
Source: Van Duin and Ross (1987)

Figure 2: Wine production and the number of vines, 1701–1793



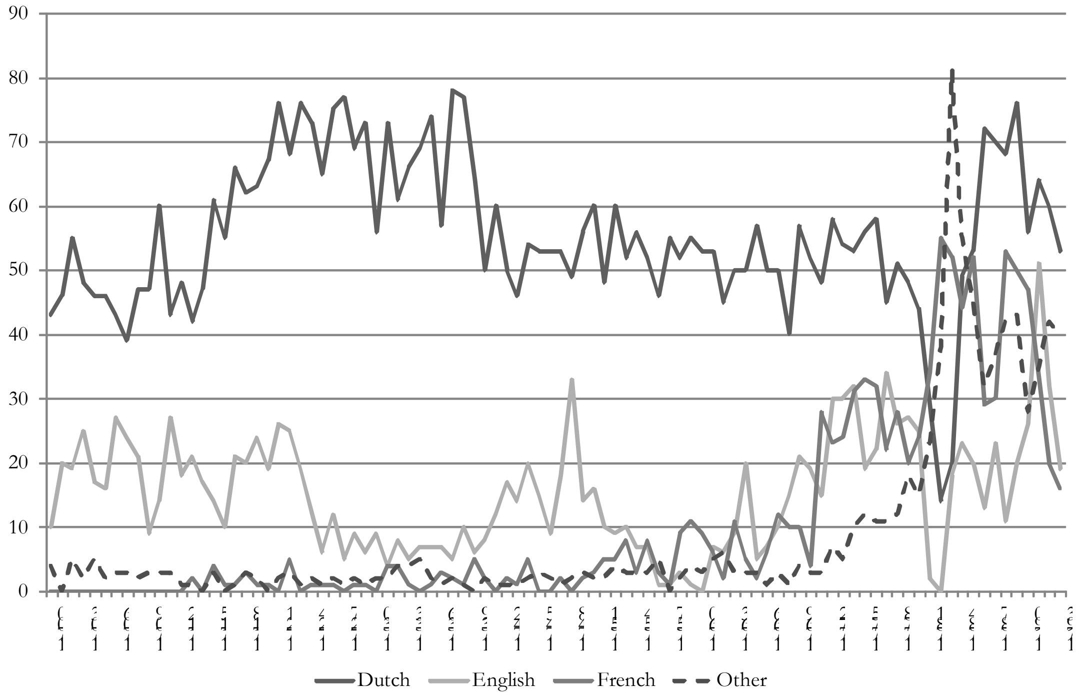
Source: Van Duin and Ross (1987)

Figure 3: Number of cattle, 1701–1793



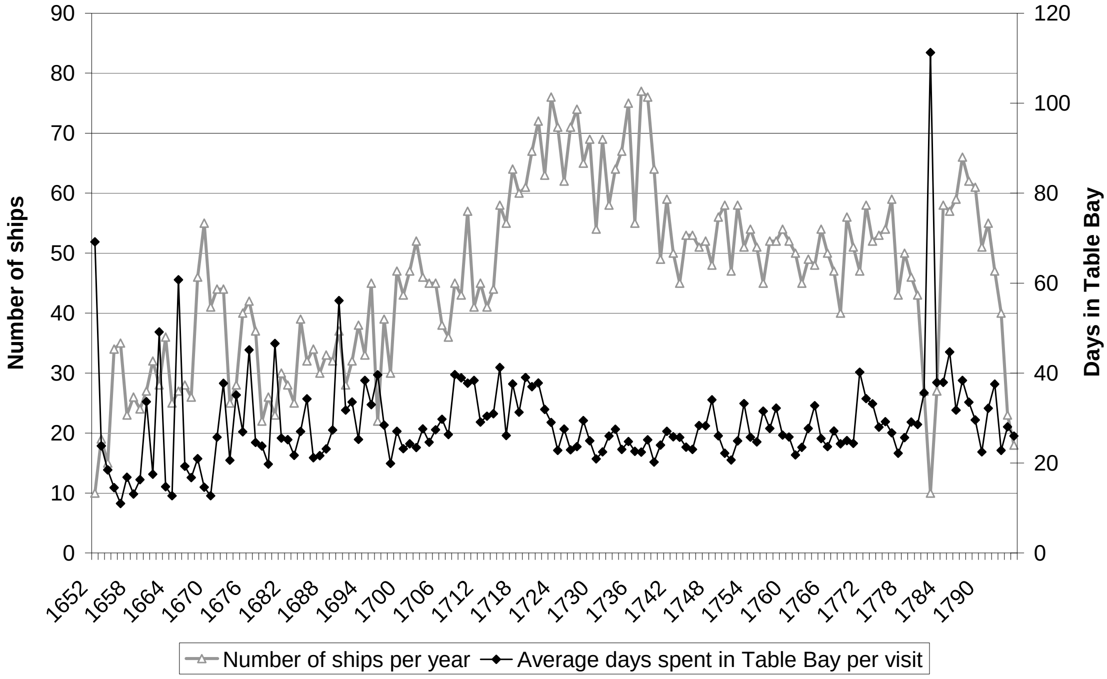
Source: Van Duin and Ross (1987)

Figure 4: Number of ships by nationality, 1700–1793



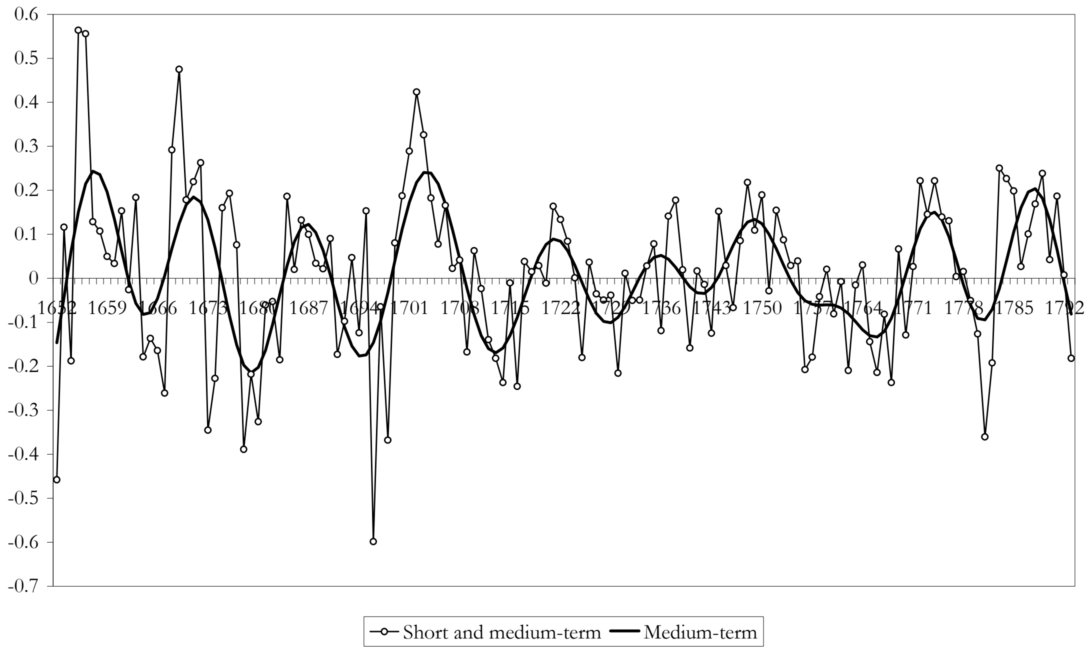
Source: Beyers (1929)

Figure 5: Number of ships and length of stay, 1652–1795



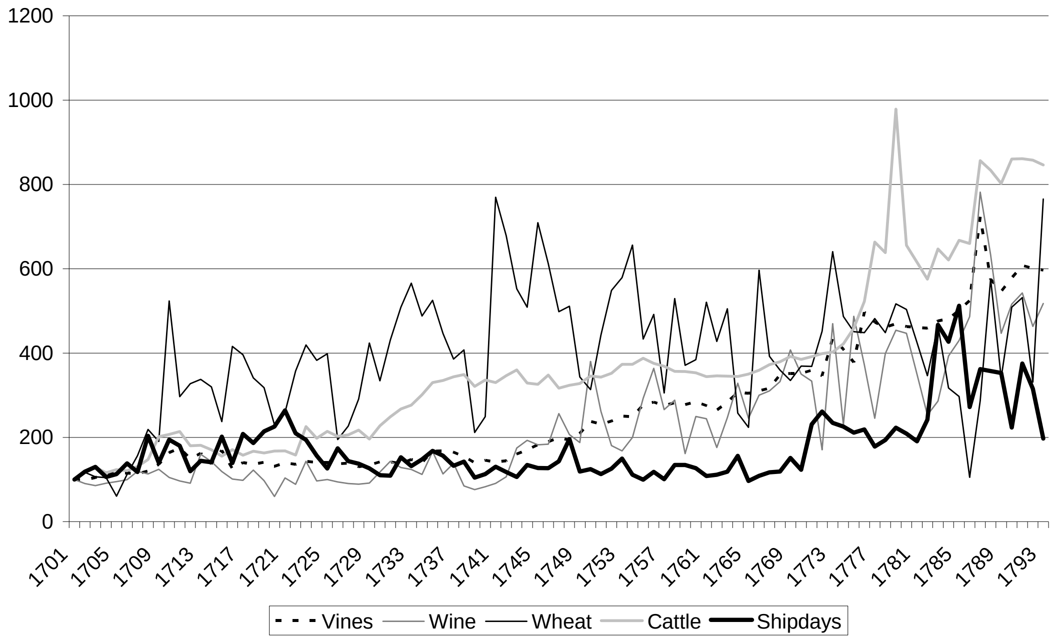
Source: Boshoff and Fourie (2008)

Figure 6: Short- and medium-term fluctuations in the number of ships, 1652 to 1793



Source: Boshoff and Fourie (2008)

Figure 7: Agricultural production and ship days, 1701 – 1793



Source: Boshoff and Fourie (2008)

Figure 8: Medium-term fluctuations in various agricultural production and ship traffic time series