Economic growth in Java 1820-1940
Is it possible to reconstruct the historical national accounts of (19th century) Java?

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Introduction: why reconstruct the historical national accounts of Java in the 19th century?

Economic-historical research on Indonesia in the 19th and 20th century has been growing rapidly in the closing decades of the 20th century. Particular topics, such as the debate on the Cultivation System and its impact on the standard of living of the Javanese population and the long term trajectory of the Indonesian economy, have been the subject of innovative new research. The series Changing Economy in Indonesia has expanded impressively during the editorship of Peter Boomgaard, now covering almost all aspects of economic development in the period before 1942. Recently this research has culminated in two new syntheses of the long term performance of the Indonesian economy in the 19th and 20th century, which cover the debates that have been going on since the 1960s and 1970s (Booth 1998; Dick et al. 2001). One might perhaps ask, what more is there to add?
In this paper I would like to make the point that a systematic reconstruction of the national accounts of Java/Indonesia should be on top of the agenda of future economic-historical research. Moreover, I will try to show how such a project can be undertaken, and present a few tentative results. But the more important point that has to be discussed first is the feasibility of such a project. The argument that may be put forward is that the quality of the available information is so poor that any attempt to estimate the level and development of GDP can only be based upon 'educated' guesses, which will resulted in estimates that have probably no relationship to the 'underlying' reality. My reasons for disagreeing with it are the following.

The amount of information available on the demographic and economic development of Java in the 19th century is large. The impressive series Changing Economy in Indonesia is a testimony of this, and one might argue that it covers only a fraction of all the quantitative and qualitative information that is still available in the thousands of articles by civil servants and travellers, in many thousands of government documents containing unpublished data in the archives etc. So the first point to make is that the real 'problem' of Indonesian economic-historical research is not the absence of 'data', but their abundance: for somebody who would like to make statements about, for example, the economic development of Java in the period 1830-1870, it is almost impossible to get a good overview of all the information that is already available in the CEI-series, let alone that he or she is also able to integrate the evidence that can be derived from other sources. We know, for example, what

happened with exports, but how should their growth be related to, for example, the decline of textile production, or the development of government expenditure? This is also the reason for focusing on Java; for the rest of Indonesia, one could argue that before 1900 information is indeed too sketchy or in fact totally absent; there is, in other words, an absolute scarcity of data, whereas for Java 'data' are abundant.

I think that there are three problems involved here: the available information does not always cover the things we would like to know about the Javanese economy (but a lot of things *are* covered); secondly, and more importantly, the quality of much of the available information is often very doubtful; thirdly, one needs a kind of conceptual scheme to weight and integrate the different kinds of information (is the increase in the output of fisheries more relevant than the relative decline in salt production?). The second, and perhaps most pressing problem, can to some extent be solved – as I hope to show in this paper – by comparing different sources and types of data. We know of some data that they are much more accurate than others. Data on government expenditure or on exports and imports are pretty good, for example, although even these data are not beyond doubt (because, for example, smuggling (of opium) did occur, and therefore government statistics cannot inform you about the precise level of opium consumption in years in which the monopoly was used to attempt to restrict consumption). The system of the national accounts presents a way to test data on their consistency – to confront, for example, data on food consumption and production with each other, or to compare expenditure and income estimates. This also addresses the issue of the overabundance of information: it would take many lifetimes to collect all available data, and probably no single scholar can integrate all this information if he or she does not have some kind of conceptual framework at his/her possession. The system of national accounts is such a framework: it focuses attention on those data that are 'necessary' for reconstructing the level of income and production in an economy, gives all relevant information its 'weight' (i.e. salt production has a different weight than rice output), and integrates all information into a single concept (GDP) that has a clear economic meaning.

The problem of historical research into the development of the Javanese economy in the 19th century is therefore not that information is not available, or that the available information is unreliable, but that there is too much information and that we have to find ways to integrate the data into one coherent framework in order to test their plausibility and accuracy. In other words, if we want to *increase the quality of our assessment of the economic performance of Java in this period by testing and comparing the available sources of information in a systematic way,* we might or perhaps should start to reconstruct the national accounts of Java for these years, as this is the only coherent framework that can do the job.

In this paper I intend to make a start. The approach that I have developed is a bit counter-intuitive, but it might work. I started my research with the most 'difficult' period: 1815-1880. The main focus of the paper is to explain how I think it is possible to reconstruct the 'national' accounts of Java between 1815 and 1880. The next stages, also reported here, is the extension of the approach developed for the period 1815-1880 to the next period, 1880-1940. Finally I will try to cover the whole of Indonesia for the post 1900 period (in cooperation with Pierre van der Eng), but this third stage of the project has not begun yet.

This will not be an exciting paper, I guess. If you don't like to play around with figures, you will probably get bored soon. What I will do is to explain in detail, sector

by sector, how estimates have been made for the period 1815-1880. I have mainly used the output approach – i.e. have attempted to estimate the value added of the different branches of the economy – although for a few branches income estimates (based on the two existing income taxes of the late 1870s) have also been used. Of course, all results are highly preliminary and will, as the project integrates new periods (and new data) be subject to revisions. But it is important for the author to get some feedback on these results (do I use the best available data? Are the results plausible?), and to find out what the implications of these estimates are.

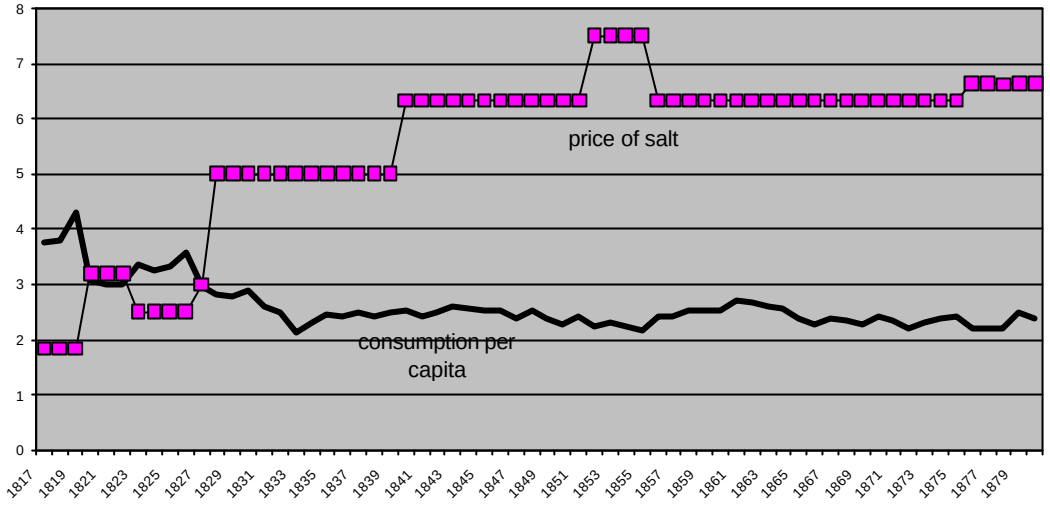
Estimates for the period 1815-1880

The agricultural sector

To show how the approach works, let me begin with the obvious example of the size of the *population* of Java. We don't know how large it was during much of the 19th century, despite the fact that the colonial administration collected and published annual estimates of the size of the population. Taking this evidence at face value lead to the conclusion that the total number of inhabitants of Java and Madura increased from about 4.5 million in 1815 to about 9.5 million in 1850 and 28.4 million in 1900 (CEI 11). Boomgaard and Gooszen (CEI 11: 82) however published a set of 'benchmark estimates' which supposedly correct for the (declining) degree of under-representation of these official figure; according to these estimates population increased from 7.5 million in 1800 to 14 million in 1850 and 30.4 million in 1900 (the degree of underestimation of the official data in their view declines from 50% in 1815 to less than 10% in 1900). Van der Eng (unpublished research) combined the information from the official figures with the estimates by Boomgaard and Gooszen to intrapolate the estimated population size in the years between the bench mark estimates. I used a slightly revised version of his estimates (in a few years his estimates imply that growth was higher than 3% annually, which is not realistic; I lowered the growth rate in these years to 2.5% to arrive at another set of annual estimates). According to this series the population of Java and Madura increases from 8.4 million in 1815 to 14.2 million in 1850 (the 14 million estimate from CEI 11: 82 does not include the European and 'other Asian' population, which is another reason for revising the Boomgaard and Gooszen estimates) to 24.1 million in 1880. The differences between this series and simple intrapolation of the Boomgaard and Gooszen-benchmark estimates are small, however.

One of the reasons for using this set of estimates and not the results of the official headcounts published by the colonial administration is that the revised estimates are consistent with the development of salt consumption. The government monopoly on salt produced more or less exact data on the sales of salt in Java from 1814/17 onwards; of course, these data have their problems as well: in the south other sources of salt were used until the 1830s (but De Waal 1864:264-66 estimated how important this *zuiderzeestrandzout* was), and the monopoly did not cover the whole of the island (the Principalities and before 1831 the south-middle section of Java that was integrated into the government lands after the Java-war were not covered by it). When corrections are made for this (they were suggested by the eminent financial specialist De Waal 1864), Figure 1 can be constructed.

Figure 1 Consumption of salt per capita (in kg) and the price of salt (in fl per kg) 1817-1880



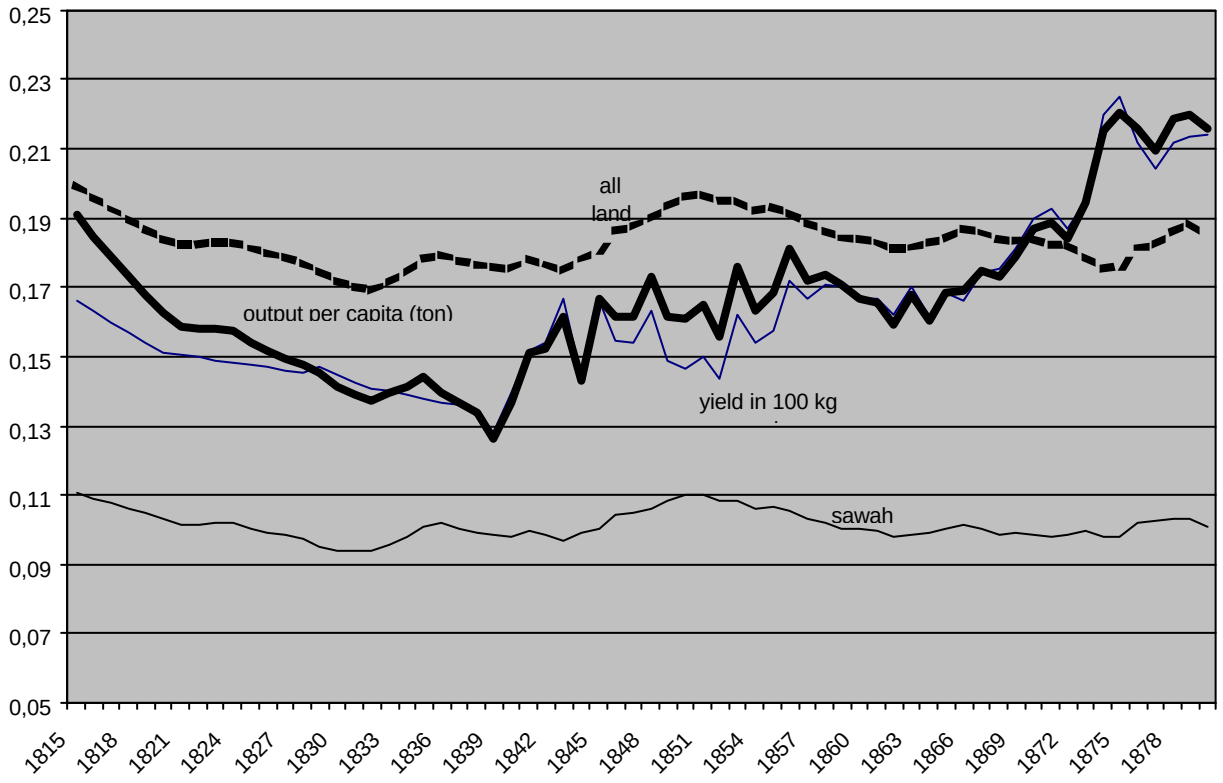
The data on the total consumption of salt are probably relatively reliable and can therefore be used to test the demographic data. Salt consumption seems to decline from almost 4 kg per capita in 1814/17 (the first observation is a four-year average) to 2.5 kg from the 1830s onwards (sources: De Waal 1864, and KV 1846-1883). Were we to use the official head counts, which show a much more rapid population growth in this period, the decline in per capita consumption would be enormous (from about 7 kg in 1814/17 to about 3 kg in the 1870s). The fact that consumption fell to some extent is quite likely, as the official sales price of salt increased enormously between 1819 and 1830. In fact, the figure suggests that consumption reacted quite nicely to the changes in prices that were introduced: it fell directly after both price increases in 1820 and 1827/28, and again in 1852/53, and stayed on par in times of constant prices, which is again more or less what one might expect. This comparison of the new set of estimates of Javanese population (based on the work by Boomgaard & Gooszen and Van der Eng) and the development of salt consumption therefore suggests that the former may be quite close to the 'truth' (and certainly more plausible than the official head counts); they show, at the same time, how Javanese consumers reacted to price signals.

The next step is estimating the development of the *land under cultivation*. Van der Eng (1993:) has presented estimates for the cultivated land in Java from 1880 onwards. He made a number of corrections for the fact that the accuracy of registration increased between 1880 and 1924, and that the private lands and the principalities are brought into the statistics in those years. His estimates are close to the ones Boomgaard and Van Zanden (CEI 10: 39-40) published for 1880 (the difference is less than 4%). The next step was assuming that the official estimates of the cultivated area published in CEI 10 for the 1815-1880 period give a 'reasonable' picture of its actual growth; additionally I had to assume that the increase of the cultivated land of the areas that were not covered by the colonial statistics – the private lands and the Principalities – grew at about the same rate as in the rest of Java. Let us first have a look at one of the outcomes of these two assumptions: the ratio between total area under cultivation – and sawah only – and the estimated population (Figure 2, upper and bottom lines). Both ratios show remarkable stability, i.e. land per capita remained almost constant during the entire 1815-1880 period. These estimates

are consistent with those previously published by Boomgaard and Van Zanden for 1815 and 1880 (the difference in 1815 and in 1880 is the same, and less than 4%). Boomgaard (1987) (1990) has suggested that the availability of land per capita declined rather sharply between 1815 and 1840, whereas I find only a relatively small decline (of about 10%-15% between 1815 and 1833). The difference is not the result of different ways to estimate the development of the agricultural area, but of the lower population estimates (for 1815) used by Boomgaard, whereas I prefer the Boomgaard/Gooszen/Van der Eng estimates mentioned earlier.

Rice production can next be estimated on the basis of the yield estimates of CEI 10, with various intrapolations for the missing years between 1815 and 1820, and again between 1820 and 1828. This gives estimates of the output per capita (and obviously of the output per ha), also presented in figure 2. The series consists of two parts: between 1815 and 1832 there are only a few observations available, and yields tend to show a declining trend; after 1832 more or less annual yield estimates can be found, which of course show more variability than the intrapolated estimates for the first 17 years. Between 1839 and 1842 yields suddenly jump up; there is no clear trend between 1842 and the mid 1860s. A new surge in yields appears to happen between the mid 1860s and the mid 1870s. On balance rice production per capita increases more than Boomgaard (1987) or Boomgaard and Van Zanden (CEI 10) estimated, but the difference should be attributed to the other population data that have been used there.

Figure 2 Output of rice per capita, per hectare of sawah, and the numbers of hectares land and sawah per capita, 1815-1880



The output of the other food crops (maize, pulses and tubers) is taken from the estimates published by Boomgaard (1987; appendices) for 1815, 1840 and 1880. These estimates imply that the value of the rice crop as a share of total arable output (including the output of compounds, but excluding livestock) was almost constant at about 60-62%. This percentage was used to estimate the total value of the output of the agricultural sector (excluding livestock products and exports crops). The output of other foodstuffs (meat, hides, coconuts etc.) was added to this (it was estimated at 20% of the total). In this way the estimates for the 1815-1880 period can be linked to the Van der Eng (1993) estimates for the period from 1880 onwards (i.e. for 1880 both sets of estimates are identical).

An important check was possible by estimating the implied consumption of calories per capita. I applied the seed ratios and the loss ratios that were used by Van der Eng (1993: 257) to estimate the difference between the gross output of agriculture and the net-supply of foodstuffs, and subtracted the exports of rice that are relatively important in the 1850s and 1860s (in 1857, the peak of rice exports, more than 6% of total output was shipped to destinations outside Java and Madura). I also added an estimated consumption of fish, meat and coconut oil of 100 kcal per day (from CEI 10: 51). The results of these calculations are presented in figure 3. They show a much lower level of per capita consumption for the first half of the period than the estimates published by Boomgaard and Van Zanden (CEI 10: 49-50), who arrive at 1917 kcal per day in 1815 (whereas the new estimates point to less than 1500 kcal per day); this is the result of (a) taking into account seed, feed, and losses of the crops, and exports (which results in a decline of per capita consumption by about 10%) and (b) the higher population totals for the early years discussed already (which explains the rest of the difference of about 27%). The figure also shows a remarkable increase in food consumption between 1840 and 1880 – from as low as 1300 kcal to 1700 kcal.

The only evidence that may corroborate these findings is related to the stature of the Javanese. Crawfurd (1820) estimated the average height of men at 1.57 m, and of women at 1.495 m, which is quite small (see Van Zanden 2002 for full details). This is confirmed by a sample taken from a register of the slaves of Batavia in 1815: their average height was only 1.47 meter, men being about 1.52 (the first mode of the distribution of all heights) and women only 1.37 (the incredibly low second mode of the distribution of the heights of all slaves!). Van der Eng (unpublished) has collected a number of studies that show that between 1888 and 1912 average heights of Javanese men was about 1.60 m, and of women 1.50. This is marginally better than the 1820-estimates by Crawfurd, which may point to a slight improvement of the dietary situation. The rise from 1300 to 1700 kcal per day is much more substantial however, and does not seem to be reflected in the stature of people. The low estimates for the beginning of the 19th century can be compared with data from Japan: Susan Hanley (1997) estimated levels of per capita consumption in 1840 at 1663 kcal per day and in 1887 at 1902 kcal, which was consistent with the average height of conscripts of 156-157 cm (comparable to the height of Javanese men at the beginning of the 19th century). At present, the average height of Indonesian men is about 167 cm, but food consumption has jumped up to 2600 to 3000 kcal in the early 1990s.

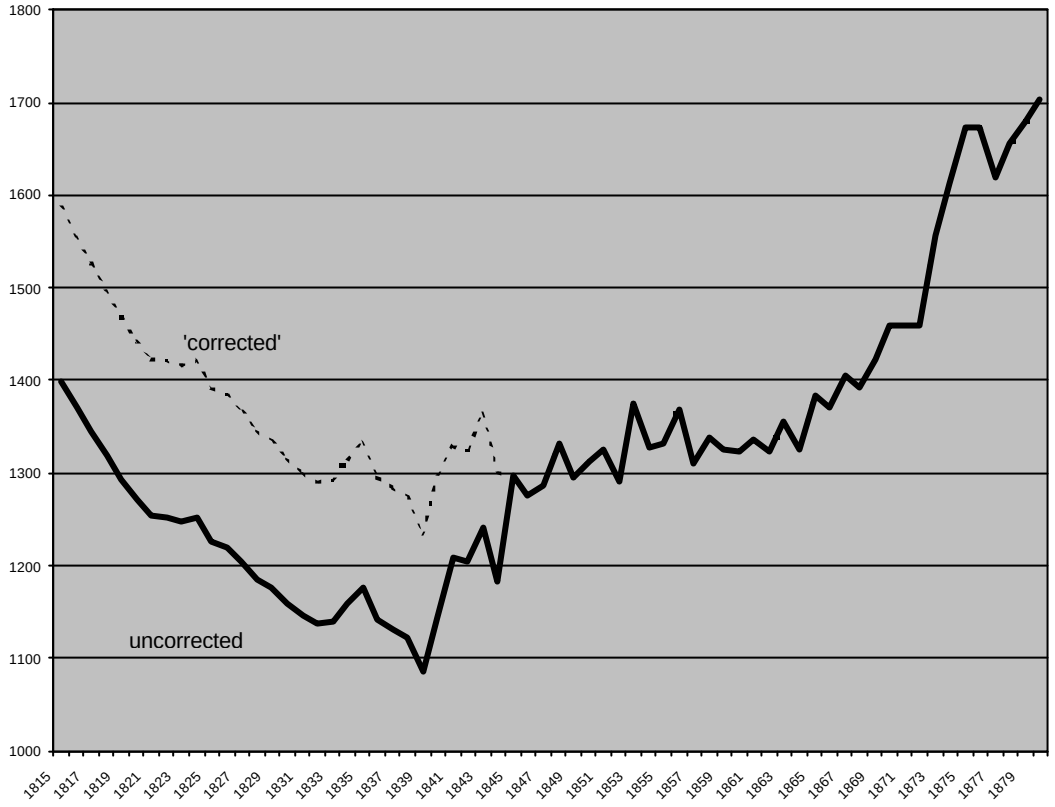
The estimates presented here, which imply that during the half of the 19th century per capita food consumption was only 1200 to 1400 kcal per capita per day therefore seem to be too low, a/ because it is very doubtful if one can survive at such a low level of consumption, b/ because the strong increase that occurs afterwards does not seem to result in a comparable increase in stature (whereas at the same time the disease environment also improved, which is another reasons why the height of

Javanese may have increased). This all points to the fact that the estimates of agricultural output for the first half of the period appear to be too low. Especially the very sudden jump in 1839-43 is quite suspect, in my view; figure 3 also presents a 'corrected' set of estimates assuming that this sudden rise in output did not occur (but was a by-product intensified attempts to raise the land rent in these years). If we are to believe these corrected estimates, per capita consumption at about 1815 was slightly less than 1600 kcal per day, which is still rather low but perhaps not unlikely, given the very short stature of the Javanese at the time. It declines during the 1820s and 1830s – the lowest points in the corrected series coincide with the famines of the 1840s – whereas after 1850 and in particular after 1862 a strong increase in food consumption begins. After 1875 this increase stops (during the next four decades food consumption remains more or less constant) (see Van der Eng 2000).

I have of course to admit that the proposed corrections are rather arbitrary, but I do not see a way to improve upon them. Probably agricultural output (and food consumption) is still underestimated on a per capita basis during the first half of the century. In my view this results from the fact that I use corrected estimates for population totals, whereas the estimates of the area under cultivation (in particular the sawah area) and of the rice output per hectare are not corrected for systematic (downward) biases. My guess is that even after the proposed corrections the degree of underestimation of per capita foodstuffs is still in the order of 10 to 30%.

The output of exports crops such as coffee, tea, tobacco, sugar and indigo could be estimated easily on the basis of the available export statistics (and additional data published in CEI 1). Prices were taken from the two volumes of CEI on rice prices and other prices (4 and 15). It was assumed that inputs formed a constant percentage of output.

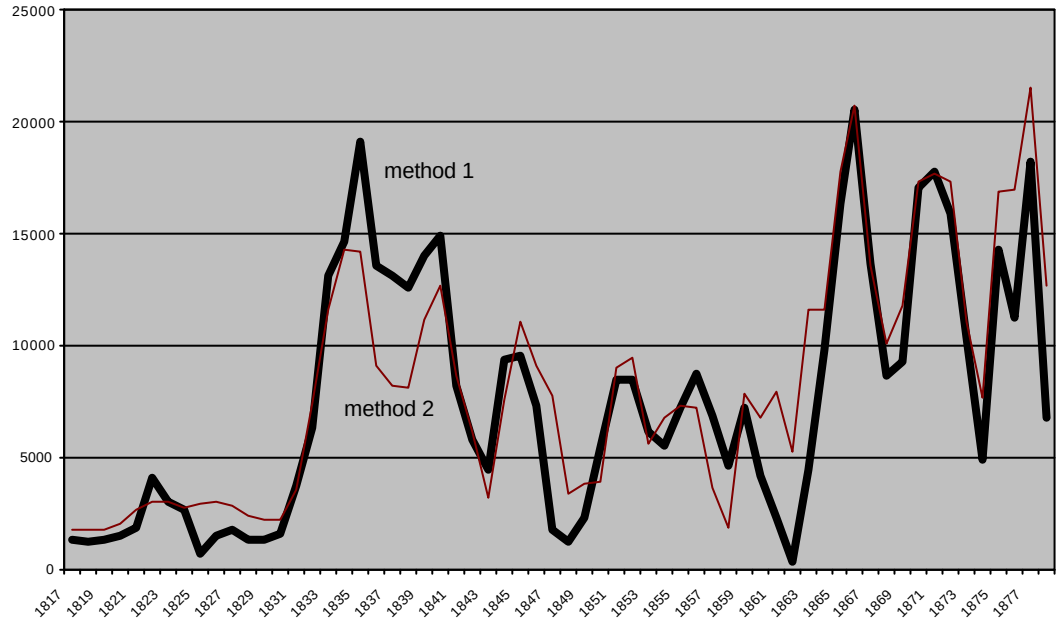
Figure 3 Uncorrected and corrected estimates of food consumption per capita (in kcal per day)



A final part of agricultural output (that is often ignored) consists of the reclamation of new agricultural land, which was a sizeable part of total investment. I already explained how the increase of the land that was cultivated by the peasantry has been estimated on the basis of CEI 10. CEI 1 (Export crops) presents much of the relevant information to estimate the land used by export crops (both the estates and the land of the peasantry used for the cultivation of sugar, indigo etc.). Van Baardewijk (CEI 14) also estimated the land used by the coffee trees that were planted under the cultivation system. On this basis, the total increase in the cultivated area can therefore be estimated relatively straightforward. It is much more difficult to estimate the costs involved, or the value of the investments made in this way. For the 1920s Van der Eng collected a number of estimates of the investment per ha (of sugar, tea, coffee, and rubber) that show that the ratio between investment per ha and value added per ha was on average about 3 (2.8 for sugar, 3.7 for tea, 3.2 for coffee, and 4.9 for rubber); the same seems to apply for land held by the peasantry: in 1926 the average value of a ha of sawah was estimated at fl 450 and of tegal at fl 150, which in both cases is close to three times the value added per ha in the 1920s (calculated from Van der Eng 1993). One way to proceed is to estimate the value of the investments in reclamations in this way, assuming that it was three times the value of the crop grown on it during a certain period (i.e. the five years before and after the moment the investment occurred); this is the first method to value the investments in new lands. Another

approach is to apply more or less constant estimates of the value of the reclamations, derived from the literature: in 1865 it was for example estimated that the reclamation of one bau of (not irrigated) land costs about 150 to 200 guilders; in 1885 that the investment in one bau of sugar was about fl 200; and in 1887 that the reclamation of one bau of kina lands, including the new roads, buildings, administration etc. was about fl 300, plus 2 times fl 50 in the second and third year (sources: Krayenbrink 1865: 272; Van den Berg 1885: 334; Berkhout 1887: 602). From these examples I estimated that the average investment per ha was: sawah fl 300, tegal fl 100, sugar and indigo (annual crops cultivated on peasant lands) fl 200 and coffee, tea and tobacco (mainly grown on newly reclaimed lands) fl 400. The total was inflated with a price index based in rice (50%) and wages (50%) (index 1865=100, because our benchmark estimate is derived from that year); this produced the results of method 2 (see figure 4). The two sets of estimates are almost identical: both show – of course – the enormous expansion of export agriculture during the 1830s, the retardation during the 1840s and 1850s, and the new phase of growth than began during the 1860s. In the final set of estimates I used the results of the second method.

Figure 4 Two sets of estimates of the value of reclamations and related investments in export crops (three years moving averages) 1817-1879 (in thousand guilders)



Industrial output: cotton textiles

There are two reasons to concentrate on textiles first: it was probably the most important item of expenditure besides foodstuffs, and its development was rather 'a-typical': the literature suggests that during the 19th century its output declined because of increased international competition. Cotton was by far the most important part of the textile industry.

In order to reconstruct the development of textiles production the time frame has to be broadened a bit. In the years before the First World War the indigenous spinning of cotton had all but ceased, and consumption consisted of cottons that were either

imported as finished products (about 95%), or as yarn (the remaining 5%) (see Hasselman 1912: 137). This makes it relatively easy to estimate the consumption of cotton goods at about 1910, which was about 1.2 kg per capita. At the beginning of the 19th century almost all cottons were produced locally; there was a relatively small import trade of Indian cottons, and some exports of local products, which may have cancelled out each other (see for example Van der Kraan 1998). The estimates Boomgaard (1987) published on the production of raw cotton (re-estimated in the way as suggested in the previous section) suggest that per capita consumption was at about 0.8 kg per capita in 1815, which is quite plausible compared to the 1.2 kg at the beginning of the 20th century.

Developments in between can be reconstructed as follows: the value of the imports of cotton goods are known from the import statistics. Import prices of calicots (unbleached cotton goods that dominated imports) are known from 1822 onwards (see CEI 15: table 1A). A number of sources suggest that 60% of the total value of imports of cotton goods consisted of calicots (this is the case in the 1835 and 1847 (see for example Posthumus 1916: 14, 40; Van der Kraan 1998: 57) and again after 1891, when detailed statistics on the composition of imports become available). Prices of the more sophisticated (dyed or printed) cotton goods of the remaining 40% of imports were on balance 50% higher than the prices of calicots (CEI 15: table 1A). This makes it possible to estimate the weight of the imports of textiles from 1822 onwards. In a similar way the weight of the imported yarn is estimated (yarn prices for the 1860s and the 1900s are derived from CEI 15; for intervening years it was assumed that yarn prices moved with the price of raw cotton, also from CEI 15).

The next thing to determine was how the imports of textiles (and of yarn) affected domestic spinning and weaving on Java. For two years there are estimates of the share of imports in total consumption of cotton goods: in 1848 the NHM estimated that the domestic weaving industry still met two-third of total demand, and in 1860 it was estimated that this share had dropped to half (see CEI 8: ….). The formula that is consistent with these trends (the share of domestic industry is 100% in 1815, 67% in 1848, 50% in 1860 and close to 0% in 1910) is that the import of one kg of cotton goods (or yarn) resulted in a decline of domestic production (spinning and/or weaving) of 0.7 kg of cotton. Figure 5 shows the results of this crude way to estimate the decline of domestic textile production and the increase of imports. Figure 6 relates the share of domestic spinning and weaving in total consumption to the development of the price of the calicots. It again shows that price changes were of fundamental importance: during the 1830s, 1850s, 1870s and 1880s the fall in the prices of imported textiles resulted in a sharp decline of the market share of the domestic industry, whereas the opposite happened during the 1860s, when the Civil War resulted in extremely high prices of (imported) cotton and cotton cloths.

These figures make it possible to estimate the value added in Javanese textiles during this period. Furthermore, it was assumed that 80% of the imports of bleached and unbleached calicots were processed by the batik industry (the 80% level is taken from the situation in 1913, and may be on the high side for the preceding period; see CEI 8:). This branch of the textile industry became increasingly important, as spinning and weaving declined under the impact of imported textiles. Moreover, the price of domestically spun yarn was set at 110%, and of domestically woven cottons at 120% of world market prices, reflecting the better quality (according to some sources) and/or the higher costs of these products.

The results of these estimates is that, on balance, value added in textiles fell from about f 25 million at the beginning of the period to slightly less than f 15 million in

1910. This fall was concentrated in two periods: the 1830s (when value added was about halved) and the 1870s and 1880s, when it again declined by almost 50%. In real terms the development was much less dramatic, because the prices of inputs and outputs fell very fast as well: the real value added still increased a bit in the long run (but on a per capita basis it also fell).

Figure 5 The per capita consumption of cotton goods from different sources, 1815-1910 (in kg)

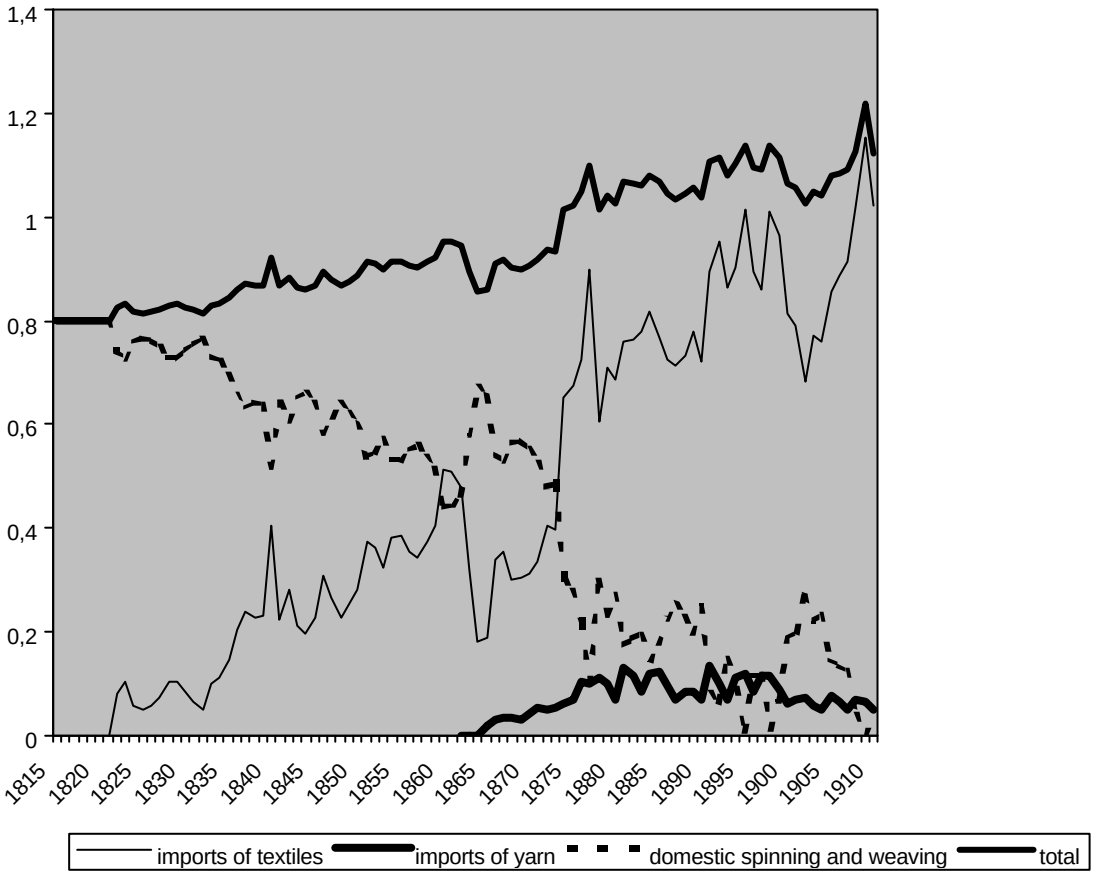
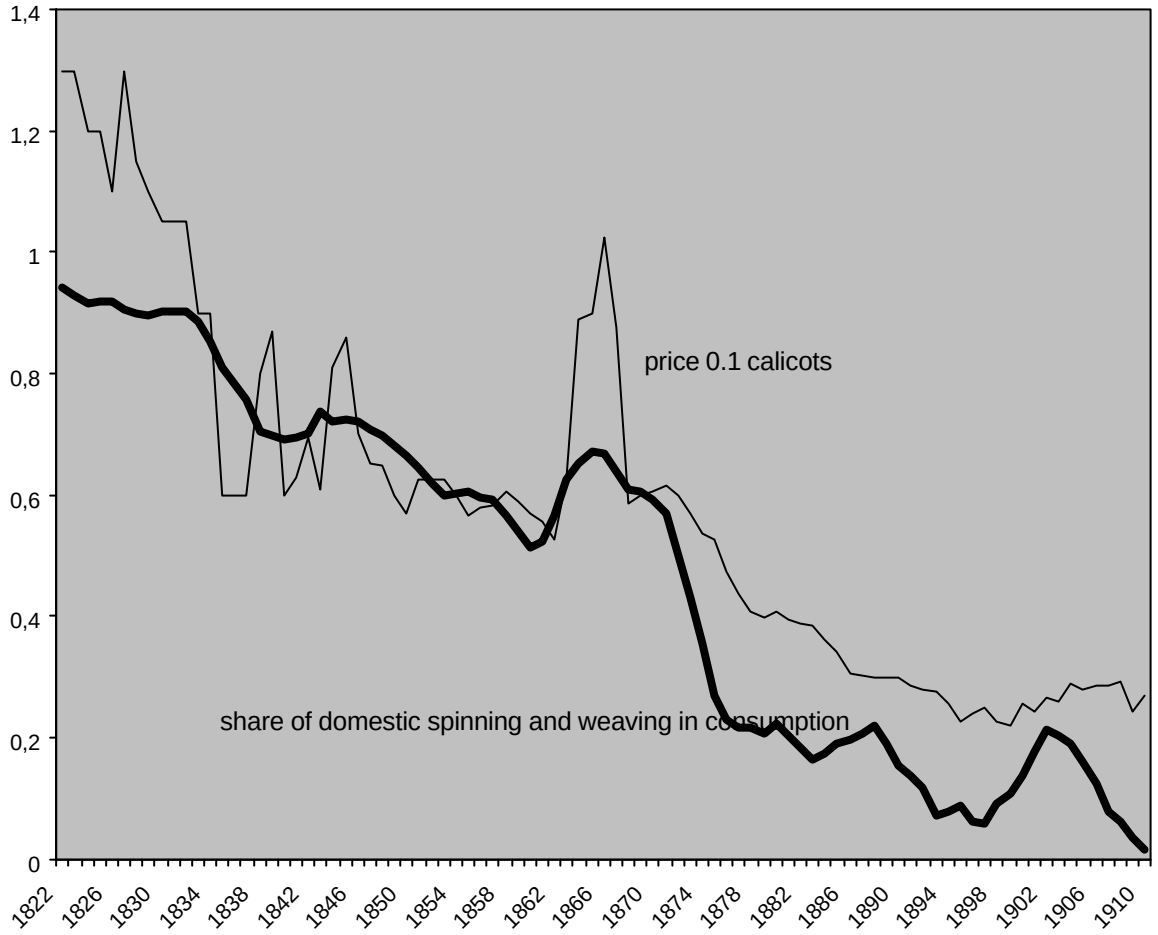


Figure 6 Share of domestic textile production in total consumption (five-years moving average) compared with the price of calicots, 1822-1910

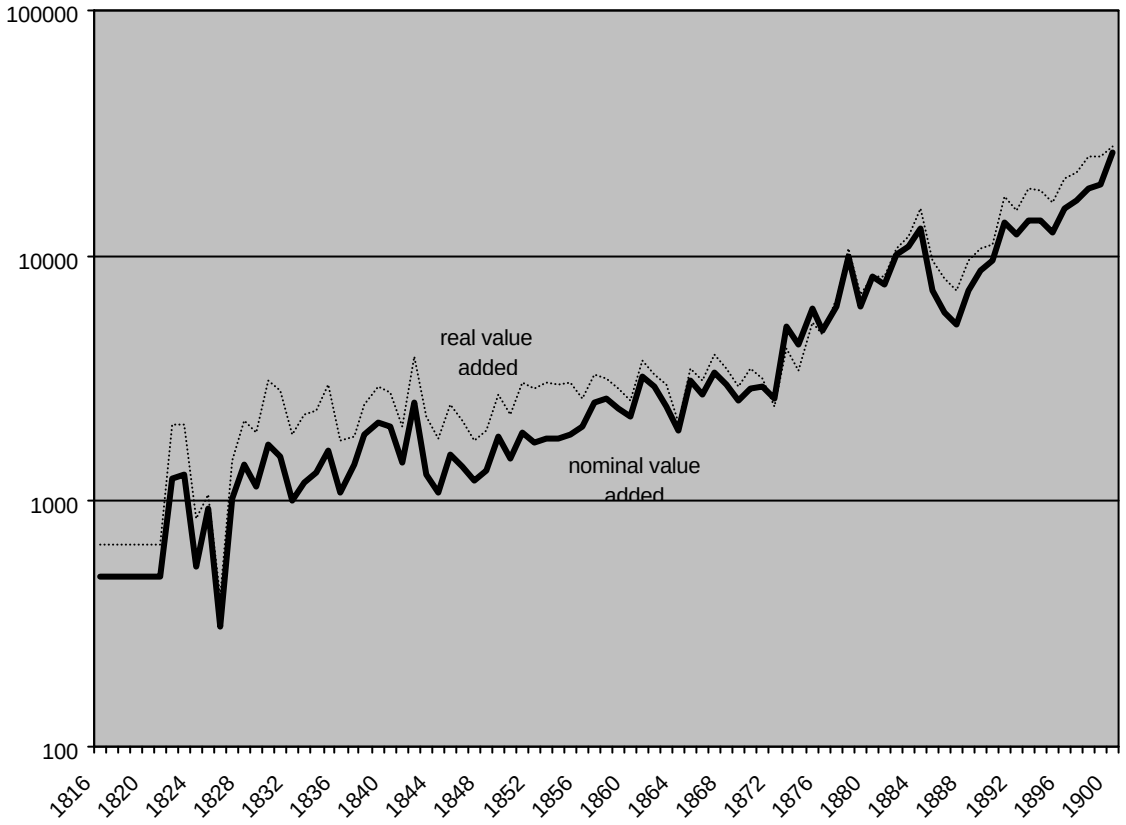


Industry: capital goods, and investment activity

Large parts of the capital goods sector (shipbuilding, engineering, metal working) were heavily dependent on the imports of inputs such as iron and copper, and (parts of) machines. These imports are known from 1822 onwards (there is a small additional problem here, as CKS 160 for the 1823-1874 period has published a slightly different series of these imports than Korthals Altes (CEI 12a); because the former series seems to fit better to the post 1874 data – which can be distinguished between imports into Java and Madura and into the rest of the Indies – I prefer the CEI series). Evidence from the reconstruction of investment in fixed assets suggests that in the 1910/12 about 50% of these investments consisted of imported inputs, the remaining 50% being value added from Java (see CEI 3: 77). I applied this figure to the 1822-1900 period to get estimates of the value added of the capital goods sector (see Figure 7). The deflator to estimate the development of real value added was based on the development of wages (50%) and the price of imported iron bars (from England) (also 50%) (see the section on prices and wages) (for the years before 1822 it was assumed that the average imports of inputs for capital goods were at 50% of the level of the 1822/29 period). The figure shows that this sector remained relatively

small before the 1870s, grew very rapidly during the 1870s and early 1880s, collapsed during the sugar crisis after 1882, and recovered strongly afterwards.

Figure 7 Value added of capital goods sector on the basis of imports of inputs (1816-1900) (in fl 1000; semi-logaritmic scale)



Public works

The government spent some money on public works in the 1820-1880 period: the budget of the department of public works was very small before the 1850s (less than one million guilders), but began to rise to a much higher level in the 1870s, when investment in railways, ports, and in irrigation became significant (see Kielstra 1904: appendix B for detailed figures from 1873 onwards). In 1867/69, when this trend began, it can be estimated on the basis of the information on the expenditure on public works in the KV that 22% of the budget of this department was actually spent on infrastructure (i.e. can be identified as public investment, using the same rules as were applied after 1873, by Kielstra 1904). It is assumed that this was also the case before 1867 (when the level of spending was close to insignificant).

A large part of investment, however – i.e. the construction of road, bridges, waterworks - was based on forced labour (corvee) and did involve limited amounts of cash spend by the government. From the mid 1860s onwards, when the colonial government began to regulate the corvee more strictly, the Koloniaal Verslag published estimates of the number of *dagdiensten* for the colonial government; for the years before 1865 some estimates (most of them based on regional studies) are available on the number of days supplied per household (see for example Van Schaik 1986: 94-105; Burger 1975, I: 127; Boomgaard 1987: 54-7). On this basis it is

estimated that during 1840s and 1850s the number of corvee days per capita was about 6, and that from the mid 1860s onwards this declined (with an acceleration as a result of the abolishment of certain types of corvee in the 1880s). It is furthermore assumed that the introduction of the Cultivation System led to an increase in corvee duties from about 4 days per capita to about 6 days (the guestimate of 4 is also maintained for the period before 1830). The economic value of one day of corvee is estimated at 50% of a daily wage of a coolie (during the 1850s corvee labourers were paid 12.5 cents per day, and free wage labourers 25 cents). Finally it is assumed, on the basis of the tables published in the Koloniaal Verslag, that about half the corvee was used to construct and maintain infrastructure, and the other half consisted of different kinds of government consumption.
It was not possible to quantify in any meaningful way investment activity in dwellings; there are simply no sources to estimate the development and size of this branch of the economy (it is included in the residual 'other industries' guestimated below).

The services sector: trade, transport and finance

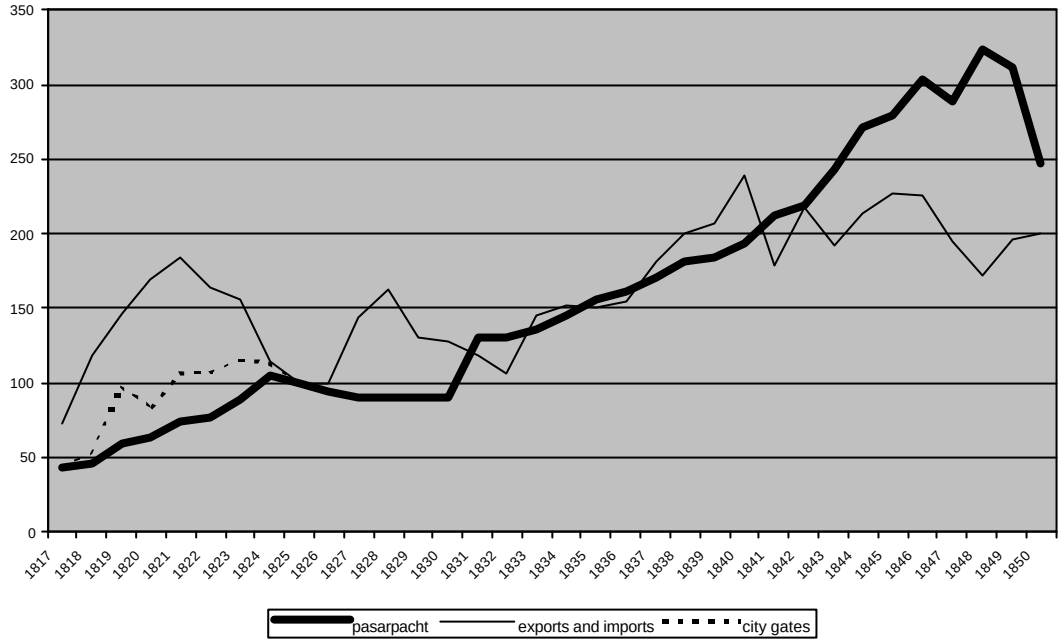
One way to approach the income that was earned in trade is by focusing on the bedrijfsbelasting that was levied on all incomes outside agriculture and government. A detailed breakdown of the Javanese and Chinese inhabitants who had to pay this tax in 1872 shows that there were 2103 'groothandelaren' (wholesale merchants) with an assessed income of 1.7 million guilders and 177.536 'kleinhandelaren' (retail traders) with an assessed income of 19.5 million guilders (the total assessed income outside agriculture and fisheries was almost 44 million guilders, the rest being industry (3.9 million), craftsmen (9.4 million), shipping (1.7 million) and others (7.6 million)(source: KV 1873). Comparably detailed statistics are not available for other years; in 1872 the residency of Batavia was not yet included in the tax (its assessed income was about 13.5 million in 1882), nor were the Principalities (with about 10% of total population). A very rough estimate of the total income of all merchants (except Europeans) would be that it was about 30 million in 1872 (this includes a substantial margin for tax-evasion). Europeans paid a comparable patentbelasting from 1878 onwards; the revenue indicates that the total income of this group was about 28.5 million guilders in 1880, of which perhaps half was earned in trade and related activities (in the census of 1880 the group of 'handelaren' was the largest occupational group outside agriculture and government, and no doubt high incomes were earned in this sector). Total income of all merchants in 1872 may therefore well have been as high as 45 million guilders. This is the net-income of those who resided in Java, excluding the income that was transferred abroad (the profits of trading firms, for example), after payments on debts have been made, and after the wages of clerks and other labourers have been paid. Total value added of the trade sector must therefore have been much higher than the estimated net income of merchants of 45 million – say 50 to 55 million guilders.

Imports and exports were probably the most important business of those merchants, in which the highest incomes were earned (also much retail trade was linked to the import trade of for example textiles). Total exports of Java and Madura were 176 million in 1872, of which 43 million 'on government account'; imports were 80 million, of which 12 'on government account' (CEI 12a). Margins were relatively high, because traded goods passed many hands: the big Dutch and English trading

firms organized the imports of the goods, sold them to Chinese middlemen who in their turn often again sold them to Chinese (and Javanese) retail traders, who finally sold them to consumers. Often more middlemen were involved: Dalenoord (**** 171-2) gives the example that cotton yarns were brokered by five different middlemen before they reach their final customers; in the meantime, the price has gone up by more than 50%. Average trade margins on imports and exports of the Netherlands (often with the Indies) were about 15% during the first half of the 19th century, and fell somewhat during the second half (Horlings 1995: 342; Smits 1995); those margins did not include retail trade. Therefore, for 19th century Java an estimated margin on imports and exports of 25% does not seem to be too high. I have excluded the trade 'on government account' (when the statistics on exports did not specify these, I reestimated 'free' exports on the basis of 'free' imports). For the years before 1822 the yield of import and exports tariffs were used as a proxy of the development of international trade.

These estimates of the income from import and export trade are used to estimate the total trade sector. For the period before 1851 the yield of the pasarpacht (a tax levied on all goods brought to local markets, which was leased out) can give an indication of the development of internal trade. Figure 8 presents the relevant series (indices 1825=100); before 1825 the pasarpacht was just being introduced into many residencies of Java, as a result of which its yield increases much more rapidly than trade. But another tax on trade, the index of the yield of the levy on goods that were brought to cities in the Principalities and passed the city gates (abolished in 1826), also shown in figure 8, suggests that internal trade may have grown rather rapidly in these years (source: De Waal 1864). The big decline in the international trade series in the early 1820s is rather suspect, however, because it is based on the yield of import and export taxes; I therefore prefer to use the 'toll gates' series to estimate the development of trade in the years before 1822.

Figure 8 Indices of the estimated exports and imports, the yield of the pasarpacht and of the levie at gates in the Pricnipalities (1817-1850, 1825=100)



Between 1825 and 1840 both series show almost identical trends, but after 1840 internal trade seems to expand more rapidly than international trade. The comparison shown in figure 8 suggests therefore that by using imports and exports as proxies of total trade, its growth is probably not overestimated.

A very profitable part of this branch that was dominated by the richest Chinese merchants was the opium trade. It is not included in the previous estimates as income of farmers of government taxes and monopolies was not taxed in the bedrijfsbelasting, opium was only a tiny fraction of total official imports, and much was smuggled into Java (it was the government monopoly which made it very expensive and resulted in enormous margins between purchase and sale prices). Thanks to the detailed statistics collected by the government, and the many reports and studies on the opium trade published from the 1840s onwards, it is possible to reconstruct how much opium was imported (and to estimate for years in which the state imposed restrictions on imports to estimate the amounts smuggled), what the purchase prices on international markets and the retail prices of the opium farmers were, which allows me to estimate the total value added of this specific branch (and the share that went to the state). The details of this reconstruction need not bother us here (I used the results and the underlying calculations of Diehl 1983, who supplied me with much of the relevant data; see also De Waal 1864, the various issues of the KV, and CEI 15). A similar detailed reconstruction is possible of the trade in salt, which was also monopolized by the state: the sources give details on the amounts produced (consumed on Java or exported), the prices paid to the salt-makers, the sales prices set by the government, and the costs of the monopoly (sources: KV, various issues, and De Waal 1864). Total trade consists of the sum of international trade, opium trade (of the state and of the opium farmers) and the salt trade.

Transport by sea was also a rather important source of income. According to the bedrijfsbelasting of 1872 9942 taxable persons earned a total of almost 1.7 million guilders; the census of 1880 gives at 24666 persons employed in this branch (sources: KV 1873 and 1882). Total value added (including Batavia, interest and depreciation, the wages of the sailors who were probably not included in the bedrijfsbelasting etc.) may bring the value added of this sector to up to 4 million guilders. Detailed statistics are available on the size of the merchant fleet of Java and Madura (CEI 9 table 1), and of the volume of international and domestic shipping to its ports (tables 2 and 3) (after 1873 CEI 9 only gives shipping movements for Indonesia as a whole, and the share of Java and Madura had to be estimated on that basis and on the size of the merchant fleet located here). It is assumed that the fleet of Java dominated domestic shipping, but had an almost negligible market share in international shipping (see also CEI 9 table ….). The growth of the volume of domestic shipping is higher than the increase of the merchant fleet, which probably means that more shipping movements were made per ship, thanks to the introduction of, for example, steam, and the intensification of shipping (for example, the number of port cities at which ships could call also rose). Freight rates were stationary, however, during much of the period (see CEI 15: 144, and additional data collected by the author from the Javasche Courant), which meant that in real terms they declined somewhat. When the volume of shipping is multiplied by an average freight rate (for the trip to Banka, to unload rice there and load tin), an estimate of the gross value added can be made. Assuming that inputs accounted for about 20% of value added (Horlings 1995 estimated for the much more modern Dutch fleet that inputs were about one-third of gross value added) gives a net value added of 4.5 million guilders in 1872, consistent with the income estimates based on the bedrijfsbelasting.

Railways: gross income and output (in freight and passenger km's) of public and private railways are available from a number of sources (CEI 9, KV various issues, and Wijnmalen 1887: 453-66), which allows me to make estimates of the value added of this branch.

Other industries, and other services

For the rest of industry (all industrial activities besides textiles, metalworking and construction) and all other services (such as religion, education, professions) no data are available on their output or value added. But we can get an idea of their importance from the 'census' of 1880 do know their share in the labour force in 1880 and the number of earners assessed in the bedrijfsbelasting of 1872 (and their assessed income). During the first stage of the research this resulted in the very rough estimates that the value added of both 'other industries' and 'other services'; both were estimated at 1 guilder per capita in 1880. Moreover, it was assumed that in real terms this remained constant between 1815 and 1880. These assumptions had to be modified during the next stage of the project, as the result was a much too low level of total value added in industry and in services during the 1920s (see below).

Government: salaries of employees on Java. Sources: budgets of colonial government 1821 (ARA) and analysis by De Waal (1882) of the structure of government expenditure at about 1880; problems: what part of spending is done on Java and Madura (it declines) and what part of spending is 'value added' (i.e. wages and salaries). The bench mark estimates made are that the share of Javanese wages and

salaries in total expenditure (in the Netherlands Indies, excluding spending on colonial products) was 36% in 1821, and 21% in 1880 (it declined even further to 15% in 1924 when only wages and salaries of central state are taken into account: see CEI 5: 55 and CEI 2). Between 1821 and 1880 this share was intrapolated.

Salt production: data of the government monopoly in the KV 1848 ff. and De Waal 1864; the production of salt outside the monopoly, which was rather large before the mid 1820s when the southern coast had its own independent sources of salt, was estimated on the basis of the information supplied by De Waal 1864: 264-66.

Fisheries: the first set of estimates are based on the bedrijfsbelasting on fisheries between 1864 and 1872 (from the KV of these years); before 1864 the yield of the excise on fish (which was abolished in that year, and replaced by the inclusion of fishermen in the bedrijfsbelasting) was taken as a proxy of the development of the industry. Between 1872 and 1880 the yield of the tax on fishing ponds was taken as an index of the value added of the sector. These estimates imply that an average worker in the fisheries in 1880 (the number of workers is based on the census of that year) produced a value added of about fl 200, which appears to be reasonable: about half of it going to 'capital', and about half being a remuneration for labour (an average coolie could earn about fl 80 per year in 1880, but fishing communities were relatively prosperous (see Hasselman 1912: 103 ff.)).

Summing up 1815-1880

The research presented so far results in series of the value added of the following branches:

- smallholders agriculture (including investments in reclamations)
- export agriculture (mainly estates, but some smallholder production as well) (including investments in reclamations)
- salt production
- fisheries
- textiles
- capital goods: metal-working, shipbuilding, engineering
- capital goods: public works
- other industry
- trade (international trade, opium, salt)
- transport (shipping and railways)
- other services
- government (including corvee labour)

Value added is valued at market prices.
The price series used are:

- rice (CEI 4)
- export crops (coffee, sugar, indigo, tobacco) (CEI 15)
- salt: purchase price by government
- fisheries: price of salt and wage index (each 50%)
- textiles: price of imported calicots (CEI 15)
- capital goods: wage and price of imported iron (50/50) (iron prices from prices of imported English iron in CEI 15; gaps in series were closed using iron prices published by Mitchell 1988).

- public works: wage and rice (50% each)
- other industry and other services: wage index (which is also used to inflate this series)
- trade: international trade: price indices of imports and of exports (50% each) (CEI 15); opium: retail price opium (CEI 15, and KV); salt: retail price salt (KV, De Waal 1864)
- transport: freight rates were constant (see CEI 15: 144; an additional data collected from the *Javasche Courant* 1828-1855)
- government: wage index (suggested improvement: I intend to make a separate index of the salaries of government employees).

The wage index was based on estimates on the level of wages of coolies on (sugar) plantations from 1855 onwards (from CEI 13 tables 3 and 5) and data on wages of coolies working for government in the 1820s from various sources (see Van Zanden 2002). Between the 1820s and 1850 no wage data are available, but there are a number of indications that wages increased relatively fast in these years (again see Van Zanden 2002 for more details). To get an index, the gap between 1829 and 1850 (when the first wage data from Surabaya are available) was simply intrapolated.

The period 1880-1939

The next step was to apply the approach developed for the period 1815-1880 to the period 1880-1939. A number of modifications and checks were possible:

- agriculture: all estimates are derived from Van der Eng (1993);
- industry: for the period 1880-1921 all estimates are made in the same way as the pre-1880 estimates, but a comparison of these estimates for 1921 with the estimates made by Van Oorschot (1956: 92) of value added during the interwar period shows that the method used for the 19th century underestimates value added in 1921 and later years (in 1921 the difference is 408.4 million according to my set of estimates and 508.5 million according to Polak/Van Oorschot) (note: in fact, Van Oorschot only published estimates for 1928-1939, on the basis of the series of wage income by Polak/CEI 5: 48-49; but Polak also indicated the development of wage income during 1921-1928 which made it possible to estimate value added in industry before 1928 in the same way). I have concluded from this comparison that my estimates of the value added in 'other industry' are too low, and therefore raised these estimates in the period before 1921 as well (which means that I assume that the per capita expenditure on products of 'other industry' was not fl 1 per capita in 1880, but fl 2.30, and that this increased/decreased before 1880 and after 1880 with the wage level); for the period 1921-39 the Polak/Van Oorschot estimates have been used; the price index was also derived from Van Oorschot (1956: 93).
- trade and transport: the same methods were applied, with few changes; in shipping it was assumed that after 1880 freights rates in domestic shipping declined as fast as in international shipping;
- other services (including rents): the confrontation with the Polak-estimates (CEI 5 : 57) also showed that the original estimates for other services were too low; in order to make them comparable with the Polak estimates they had to be increased by a factor 4 (i.e. originally it was estimated that in1880 per

capita spending on other services was 1 guilder, which was increased to 4.25 to make them consistent with the 1921-1939 estimates);

- fisheries: data on the yield of the tax on fishing ponds are used to estimate the development of income/value added in this branch until 1921; after 1921 the estimates of Polak/CEI 5 are used; the result is that, for example, total value added in 1903 is estimated at f 18,3 million, or f 162 per fisher (Hasselman 1912: 104 mentions a total number of 112351 fishers in 1903); in 1880 value added per fisher was still about fl 200, but prices and wages declined by about one third between 1880 and 1903.

All other series were estimated in the same way as before 1880. The resulting estimates for the interwar period broadly in agreement with those of Polak/CEI 5 (but some of the inconsistencies of the Polak estimates, the result of the fact that he used both value added and income estimates but did not clearly differentiate between the two approaches, are repaired here).

Finally, price indices were calculated for four sub periods: 1815-1830, 1830-1870, 1870-1913, and 1913-1939, using weights for 1826/30, 1865/70, 1908/13 and 1924/29; these indices were linked to create one deflator for 1913=100. This index were used to deflate the series of GDP in current prices.

The results

Within the scope of the paper only some of the preliminary and highly tentative results can be presented. I will focus on 1/ the comparison of the structure of GDP and the structure of the labour force in 1880 and 1930 (also as a check of the estimates); 2/ the growth of GDP per capita, and 3/ the share of investment in GDP.

Table 1 shows the confrontation between the structure of GDP in 1880 and the structure of the labour force in that year. Both set of estimates are broadly consistent, but the share of agriculture seems to be rather high. Part of the explanation is that perhaps the most dynamic sector during the 19th century is export agriculture, which is of course included in agriculture; economic growth therefore does not result in a continuous decline of the share of agriculture in GDP. But the share of smallholders' agriculture also did not decline much in the long run: it was about 45% in the 1920s, and still 40% in 1913 (during the interwar period it began to decline more rapidly, to 34% in 1929 and 29% in 1939). The pace of structural transformation was quite small, as is also evident from the comparison of the structure of the labour force in 1880 and 1930.

Table 1 The structure of the labour force and of GDP in 1880 (in %)

Sector	Share labour force	Share GDP (1878/80)
Agriculture	75	61**
Fisheries	2	2
Industry	3	10
Trade	9	10
Transport (shipping & railways)	1	2
Government	2	4
Other services	2	12
Labourers*, and others	6	0
*many of these labourers worked in agriculture; ** of which 13% from export agriculture and 48% from foodcrops	100	99

NB the classification of the labour force and the interpretation of the census of 1880 followed here differs slightly from Fernando 1993

Sources: Labour Force: KV 1881; GDP: this reconstruction.

Table 2 The structure of the labour force and of GDP in 1930 (in %)

Sector	Share labour force	Share GDP (1925/29)
Agriculture	63	57**
Fisheries	1	1
Industry	12	16
Trade	7	11
Transport (shipping & railways)	2	4
Government	3	5
Other services	2	6
Labourers*, and others	10	0
*many of these labourers worked in agriculture; ** of which 22% from export agriculture and 35% from foodcrops	100	100

Polak/CEI 5: 96-7; GDP: this reconstruction

Table 3 The estimates of the development of Real GDP, Population, GDP per capita, and the GDP deflator, 1815-1939 (average annual growth rates)

	GDP	Population	GDP per capita	GDP deflator
1815-30	1.7	2.3	-.6	-.9
1830-40	2.7	1.3	1.4	1.2
1840-60	1.6	1.3	.3	.4
1860-80	2.4	1.6	.8	.8
1880-1900	2.1	1.2	.9	-2.4
1900-13	3.7	1.1	2.6	1.1
1913-21	1.0	.8	.2	7.9
1921-29	3.0	1.0	2.0	-3.8
1929-39	.9	1.2	-.3	-5.4

Figure 9 Estimates of the development of GDP per capita in Java (1815-1939), Indonesia (Van der Eng; 1880-1939), and food production per capita (1815-1939)

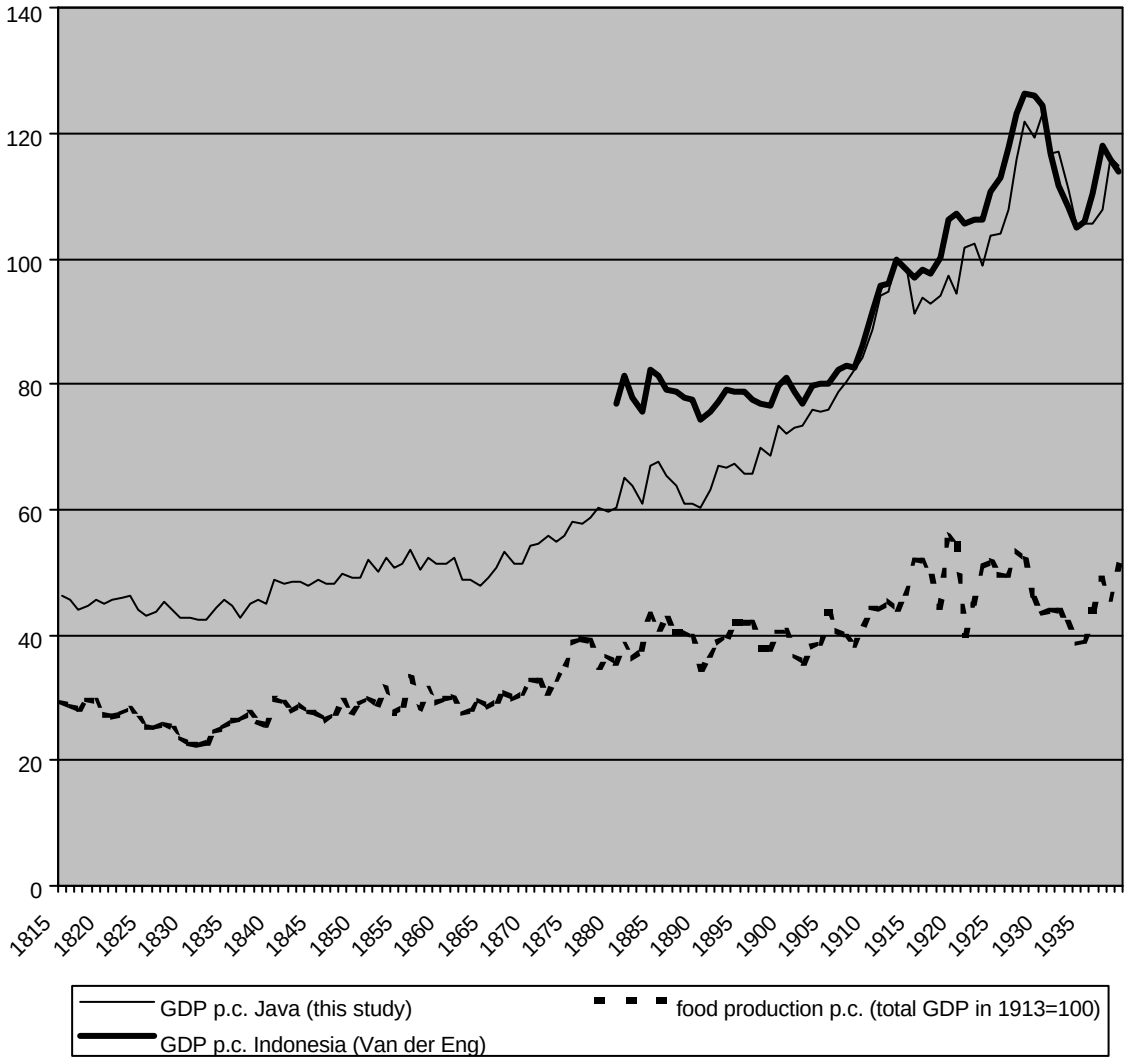


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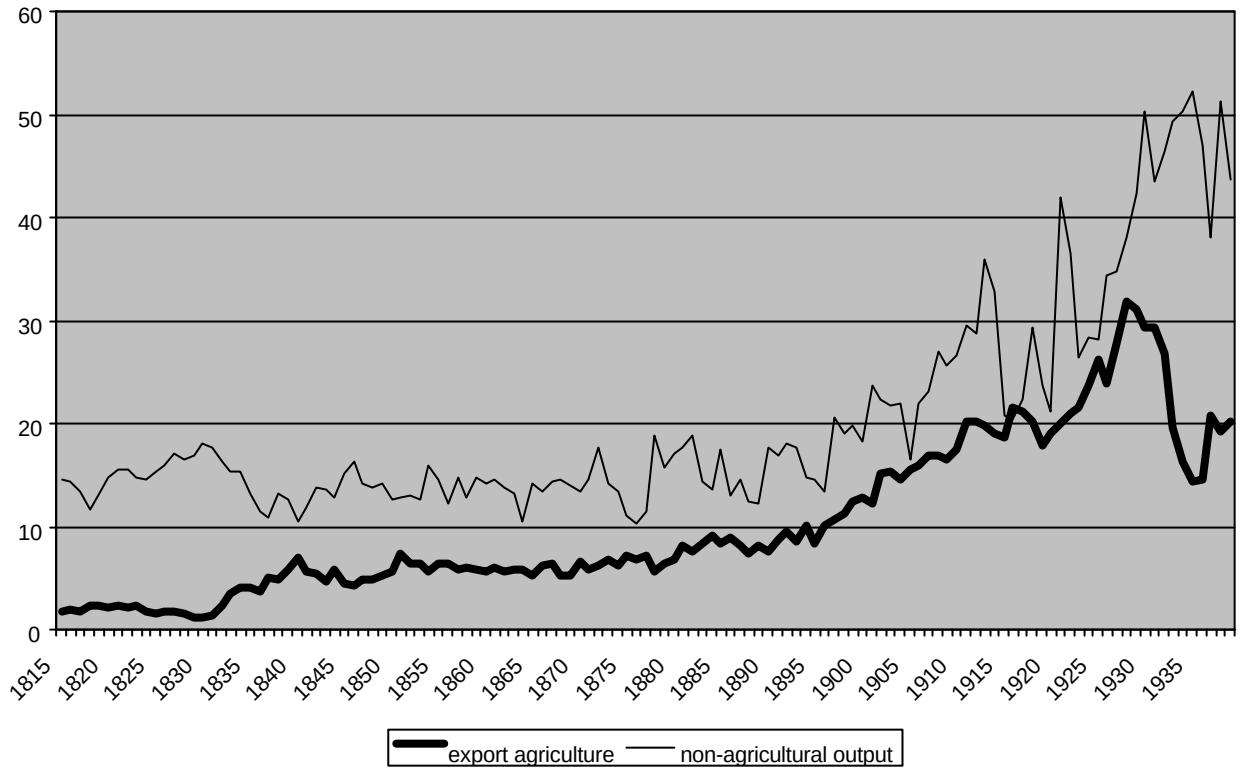
Table 3 and Figure 9 present the estimated growth of GDP per capita. During the first half of the 19th century GDP growth is almost the same as population growth, and GDP per capita hardly increases at all (it declines somewhat during the 1820s, increases during the next decade, but remains virtually constant between the early 1840s and the early 1860s). A first growth spurt occurs between 1865 and 1880, resulting in an increase of about a third. The 1880s and first half of the 1890s are another period of stagnation, but after 1896 a new growth spurt begins that results in an increase of GDP per capita by 50% in less than 20 years. This second growth spurt may overestimated; the GDP estimates for Indonesia published by Van der Eng (1992), also shown in figure 9, indicate that there was per capita growth between 1896 and 1913, but much less, only by about 30%. During the period 1913-1939 both set of estimates show a great deal of similarity.
On balance GDP per capita increases by about 150% during the 1815-1939 period, which is more than I expected on the basis of my reading of the literature. It roughly doubles during the 1815-1913 period (and in particular between 1865 and 1913), and again shows strong growth during the 1920s (and a decline during the next decade).

The bottom/dashed line in figure 9 represents that share of GDP per capita that is the output of food crops. It shows that part of the growth during the first spurt can be attributed to the expansion of food crops (per capita), which however remained stationary during the second growth spurt, but increased again during the third growth spurt of the 1920s. It was noted before that food production and consumption is probably underestimated before the about 1870. As a sensitivity test we can assume that per capita food production remained constant before, for example, 1875; in that case growth during the 1815-1875 period would be much lower (i.e. the level of GDP per capita in 1815 would increase with nine points to 56). This would, of course, lower the rate of growth of GDP per capita, but growth would still be substantial; the estimates presented here imply an average rate of per capita growth of .77 per annum, assuming a constant output of foodstuffs before 1875 would lower this to .60 per annum. The reason is that much of the growth occurred outside smallholders' agriculture, and that we can be quite certain that this growth is 'real' (for example the growth of trade, shipping, export agriculture, government etc.).

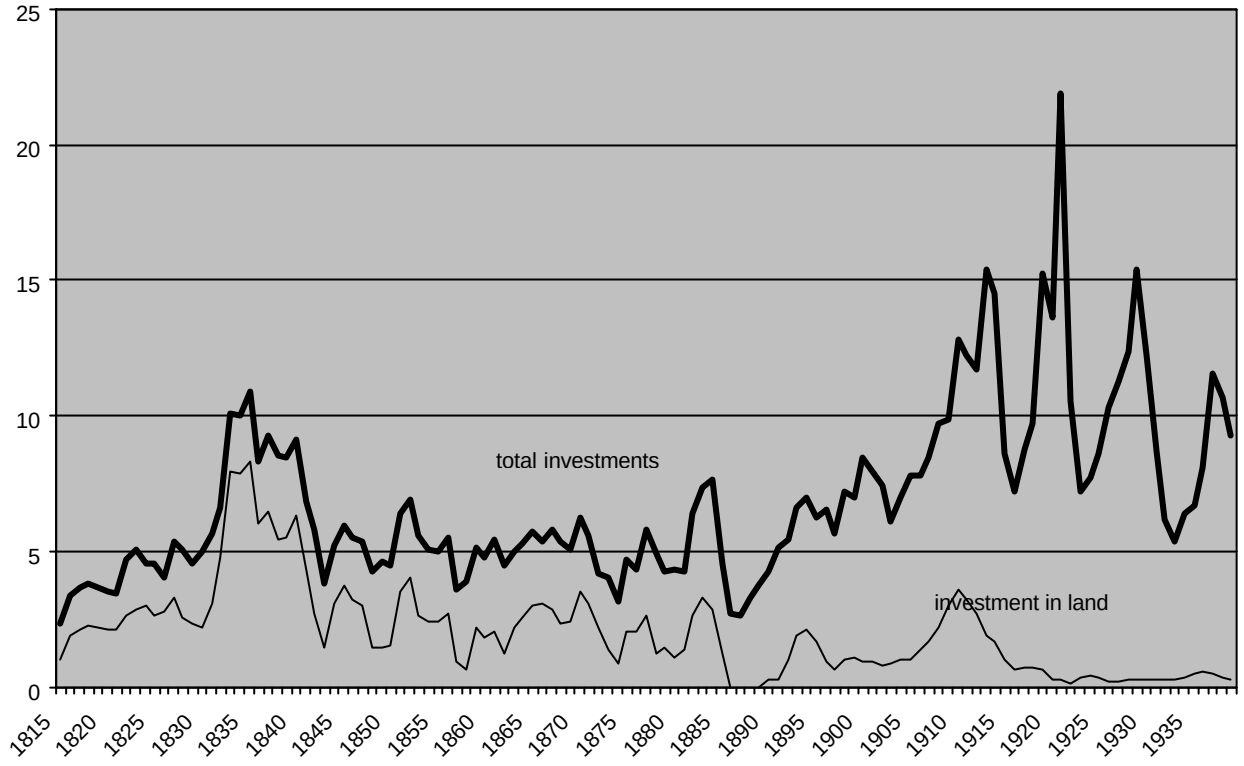
Figure 10 covers these other sectors of the economy: export agriculture and non-agricultural output. It shows that the strong expansion of export agriculture during the first phase of the Cultivation System was compensated for by an almost equally strong decline of non-agricultural output (i.e. textiles), which explains why on balance there was almost no per capita growth during the 1830s. This pattern changed during the second half of the 19th century: growth of export production became linked to the growth of non-agricultural output, and vice versa. Both parts of the economy expanded significantly during the 1870s (first growth spurt), stagnated during the 1880s and early 1890s, and grew rapidly in the two decades before 1914, and again during the 1920s. The 1930s shows a pattern of development that is the reverse of the 1830s: a contraction of export agriculture combined with an expansion of industry and services, both heavily oriented towards the domestic market. The parallel goes even further: the main reason for the contraction of non-agricultural output during the 1830s is the relative decline of textiles, whereas the strong expansion of textile production during the 1930s is the most important factor behind the growth of non-agricultural output in that period.

Figure 10 Export agriculture and non-agricultural output, per capita in real terms (total GDP per capita in 1913=100), 1815-1913



Finally, figure 11 presents the evidence about the share of investment in GDP. No estimates for investments in dwellings is available, which means that in order to compare this figure with investment ratios from other periods and countries, we have to add perhaps 2 to 4 percent of GDP, being the 'normal' level of investments in dwellings in a pre industrial economy (in the Netherlands this share fluctuated around 4% in the period 1807-1830; see Smits, Horlings and Van Zanden 2000: 163, 219, but housing was more costly in the Netherlands than on Java). These estimates indicate, however, that the investment ratio was already relatively high, and fluctuated sharply, during the 19th century. Until about 1890 investment was dominated by the increase in the cultivated area and related investments in (perennial) crops, equipment etc. The investment boom of the 1830s clearly stands out in the graph. 'Modern' forms of investment took over after 1890 – in railways (beginning already in the 1860s), irrigation, and manufacturing. During the interwar period a large share of GDP was invested, comparable to the investment ratio of the Netherlands in this period; the big swings in economic activity are clearly discernible in the investment series.

Figure 11 Investments (excl. investments in dwellings) as a share of GDP, 1815-1939



Conclusion.

It is, of course, much too early to draw firm conclusions from the preliminary results presented in this paper. Yet a few concluding remarks can be made. It appears that during the 19th century economic growth was probably more rapid than was assumed so far – GDP per capita may have doubled between 1815 and 1913 – which is consistent with the relatively high level of investment in the 19th century economy (which is another rather striking result). This growth accelerated during the 1920s; at the end of the interwar period GDP per capita was probably more than 100 to 150% higher than in 1815. Yet, at the same time, the standard of living of the Javanese population did not improve a lot, if at all. Real wages, for example, did not show a rising trend, and the data on the stature of the Javanese population also suggest stability at a low level (Van der Eng, unpublished). Perhaps the estimates 'national' accounts are quite wrong, or not the right concepts to measure the performance of the Javanese economy in this period. Or perhaps these two stories, this apparent paradox, tell(s) us a lot about what happened in Java between 1815 and 1939.

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