Economic growth in Java 1815-1939
The reconstruction of the historical national accounts of a colonial economy[1]

Jan Luiten van Zanden

Introduction: why reconstruct the historical national accounts of Java in the period 1815-1939?

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* (CEI) has expanded impressively during the editorship of Peter Boomgaard and now covers 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 of the limitations of the series CEI and of the recent synthetic works, is that a macro-economic analysis of the long term development of the economy of Indonesia in the 19th century is still missing. The individual volumes of CEI give detailed data of topics ranging from forestry to rice prices, but a comprehensive account of the growth of the Indonesian economy is still beyond its scope, although initially such a macro-economic coverage was formulated as one of the ultimate aims of the project. Van der Eng (1992) has furnished a set of estimates of the growth of GDP of Indonesia in the period after 1880, but these estimates have serious limitations. He did not make, for example, estimates of GDP and its components in current prices. Moreover, because the 19th century is at quite a distance from his base year in 1980, biases may exist in the estimates for the period before 1913 (see also the discussion with Booth (1995)). It is, therefore, still not possible to evaluate accurately the effects of the Cultivation System on Javanese economic development, or to analyze the backgrounds of the debate on the declining prosperity of the Javanese population at the start of the 20th century.

In this article I will first 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 is feasible, and present the first set of estimates for Java between 1815 and 1939. One of the aims of the paper is to discuss at some length the quality of the available information – mainly from published sources such as the CEI, but also from a few

[1] Different drafts of this paper have been presented at conferences/seminars in Kuala Lumpur, Tokyo, Canberra and Amsterdam (IISH); I would like the participants at those meetings, and in particular Raja Narzin, Pierre van der Eng, Peter Boomgaard, Thomas Lindblad, Jan-Pieter Smits and Shaharil Talib for their valuable comments; Frits Diehl kindly supplied me with detailed data on government revenue and expenditure and on the opium farm.

archival sources – in order to show that these estimates can be based on a relatively rich variety of different sources, which all have their problems and limitations, but which taken together can probably give a relatively accurate picture of the underlying trends of the Javanese economy between 1815 and 1939. In fact, the richness of the available sources is rather unique; it will be difficult to find a non-OECD country for which comparable sources exist for the 19th century. This creates the unique opportunity to study the long term development of the economy of a 'developing' country in the one-and-a-half century before independence in some detail.

To consider this point in more detail: it can be argued that the amount of information available on the economic development of Java in the 19th century is enormous. First of all there is the impressive series *Changing Economy in Indonesia*, covering almost all parts of the economy. Yet, it contains only a fraction of the relevant quantitative and qualitative information available in many hundreds, of not thousands of articles written by often well informed civil servants and colonial experts during the 19th century, not to mention the many thousands of government documents still waiting to be researched. Perhaps the real 'problem' of Indonesian economic-historical research is not the absence of 'data', but their abundance. At present it is quite difficult to make, for example, a balanced assessment of the economic development of Java in the period 1830-1870 because of the sheer number of published (and unpublished) sources and studies. We know, for example, what happened to exports, but how is their growth related to, for example, the decline of textile production (suggested in the literature), or the expansion of government expenditure? [2]

The fact that data do exist, does not mean that we can simply put them together with the framework of national accounting; other problems have to be solved as well. Firstly, 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 low – or unknown. The second, and perhaps most urgent problem, can to some extent be solved – as I hope to show in this paper – by comparing different sources and types of data. To begin with, we know of some data that they are much more accurate than others. Data on government expenditure or on exports and imports are rather reliable, for example, although even these data are not beyond doubt (because, for example, smuggling of opium did occur, and therefore government statistics cannot inform us 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 figures, and probably no single scholar can integrate all this information if he does not have some kind of conceptual framework at hand. 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 the information into a single concept (GDP) that has a clear economic meaning.

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[2] The availability of sources is also the reason for focusing on Java. For the period before 1900 data on other parts of Indonesia information are extremely patchy and often totally absent.

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 should start to reconstruct the national accounts of Java for these years, as this is the only coherent framework that can do the job.

This article makes a start. The approach that is suggested is a bit counter-intuitive, but hopefully will work: the research has concentrated on the most difficult period, i.e. 1815-1880. The main object of the paper is to explain how it is possible to reconstruct the 'national' accounts of Java between 1815 and 1880. The next stage is the extension of the approach developed for the period 1815-1880 to the next period, 1880-1939, and to check those results with other estimates.

The goal of the paper is to explain in some detail, sector by sector, how estimates have been made. As often in historical national accounting, the output approach was the starting point of the project. The result of the work that is presented are estimates of the value added of the different branches of the economy, which added together give a series of the GDP of the island, which are then deflated in order to get estimates of real GDP (and of GDP per capita). The final section contains a brief analysis of the results of this endeavour.

Estimates for the period 1815-1880

The agricultural sector

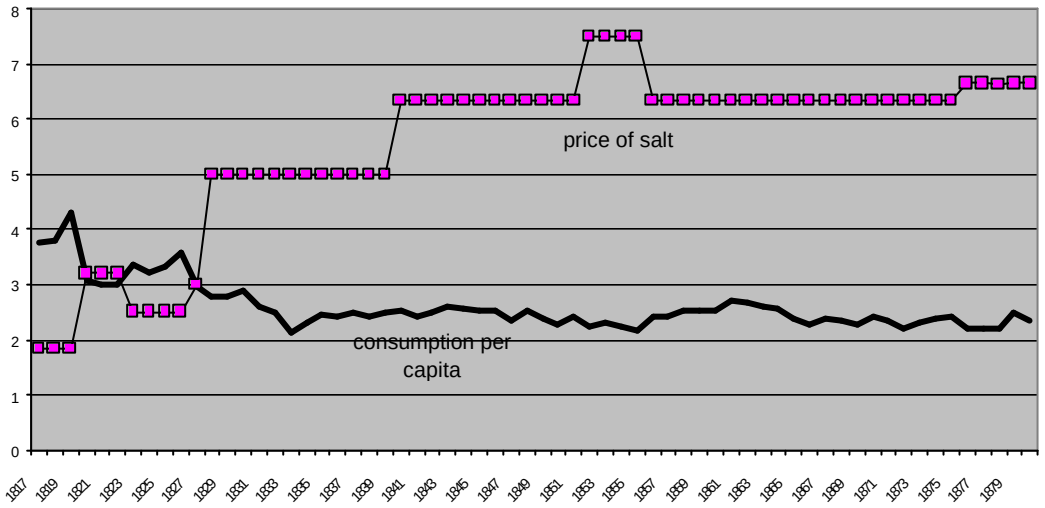
The obvious starting point is the development of the *population* of Java. We don't know how large it was during much of the 19th century, despite the fact that the colonial administration collected and published many detailed figures of its size (and structure). Taking this evidence at face value leads 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. From this it can be inferred that the degree of underestimation of the official data in their view declined 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 three bench mark estimates.[3] According to this series the population of Java and Madura increased from

[3] I used a slightly revised version of his estimates, because in a few years his estimates imply that population rowth was higher than 3% annually, which is not realistic; I lowered the growth rate in these years to 2.5%, which gives somewhat higher estimates for the first few years.

8.4 million in 1815 to 14.2 million in 1850[4] and 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 relatively reliable 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 before the early 1830s the monopoly did not cover the whole island. 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 likely, as the official sales price of salt increased strongly between 1819 and 1830. In fact, Figure 1 suggests that consumption reacted quite well 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 was relatively stable in times of constant prices. 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 are more plausible than the official head counts. This comparison shows at the same time that Javanese consumers reacted strongly to price signals.

[4] 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 figures.

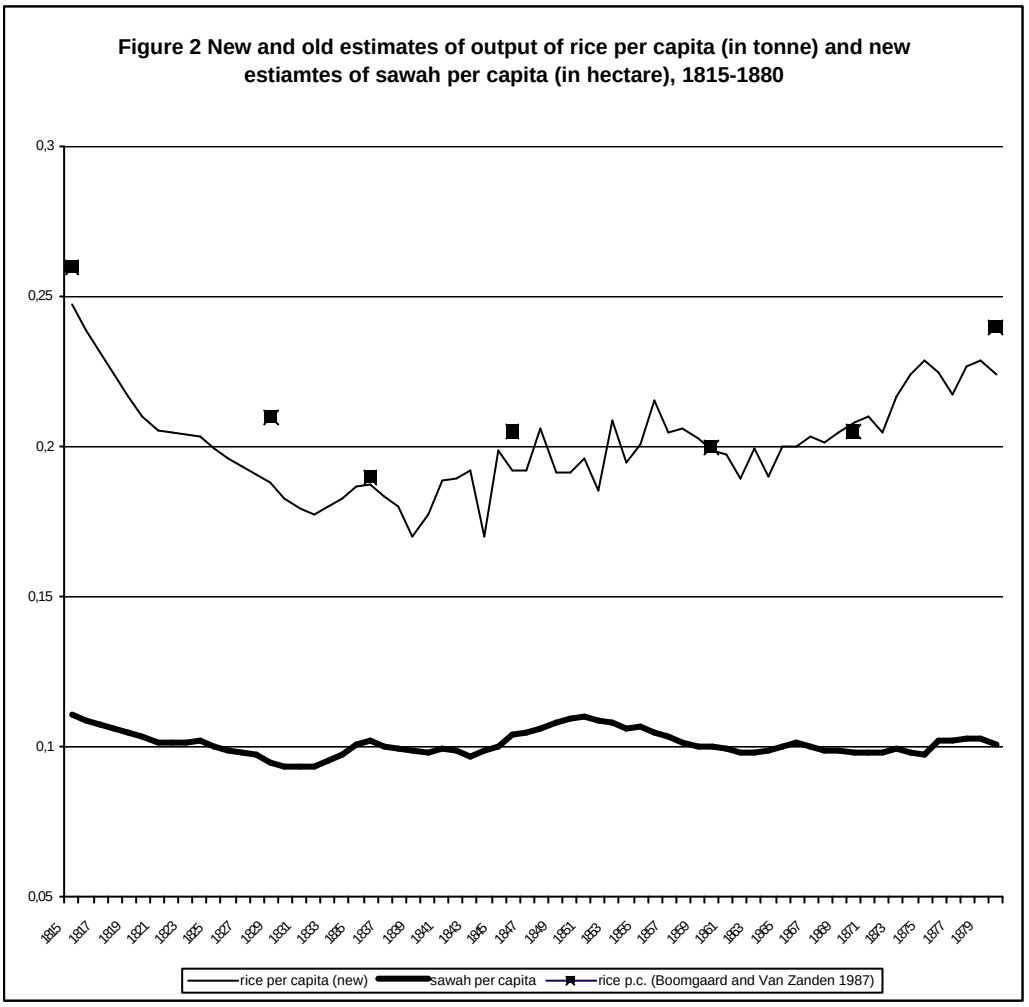
The next step is estimating the development of the *land under cultivation*. Van der Eng (1993) has presented estimates for the cultivated land in Java from 1880 onwards. He made a number of corrections for the fact that the accuracy of registration increased between 1880 and 1924, and that private lands and the Principalities are brought into the statistics in this period. 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 actual growth.[5] This results in a series of estimates of the total area under cultivation and of sawahs, which can be divided by total population (see Figure 2 for sawah p.c.). Both ratios show remarkable stability, i.e. cultivated 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 initially by Boomgaard, whereas I prefer the Boomgaard/Gooszen/Van der Eng estimates mentioned earlier.

Rice production can now be estimated by multiplying the series of the area of sawahs with the yield estimates of CEI 10.[6] The yield series shows two 'jumps' which are probably linked to changes in administrative procedures and in the efforts of the colonial administration to raise the land rent, which was based on the estimated yield of the land. During the 1870s an extensive cadastral survey of Java was conducted, which resulted in a strong increase in estimated yields; a similar jump in estimated yields occurred around 1840, when the colonial government attempted to increase the revenue from the land rent as well. In order to correct for these discontinuities, I assumed that half the increase in yields in these years (1839-43 and 1866-74) was caused by these administrative changes, and that the other half was 'real'. This makes it possible to estimate rice output per capita (Figure 2). The series consists of two parts: between 1815 and 1832 there are only a few observations available, and yields show a declining trend; the more or less annual yield estimates from 1832 onwards of course show more variability than the intrapolated estimates for the first 17 years. In the long run rice production per capita these new (annual) estimates appear to be consistent with the 'old' estimates by Boomgaard (1987) and Boomgaard and Van Zanden (CEI 10).

[5] In addition I had to assume that the increase of the cultivated land in the areas that were not covered by the colonial statistics – the private lands and the Principalities – grew at the same rate as in the rest of Java

[6] A number of intrapolations for the missing years between 1815 and 1820, and again between 1820 and 1828 are necessary, however.

Figure 2 New and old estimates of output of rice per capita (in tonne) and new estiamtes of sawah per capita (in hectare), 1815-1880



The output of the other food crops (maize, pulses and tubers) for 1815, 1840 and 1880 is taken from Boomgaard (1987; appendices). 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.) and of foraging (i.e. the collection of foodstuffs from the wild) was added to this. It was estimated to decline from 40% (1815) to 20% (1880) of the value of total arable output. In this way (by assuming a 20% mark up for 1880) the estimates for the 1815-1880 period can be linked to the Van der Eng (1993) estimates for the period from 1880 onwards.

A 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 (CEI 4, table 6). I also added an estimated consumption of fish, meat and coconut oil of 100 kcal per day (from CEI 10: 51). Two series are presented: one excluding foraging, another one including very tentative estimates of the contribution of this undocumented activity to food supply (Figure 3). They can be compared with the two estimates of per capita *production*

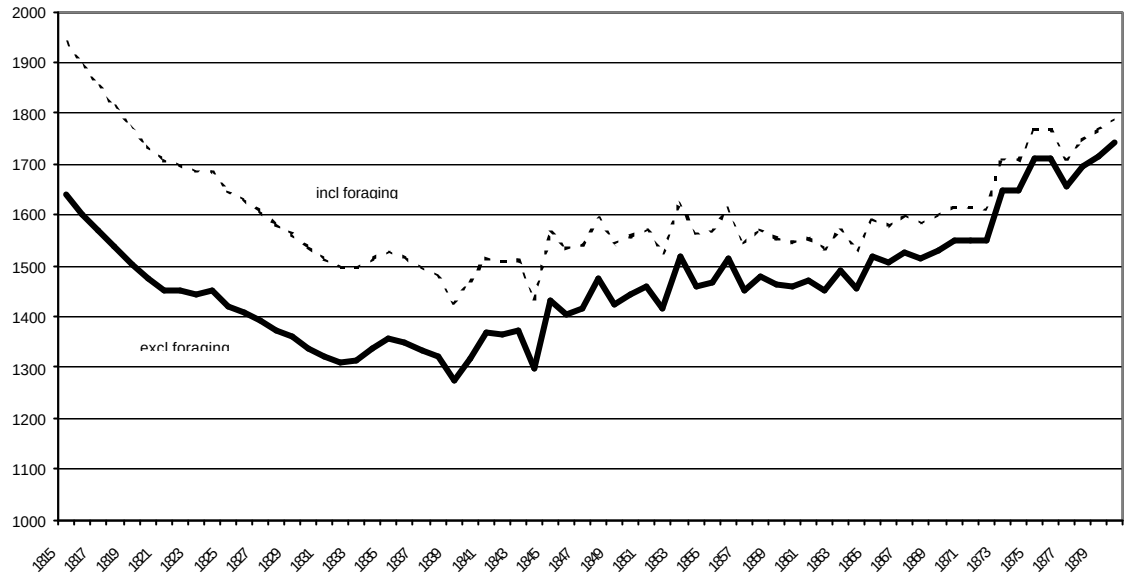
published by Boomgaard and Van Zanden (CEI 10: 49-50), who arrive at 1917 kcal per day in 1815 and 2288 kcal in 1880. The difference with the new results (1640 kcal in 1815) is the result of (a) taking into account seed, feed, and losses of the crops, and exports, and (b) the higher population totals for the early years discussed already.

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 1.49[5] m, which is quite small (see Van Zanden 2002b for more details). This is confirmed by a sample taken from a register of the slaves of Batavia in 1815: the average height of adults (older than 20 years) 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 very low second mode of the distribution of the heights of all slaves!). Van der Eng (unpublished research) 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 higher than the 1820-estimates by Crawfurd, which may point to a slight improvement of the dietary situation. The long term stability of food consumption – at least, when 1880 is compared to 1815 - is more or less consistent with this evidence. Moreover, the U-shape of the consumption-series coincides with the series of poor harvests and famines on Java during 1840s. The estimates of food consumption 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 fluctuating around 1600 kcal per capita per day, seem to be relatively low but are not impossible. The consumption estimates of 1880 are consistent with those of Van der Eng (2000).

The output of exports crops such as coffee, tea, tobacco, sugar and indigo could be estimated 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 share of output of 10% (again following van der Eng 1993).

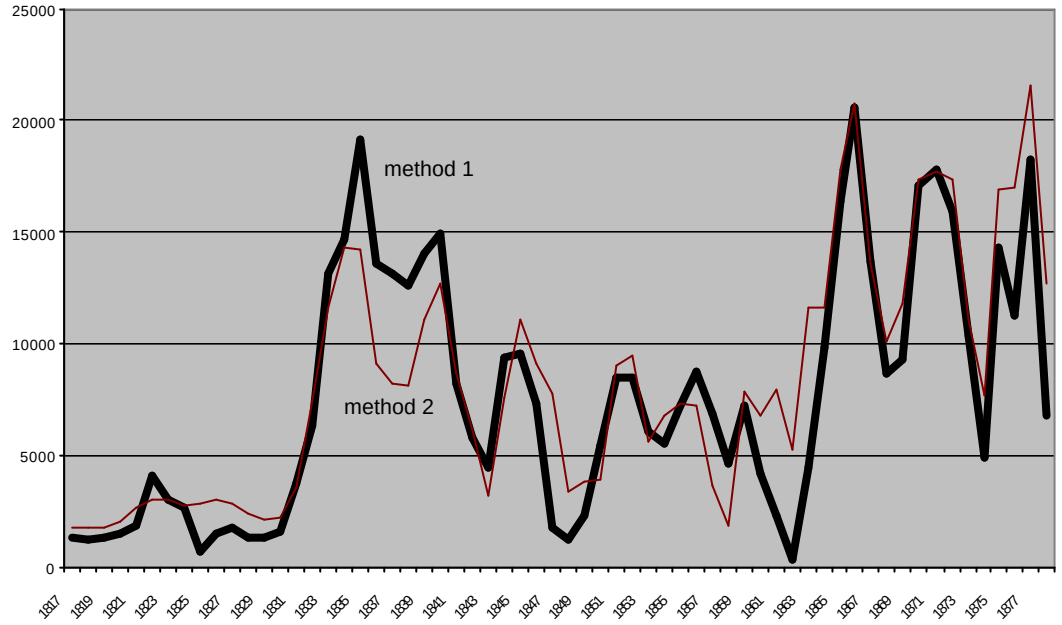
Figure 3 Two set of estimates of food consumption per capita (in kcal per day)



The final part of agricultural output (which is often ignored) consists of the reclamation of new agricultural land. 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 the relevant information for estimating 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 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 dry land (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 investment in reclamations. 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 expenses of the reclamation of one bau of non-irrigated land was 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). On the basis of 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 national accounts 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)



Other primary activities

Salt production: detailed data of the government monopoly were published in the Koloniaal Verslag (KV) (1848-1880) and by De Waal (1864). The production of salt outside the monopoly, which was rather large before the mid 1820s, 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 assuming that about went to 'capital', the other half being the 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.)).

Forestry: Volume 16 of CEI contains a lot of information on the development of forestry. The series of timber production on Java beginning in the 1830s has been used to estimate this part of forestry output; the output of firewood is from the 1913 onwards based on the same source, but before 1913 these figures appear to be (much) too low. Therefore I estimated the annual per capita consumption of firewood. Before 1850 much firewood was still used in Java, both for domestic consumption and for the processing of cane sugar. Average consumption per capita was estimated at 0.1 vadem. After 1850 firewood became more scarce, and in sugar processing was replaced by coal. Firewood consumption between 1850 and 1913 (the level of the official government estimates) has been intrapolated.

Industry: 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' because the literature suggests that during the 19th century output declined because of increased international competition. Cotton textiles were by far the most important part of the industry.

In order to reconstruct the development of cotton 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%) (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 (Van der Kraan 1998). The estimates Boomgaard (1987) published on the production of raw cotton suggest that per capita consumption was 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.[7] 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

[7] This is the case in the 1835 and 1847 (Posthumus 1916: 14, 40; Van der Kraan 1998: 57) and again after 1891, when detailed statistics on the composition of imports become available.

is consistent with these trends (the share of domestic industry in supply was 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 relative to 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 American 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)

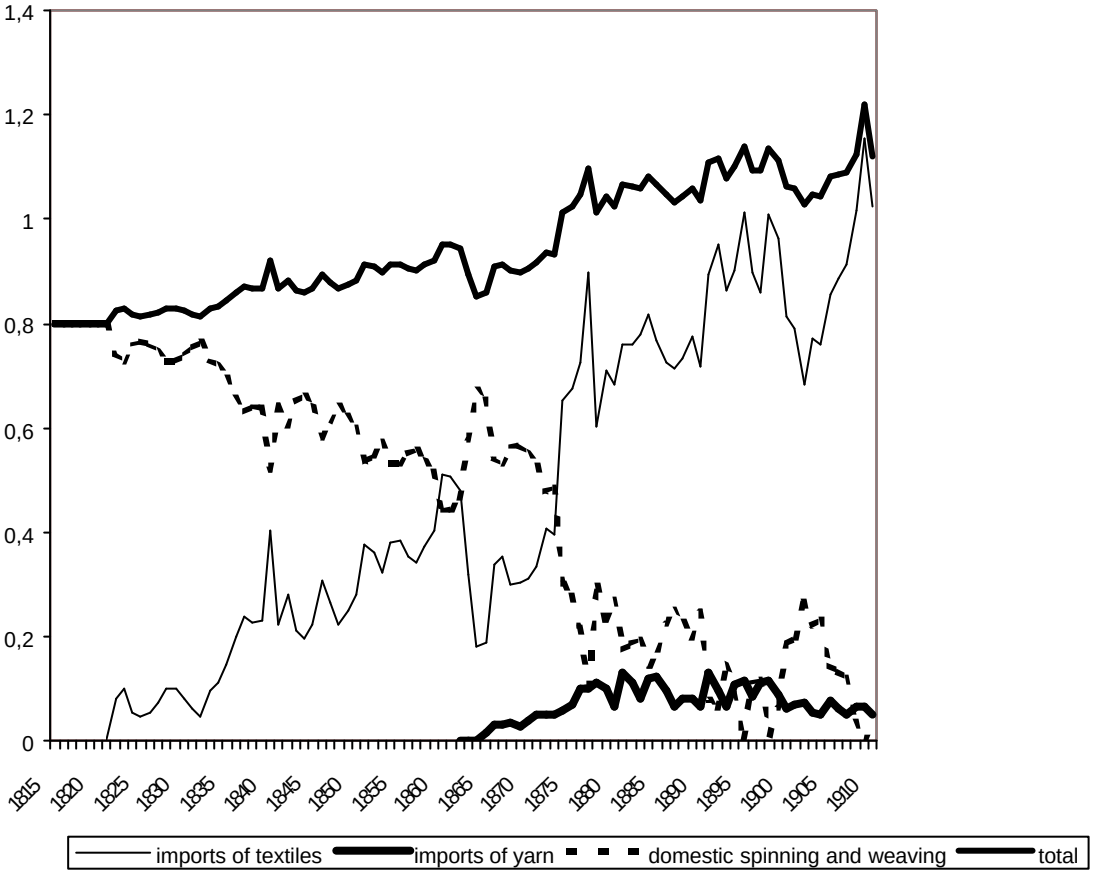
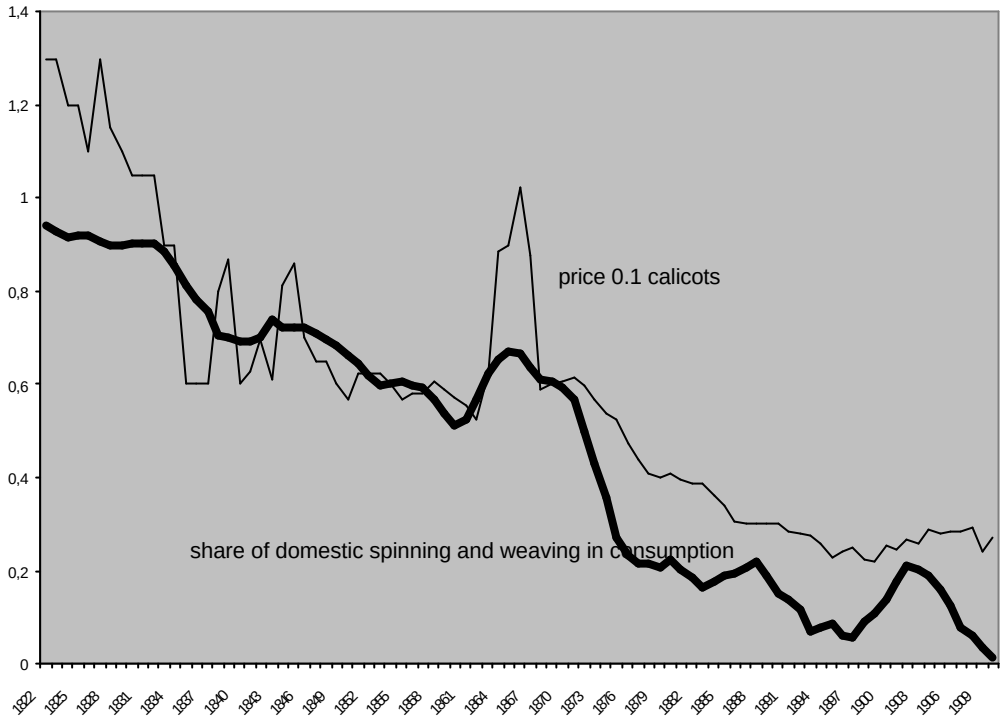


Figure 6 Share of domestic textile production in total consumption (five-years moving average) compared with the price of calicots, 1822-1910



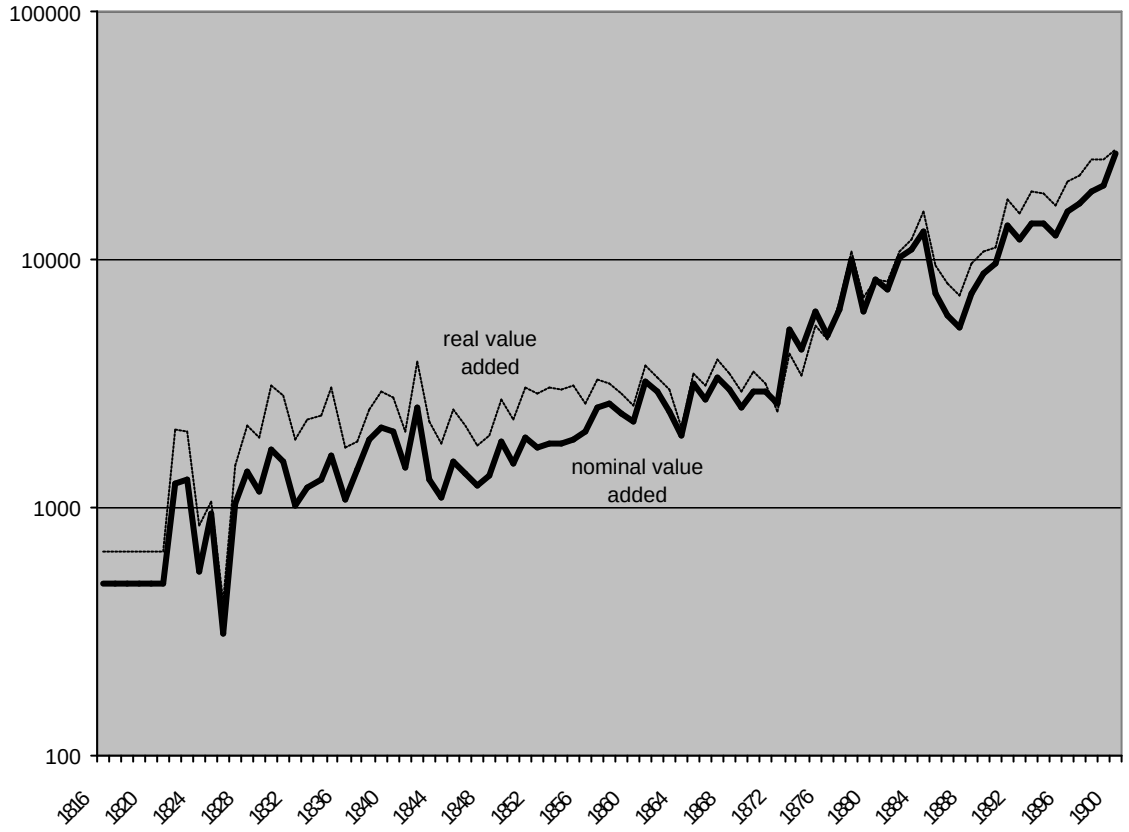
Industry: capital goods

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.[8] 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 (CEI 3: 77). This figure was applied to the 1822-1900 period to get estimates of the value added of this part 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).[9] The figure shows that this sector remained relatively small before 1870, grew very rapidly during the 1870s and early 1880s, collapsed during the sugar crisis after 1882, and recovered strongly afterwards.

[8] There is a small additional problem here, because *Mededeelingen* 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 the post 1874 data – which can be distinguished between imports into Java and Madura and into the rest of the Indies – I prefer the first series.

[9] 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.

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



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 (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 (before 1867 the level of spending on this was very low).

A large part of investment, however – i.e. the construction of road, bridges, waterworks - was based on forced labour (*corvée*) and involved only limited amounts of cash spent by the government. From the mid 1860s onwards, when the colonial government began to regulate the *corvée* 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 *corvée* 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 forced labour in the 1880s). It is furthermore assumed that the introduction of the Cultivation System led to an increase

in *corvée* duties from 4 days per capita to 6 days (the guestimate of 4 is also maintained for the period before 1830). The economic value of one day of *corvee* was about 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.

The remaining category of the production of capital goods was investments in dwellings. It was not possible to quantify this branch independently because there are simply no sources available. It is included in the residual 'other industries' guestimated below. To get overall estimates of investment activity, however, a very tentative set of guestimates of investments in dwellings were made on the basis of data from the census of 1930; these will be explained 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.[10] 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) is about 30 million guilders 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 all Europeans 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 had been made, and after the wages of clerks and other labourers had 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.

Organizing imports and exports were probably the most important business of those merchants, in which the highest incomes were earned; much retail trade was also linked to the import trade. 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

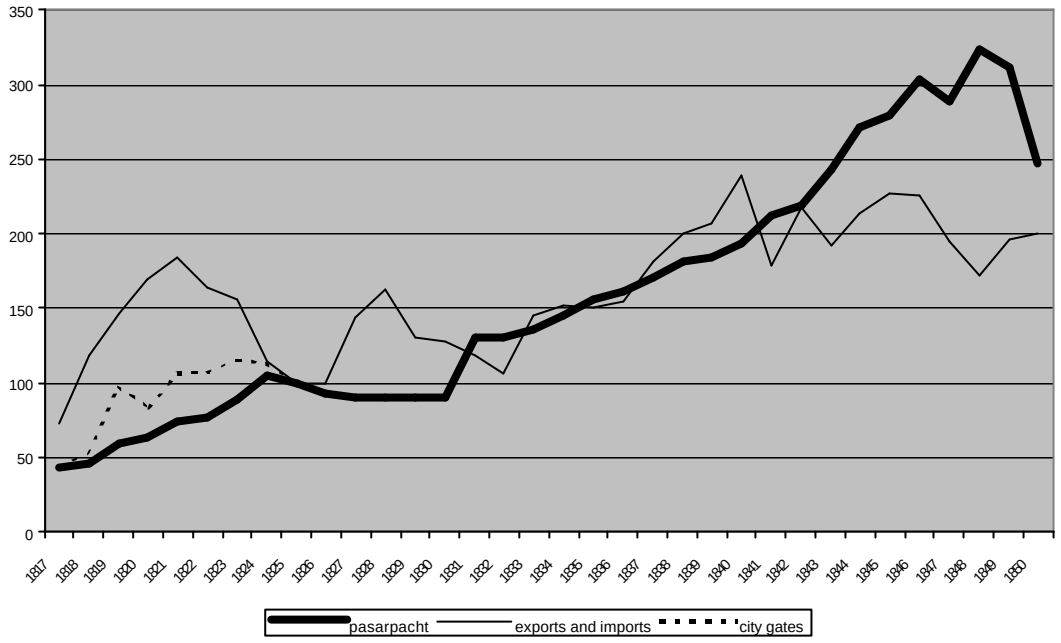
[10] According to the business tax of 1872 the total assessed income outside agriculture and fisheries was almost 44 million guilders, the rest originating from industry (3.9 million), craftsmen (9.4 million), shipping (1.7 million) and others (7.6 million)(source: KV 1873)

consumers. Often more middlemen were involved: Dalenoord (**** 171-2) gives the example of cotton yarns being brokered by five different middlemen before they reached their final customers; in the meantime, the price has gone up by more than 50%. In the Netherlands average trade margins on imports and exports (often on trade with the Indies) were about 15% during the first half of the 19th century; they fell somewhat during the second half of the century, but those margins did not include retail trade (Horlings 1995: 342; Smits 1995). 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'.[11] 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 value added of international 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 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, 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.

[11] When the statistics on exports did not specify these, I re-estimated 'free' exports on the basis of 'free' imports: CEI 12A, table 1 and 2; for the years before 1822 I initially used the yield of the tariffs on imports and exports (see Figure 8).

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 perhaps even underestimated.

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 (the government monopoly on opium 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 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, including the share that went to the state. The details of this reconstruction need not bother us here.[12]

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.

[12] 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 for retail prices.

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). Including Batavia, interest and depreciation and the wages of the sailors who were probably not included in the *bedrijfsbelasting* 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 (CEI 9 tables 2 and 3).[13] It is assumed that the fleet of Java dominated domestic shipping, but had an almost negligible market share in international shipping (see CEI 9). 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 (i.e. the number of port cities at which ships could call also rose). Freight rates were stationary, however, during much of the period,[14] 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[15] gives a net value added of 4.5 million guilders in 1872, consistent with the income estimates based on the *bedrijfsbelasting*.

Railways was still a small branch before 1880. 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

The value added of the public sector is estimated as the total sum of the salaries of government employees on Java.[16] One of the problems is to establish what part of spending was done on Java and Madura 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.

For the rest of industry, i.e. all industrial activities besides textiles and the production of capital goods, and all other services (such as religion, education and other professions) no data are available on their output or value added. But we can get an

[13] 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 there.
[14] See CEI 15: 144, and additional data collected by the author from the *Javasche Courant*.
[15] Horlings 1995 estimated for the much more modern Dutch fleet that inputs were about one-third of gross value added.
[16] Sources: budgets of colonial government from 1817 onwards (available in the ARA, Ministerie van Koloniën) and the analysis offered by De Waal (1882) of the structure of government expenditure at about 1880.

idea of their importance from the census of 1880, which gives an indication of their share in the labour force in 1880, and from and the number of tax payers 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 a comparison with the estimates of value added in industry and services showed that this approach systematically underestimated the values arrived at for the interwar period by Polak (CEI 5). The first modification of the estimates was therefore to raise the level of value added in 'other services' and 'other industry' to the level that was found for 1921 on the basis of the more detailed Polak-figures (see below). This procedure also made me question the assumption that it could be assumed that expenditure on these items remained more or less constant in the long run (the underlying assumption of the first set of estimates). In the final series it was assumed that value added in these branches grew with the degree of specialization in town and countryside. An index of specialization could be derived from research into the monetary history of Java: it was possible to quantify the growth of the currency stock that was used by the Javanese population itself – mostly copper coins and small silver change (Van Zanden 2002a). This index, which shows strong increase during – for example – the first decade of the Cultivation System (a period in which specialization also was on the rise), probably reflects the actual growth of these non-agricultural activities rather well.

Summing up 1815-1880

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

- smallholder 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 (those industries that use modern, imported inputs)
- capital goods: public works
- other industry
- trade (international trade, opium, salt)
- transport (shipping and railways)
- government (including corvee labour)
- other services

All series are valued at market prices.
The price series used are:

- rice (CEI 4)
- export crops (coffee, sugar, indigo, tobacco) (CEI 15)
- forestry: wood prices were derived from CEI 15, table 3F (timber, other kinds) and table 2B (export price of rattan, in 1913 linked to the timber series).

- 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: purchase price and retail price opium (CEI 15, and KV); salt: purchase price and retail price (KV, De Waal 1864)
- transport: freight rates were constant (see CEI 15: 144; and additional data collected from the *Javasche Courant* 1828-1855)
- government and corvee labour: wage index.

The wage index was based on estimates on the level of wages of coolies on (sugar) plantations from 1850 onwards (from De Waal 1864; and CEI 13 tables 3 and 5) and data on wages of coolies working for government in the 1820s from various sources (see Van Zanden 2002b). 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. To get a consistent index, the gap between 1829 and 1850 (when the first wage data from Surabaya are available) was simply intrapolated.[17]

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 were derived from Van der Eng (1993);
- industry: for the period 1880-1921 all estimates were made in the same way as the pre-1880 estimates; they were linked to the series for the interwar period made by Van Oorschot (1956: 92) in 1921.[18] 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 those in international shipping.
- other services: these were again linked to the Polak-estimates (CEI 5 : 57).
- 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.

[17] The method of deflation is explained in the next section.

[18] 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.

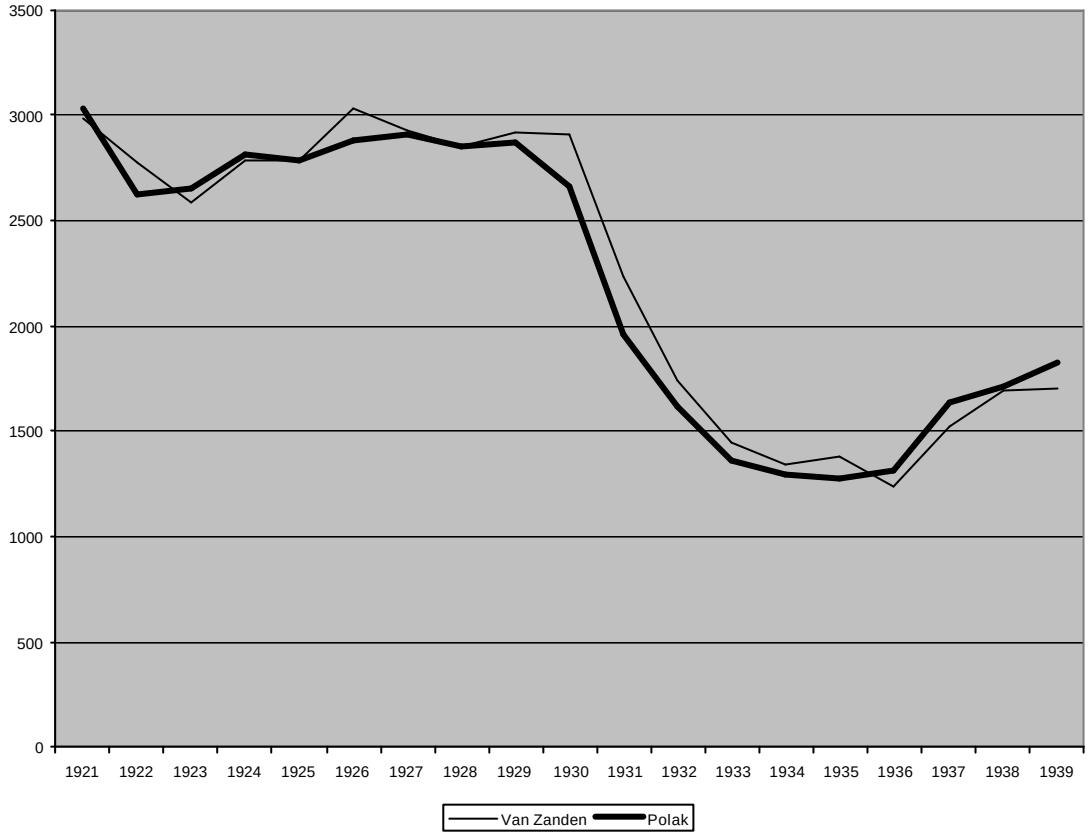
- oil: Java became an oil producer from 1889 onwards; because until 1911 the oil industry was completely dominated by the Dordtsche Petroleum Maatschappij, detailed accounts of prices, yields and costs are available for 1889-1910 from the annual reports of that company; from 1911 onwards we have to rely on the statistics of crude oil production published by the colonial government, and on the prices of kerosene (different qualities) onwards from the official price statistics; it was assumed that inputs as a share of total sales value remained the same between 1911 and 1939.[19]

All other series were estimated in the same way as before 1880. The resulting estimates for the interwar period are broadly in agreement with those of Polak/CEI 5 (Figure 9). The similarities between these two sets of estimates are not that surprising, because I have made use of some of the same basic data and estimates used by Polak, in particular for industry and parts of the services sector. The important difference is that in this experiment I have used the production approach systematically (and I am able to link the 1921-1939 to identical estimates for the 1815-1920 period), whereas Polak used a mixture of income and production approaches which may have created certain biases in his results.

Finally, price indices were calculated for four sub periods: 1815-1830, 1830-1870, 1870-1913, and 1913-1939, using fixed weights for 1826/30, 1865/70, 1908/13 and 1924/29 (the weights were derived from the share of each branch in total value added). These indices were linked to create one deflator with 1913 as a base year. This index were used to deflate the series of GDP in current prices.

[19] Sources: Annual Reports Dordtsche Petroleum Maatschappij available in the Neha-archive Amsterdam; prices from CEI 15, table 3C.

Figure 9 Two sets of estimates of the GDP of Java, 1921-1939 (in million guilders)



The results

It is beyond the scope of this paper to analyse the results of the 'national' accounts of Java between 1815 and 1939 in detail. I will concentrate on a number of interesting outcomes of this experiment:

- the development of the structure of the economy; it is also possible (as a kind of cross check of these results) to make a comparison of the structure of GDP and the structure of the labour force in 1880 and 1930;
- the growth of GDP (per capita) and of the most important branches of the economy
- the share of investment in GDP.

Figure 10 gives an overview of the long run changes in the structure of the economy of Java. It shows that the share of smallholders agriculture tended to decline in the long run, from 50 to 60 percent in 1815-30 to about 30% in the second half of the 1930s. Between 1830 and 1930 the most dynamic sector of the economy – in terms of growing relative size – was export-agriculture: its growing size compensated the relative decline of smallholders agriculture, as a result of which the share of agriculture (in total) remained more or less constant at about 55-60% of GDP until the late 1920s. Other primary activities more or less maintained their relative position, which was mainly due to the rise of the oil industry after 1890 compensating for the relative decline of forestry, salt production and fisheries. During the 19th century textiles was a true declining industry; between 1815 and 1913 its share fell from about 15% to less than 1% of GDP. This fall was hardly compensated by the growth of other industrial activities (from 4 to 10% of GDP in the same period); on balance, the industrial sector saw its share of GDP decrease. Growth in services was more spectacular, in particular in trade and transport, both of which saw their share of GDP increase during the 19th century. The government and 'other services' were more or less stable in the long run.

This pattern of development more or less continued into the 1920s, but changed fundamentally during the 1930s, when export agriculture went into sharp decline, and industrial growth was very rapid. To some extent the 1930s saw a reversal of the structural change set in during the 1830s, when de-industrialization went together with a very rapid expansion of export agriculture.

Figure 10 The structure of the Javanese economy, 1815-1939

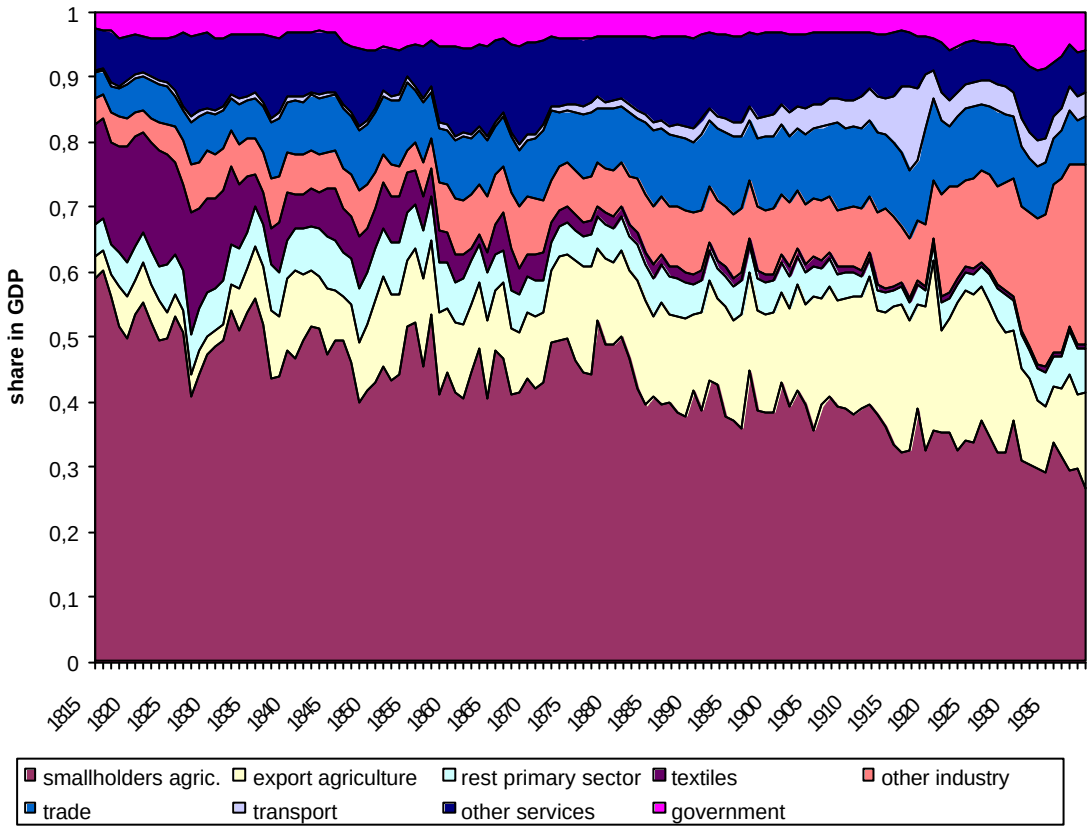


Table 1 shows the confrontation between the structure of GDP in 1880 and the structure of the labour force in that year. Both set of estimates are broadly consistent, but the share of agriculture appears to be rather high. The share of the labour force working in industry may have been underestimated by the 'census' of 1880, which concentrated on the main activities of the heads of households, and therefore ignored the many side-activities of those men, but also the many non-agricultural activities performed by women. The same applies to the low share of (other) services in the labour force; again I think that the GDP-estimates may be closer to the 'truth' than the census-figures. It is, on the other hand, quite normal that productivity (in terms of value added per labourer) is higher outside agriculture (see for example Crafts 1985: 55). Table 2 shows the same information for 1930, and more or less the same patterns are visible, i.e. productivity outside agriculture is higher than within this sector. The limited degree of structural transformation between 1880 and 1930 is also evident from a comparison between the two tables.

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

Sector	Share labour force	Share GDP (1878/80)
Agriculture	75	62**
Fisheries	2	2
Industry	3	9
Trade	9	9
Transport (shipping & railways)	1	2
Government	2	4
Other services	2	10
Labourers and other industries*	6	2
*many of these labourers worked in agriculture; the other industries are forestry and salt production ** of which 13% from export agriculture and 49% from foodcrops	100	100

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 1929/30 (in %)

Sector	Share labour force	Share GDP (1925/29)
Agriculture	63	51**
Fisheries	1	1
Industry	12	18
Trade	7	10
Transport (shipping & railways)	2	4
Government	3	5
Other services	2	6
Labourers* and others activities (including oil)	10	5
*many of these labourers worked in agriculture; the other activities are forestry and salt production ** of which 16% from export agriculture and 35% from foodcrops	100	100

Sources: 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	2.5	2.3	.2	-.8
1830-40	2.1	1.3	.7	1.3
1840-60	.9	1.3	-.4	.4
1860-80	1.8	1.6	.2	.8
1880-1900	2.3	1.3	1.0	-2.3
1900-13	3.7	1.1	2.5	1.0
1913-21	.8	.8	0.0	8.1
1921-29	3.3	1.0	2.3	-3.8
1929-39	.9	1.2	-.3	-5.3

Figure 11 Estimates of the development of GDP per capita in Java (1815-1939) and Indonesia (Van der Eng; 1880-1939) (indices 1913=100)

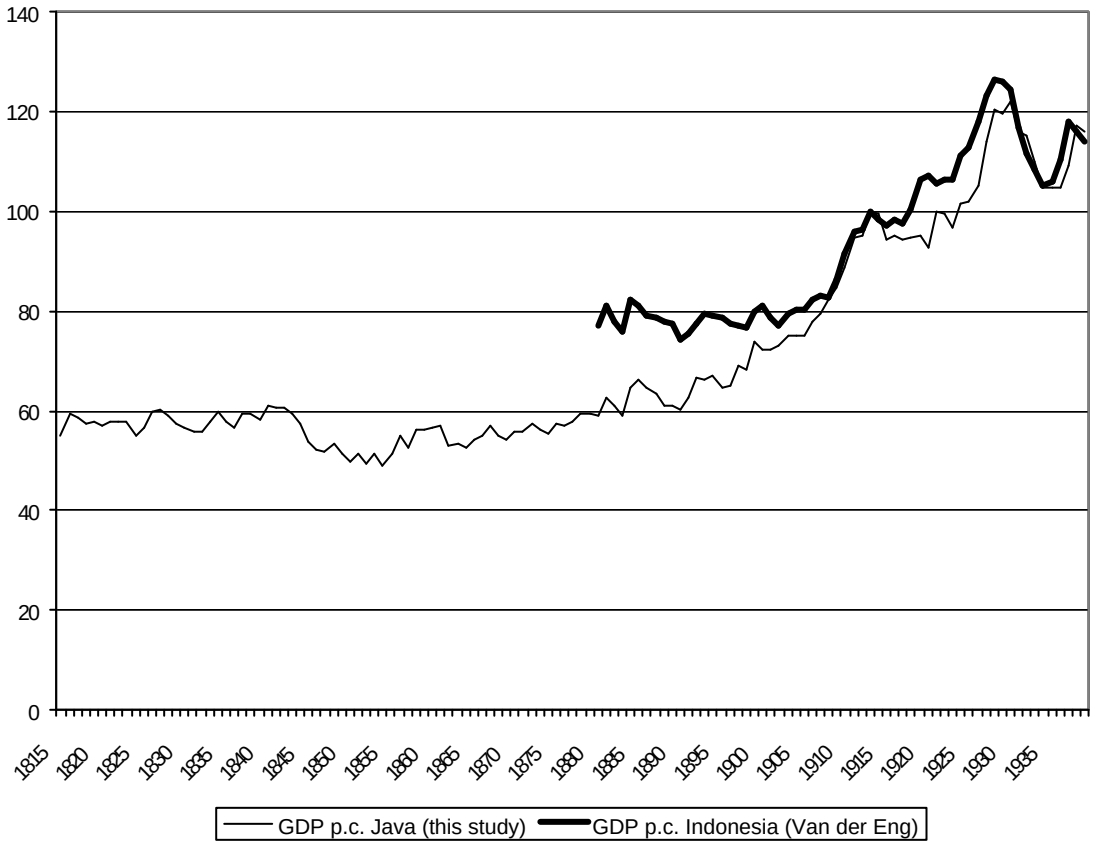


Table 3 and Figure 10 present the estimated growth of GDP per capita. During the first half of the 19th century GDP growth is almost the same as population growth, and GDP per capita was more or less constant (given the large margins of error of these estimates, not much conclusions can be derived from the annual fluctuations). Sustained growth of GDP per capita began in the final decades of the 19th century; after about 1900 growth clearly accelerated. The growth spurt in the 15 years before the First World War may be overestimated somewhat, however.. The GDP estimates for Indonesia as a whole published by Van der Eng (1992), also shown in figure 10, indicate that there was per capita growth between 1896 and 1913, but less than my series suggest. During the period 1913-1939 both set of estimates show a great deal of similarity.[20]

On balance GDP per capita doubled between 1815 and 1929, which is more than was expected on the basis of the available literature. It increased by about two-third during the 1815-1913 period (and in particular between 1890 and 1913), and again showed strong growth during the 1920s, but also a very sharp decline during the next decade.

Table 4 The estimated growth rates of real value added in the most important sectors of the economy, 1816-1938 (average annual growth rates)

Period	Smallholders' Agriculture	Export Agriculture	Rest primary sector*	Textiles	Rest Industry	Trade	Transport	Rest Services	Governm
1816-30	.7	-.4	3.6	2.3	6.3	7.0	2.8	5.2	3.6
1830-40	1.0	18.6	.6	-1.2	.0	5.7	3.7	.0	-.3
1840-60	.5	1.0	.4	.7	1.5	3.0	2.2	.9	2.1
1860-80	2.2	2.7	-.3	.0	1.2	3.3	5.3	.7	.3
1880-1900	1.0	4.1	.5	.8	3.0	2.9	11.6	2.7	.6
1900-1913	1.8	4.7	2.0	.2	5.2	4.5	7.0	2.2	4.4
1913-21	.3	1.0	.6	-2.0	4.3	-2.0	-.7	-1.4	8.5
1921-29	1.4	6.6	7.2	.8	4.2	4.6	2.6	-.1	.8
1929-38	2.0	-3.5	2.4	2.8	5.4	-3.4	-5.6	1.2	2.2

* salt, forestry, fisheries and oil

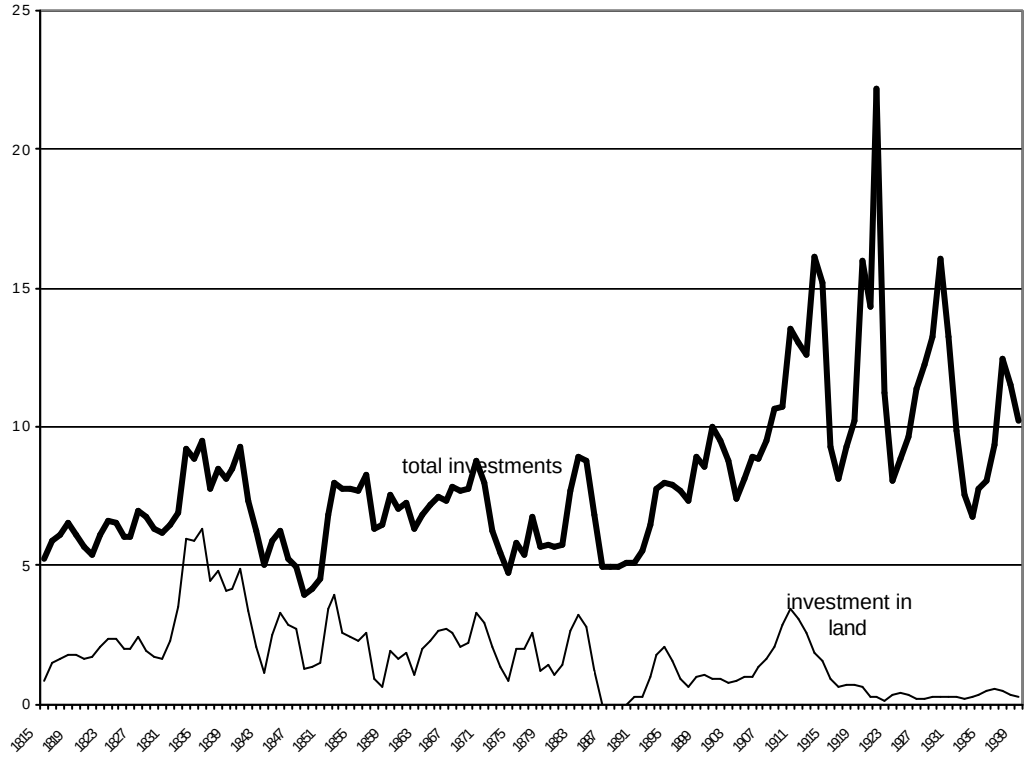
NB: 1816 is average of 1815/17, 1830=1829/31 etc.

Table 4 presents the estimates of the growth of real value added on the branch level. It should be stressed that these estimates, in particular for the period before 1880, are highly tentative (but the best summaries of our state of knowledge). But they do highlight the different patterns of economic development in the various periods

[20] In the series presented here, 1913 is a bit of an outlier, and therefore perhaps not the best point of comparison with the Van der Eng series.

concerned. It appears, for example, that growth before 1830 was based on a gradual development of all sectors of the economy, with the surprising exception of export agriculture, which stagnated in real terms (see also Boomgaard 1989 for the relative stagnation of export production after the boom between 1795-1810). The export boom during the first decade of the Cultivation System is of course well known, but my estimates suggest that it coincided with a sharp decline of textile production, and that government services and 'other industry' also did not contribute to the expansion of the economy. The decades between 1840 and 1860 were a period of stagnation in almost all branches of the economy. From the 1860s onwards export agriculture, trade and transport became the engines of the growth process that continued until the 1920s. After 1900 the expansion of the government sector in the wake of the 'ethical policy' also contributed to economic growth. The effects of World War I are rather mixed, but after 1921 expansion of the export-agriculture cum international trade complex resumes again, this time also supported by the strong performance of the oil industry (included in other primary activities). The 1930s were a very difficult period for Java, with a collapse of the 'export-agriculture-complex' which was not compensated for by the expansion of industrial activities geared to the domestic market (the literature stresses very much the rapid growth of textiles in the 1930s, which is not corroborated by my findings).

Figure 12 Total investments and investments in land as a percentage of GDP, 1815-1939



Finally, figure 12 presents the evidence about the share of investment in GDP. This consists of four different kinds of capital formation: land clearance (including new

investments in crops etc.), investments based on imported inputs (new machinery, railways, steamships), investment in infrastructure by the government (using coerced labour) and investment in new dwellings, which was linked to the growth of population.[21] These estimates indicate, however, that the investment ratio was already relatively high, and fluctuated sharply, during the 19th century; in particular during the 1830s investments peaked at almost 9 percent of GDP, and after the 1830s they remained on average higher than 6%. Until about 1890 investment was dominated by the increase in the cultivated area and related investments in (perennial) crops. Modern forms of investment took over after 1890, such as 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.

Conclusion

It is not the purpose of this paper to draw detailed conclusions from the results presented here. Yet a few concluding remarks can be made. It appears that during a large part of the 19th century GDP per capita was stagnant, in spite of the rapid growth of export agriculture and related services after 1830. But from the 1860s onwards a process of growth begins, slowly at first, but accelerating in the final decades before the First World War. In sum, GDP per capita increased by about two-third between 1815 and 1913. During the 1920s growth was quite rapid again; in 1929 GDP per capita was probably about double the 1815 level. 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 estimated 'national' accounts for Java give a too optimistic picture of the performance of its economy. But it may well be the case that these two stories, of slowly accelerating growth of GDP per capita and stagnating standards of living, tell us a lot about what happened in Java between 1815 and 1939.

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[21] The first three parts of capital formation are explained in the paper; the series for investment in dwellings is constructed in the following way: I estimated the share of the labour force in the construction of dwellings on the basis of the census of 1930 at 1.5% and assumed that labour productivity in this branch was the same as in the rest of the economy (i.e.: its share in GDP was also 1.5% in 1930); next it is assumed that this share was related to the rate of growth of the population: when population growth was relatively high – during the first half of the 19th century – investment in dwellings was comparably high (up to as much as 3% of GDP). It is obvious that these estimates are very experimental, and can only be used to get a very rough impression of the level of investment.

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