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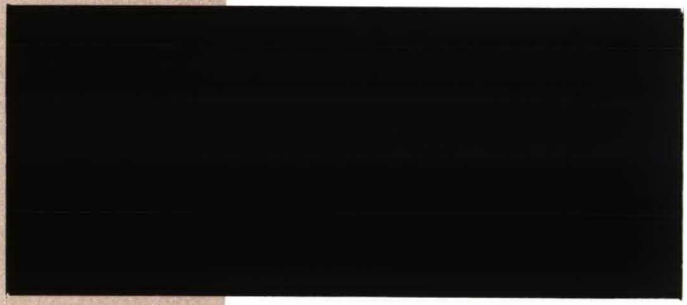

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HOW GOVERNMENT POLICY AFFECTS THE CONSUMPTION OF HARD DRUGS: THE CASE OF OPIUM IN JAVA, 1873-1907

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1 Introduction

The use of drugs is a major problem in modern society. There is drug related criminal activity of both suppliers and consumers. There are health risks involved in the consumption of drugs. In most countries leading politicians on the national level advocate prohibition of the consumption of drugs. Yet, drug prohibition policy is difficult to enforce. Despite major efforts like the "war on drugs" in the United States, drug business is flourishing. Although there is a market for drugs where supply and demand determine the price, not many economists are involved in drug research. A rare example is Chaloupka and Saffer (1995) who find for the annual prevalence of heroin a price elasticity of -0.90 and for the annual prevalence of cocaine a price elasticity of -0.55. Grossman, Chaloupka and Brown (1996) find that the frequency of use of cocaine by American youth is also price sensitive. Economists who are involved in drug research seem to be in favor of a more liberal policy towards drug use. Miron and Zwiebel (1995) advocate that prohibition of drugs may not be the right answer to the problem. Becker is also an advocate of drug legalization: "Legalizing drugs will not solve every problem. But it is the best feasible solution" (Becker and Becker (1997)).[1]

The main problem with an economic analysis of drug markets is that drugs are currently illegal. Therefore, it is difficult to get good data as a basis for analysis. Yet, economic parameters are very important. In the discussion about the pros and cons of the legalization of drugs, information about the size of the price elasticity of drugs can be useful. Legalization will probably lead to substantially lower prices. A combination of high price elasticities and low prices will expand drug use substantially. However, legalization of the drug market may also have an autonomous negative effect on drug use. It could be that if drugs are cheaper and more easy to get than they are today, drug addicts have no incentive to sell drugs themselves and push other people to start consuming drugs.

This paper uses data from about a century ago, when the use of opium, a hard drug, was not prohibited. We analyze historical data from Java, the main island of the Dutch East Indies (present day Indonesia). We consider the period 1873-1907, during which there was a transition from one policy regime to the other. Private opium monopolies established by the government were gradually replaced by a monopoly from the government itself, known as the *opium regie*. We use historical information to shed light on current drug issues. We present estimates of the price elasticity of opium and we analyze the size of the incentive

[1] Other examples of a discussion on alternative drug policies are Clague (1973), Moore (1973), White and Luksetich (1983).

effect which was caused by the change in opium policy.

Dutch influence in the Indian archipelago started in the early seventeenth century with limited control over the area. In the early nineteenth century, they were in full control of Java whereas on the other islands they only had strongholds. By the end of the nineteenth century the Dutch became interested in controlling all islands of the archipelago. However, it took them until the early twentieth century before they managed to do so.

Opium has been a money making business in the Dutch East Indies from the seventeenth up to the twentieth century.[2] Dutch involvement in the opium trade started soon after the founding of the Dutch East Indies Company, the *VOC* (*Verenigde Oost-Indische Compagnie*), in 1602. Initially this company bought raw opium in India, paid with silver, and bartered it against spices in the East-Indian archipelago. When in the early 17th century the Dutch took over Malacca from the Portuguese they started to trade in opium on a regular basis. For a hundred years they auctioned opium in Batavia (present-day Jakarta). After that, there have been several ways in which the Dutch government directly or indirectly controlled the opium market in the Dutch East Indies. In the second half of the eighteenth century a private opium corporation which had bought from the *VOC* the right to auction opium controlled the opium supply. In the nineteenth century there were opium tax farms. Lacking sufficient administrative capacity for collecting taxes the Dutch government auctioned district monopoly concessions for selling opium, the so called opium tax farms. Opium was used by regular consumers as well as by consumers who restricted their use to special occasions. For many people using opium was very costly. Yet, it was preferred to alcohol by many, because opium did not affect outward behavior that much. Therefore opium users could maintain decorum. Because opium was quite expensive the majority of opium users consumed small quantities, thereby escaping severe addiction. As Rush (1990) puts it "the characteristic form of opium consumption in nineteenth-century Java was the regular or intermittent smoking of very small amounts of morphine-weak opium preparations by large numbers of Javanese people".

Associated with opium farms were abuses like the smuggling of illegal opium. Under the system of private monopolies tax farmers had a big incentive to stimulate consumption of opium in order to increase their profits. Furthermore, the wealth of tax farmers was believed to induce corruption of government officials.

[2]Colonial opium revenues were important in other Southeast Asian colonies as well, for example in Hongkong, the Federated Malay States, the Straits settlement, French Indo-China, Formosa, Siam and The Philippines.

By the end of the nineteenth century a new scheme was gradually introduced. Under this scheme, the *opium regie*, import, refinement and retailing were fully under control of the government. The basic idea was to control excessive opium consumption by keeping prices high. By having salaried employees do the retailing there was no direct incentive for retailers to stimulate opium consumption. The *opium regie* lasted until the Japanese invasion of 1942.

Previous work on opium consumption in the Dutch East Indies gives some indications about the nature of this type of consumption. In Van Ours (1995) information gathered during the 1923-1938 period of the *opium regie* is used to estimate income and price elasticities of the demand for opium for two different groups of consumers: Chinese and Indigenous. The estimated short term income elasticities of opium are about 0.8, the long term are about 1.3. The estimated short-term price elasticities are about -0.7, long-term price elasticities are about -1.0. Van Ours concludes from this that opium was not very addictive. This conclusion is in line with the opinion of most contemporary colonial researchers (Van Luijk (1992)) and with the observation by Rush (1990) that Javanese experienced many income and price fluctuations over time so that opium consumers were accustomed to externally imposed variation in their consumption[3].

In Van Luijk and Van Ours (1998) regional differences in opium consumption are studied for the year 1930. It appears that in districts with strict opium regimes smoking was less widespread[4]. Furthermore, differences between the districts were mainly due to differences in the numbers of light smokers. Finally, it is found that in districts with high opium price opium use was less widespread.

The current paper is about opium consumption in the last years of tax farming and the first years of the *regie*, covering a total period of about 35 years. From this period, annual opium data are available for 15 Javanese districts. We analyze this period because we are interested in the determinants of opium consumption and we want to investigate whether or not the change in opium policy from tax farm to government monopoly reduced opium consumption. If there was such an effect then this must have been due to the disappearance of the profit-led incentive to stimulate opium consumption. From the existence of such an effect we can draw inferences about what might happen if the present drug prohibition is changed into some sort of government controlled legalization of drug use. This too could reduce drug consumption because the incentive to push drug use vanishes.

[3]In the yearly accounts of the *opium regie* changes in regional consumption were mostly explained by economic factors. See also Lubbers (1935).

[4]There were so-called closed districts in which opium use was prohibited except for the cities within this region where consumption was regulated.

This paper is organized as follows. Section 2 presents a short history of the opium business in the Dutch East Indies, distinguishing several periods with different types of government intervention. Section 3 discusses the final years of the opium tax farm and the first years of government monopoly more thoroughly. In this section we also present our data. Section 4 gives the results of the empirical analysis. Section 5 presents conclusions.

2 A short history of opium in Java

2.1 The early history

In the early seventeenth century the *VOC* started its activities in the Indian archipelago[5]. These activities were more of the war type than commercial, until in 1640 the *VOC* took over Malacca from the Portuguese. Now Dutch ships had a free passage through the Strait of Malacca, and the *VOC* could expand its trade between opium producing India and Batavia. Initially the *VOC* bought raw opium in Saratte at the West Coast of India. In 1659 the *VOC* started to import directly form Bengal, which was the most important opium producing region of India. Two years later this 'Bengal connection' was firmly assured by a treaty between the *VOC* and the Great Mogul of Bengal. Opium business flourished and proved to be very profitable, but it still was a commodity of minor importance. The *VOC* could not draw full benefit from the Javanese opium market for two reasons. First, it had to deal with fierce competition from other seafaring European nations and Asians. Second, it had no access to the interior market of Java. This situation changed dramatically when in 1677 the king of Mataram (Central Java) granted the monopoly right on the importation of opium in his territory to the *VOC* in exchange of assistance in case of war. The following year opium import in Batavia almost sevenfolded.

In Batavia opium was sold in large quantities to the highest bidder who got a permit to bring the opium to one of the other Javanese harbors or one of the other islands. In doing so toll taxes and export duties had to be paid. Transportation into the inland of Java was also subject to these taxes.

The opium business was a source of income for all parties involved. The *VOC* got the difference between the price they paid in Bengal and the auction price in Batavia. The opium wholesalers got the difference between the auction price in Batavia and the price they received in the sea-harbors. Finally, the indigenous

[5]Baud (1853) tells an excellent story about the early history of opium use. Ricklefs (1993) gives a detailed description of the history of Indonesia.

rulers had benefits from the tax on import in harbors and transport over land. Still, for smugglers it was beneficial to avoid the intermediary of the *VOC*. Many high *VOC*-officials were involved in smuggling opium.

In an attempt to reduce opium smuggling the Opium Corporation (*Amphioen sociëteit*) was established. The *VOC* was forced to sell the right of the opium trade within the Dutch East Indies to the Opium Corporation, which in exchange took the obligation to buy an annual fixed amount of opium at a fixed (high) price. The difference between this fixed price and the price of opium sold by the corporation was intended as a profit for the shareholders who thus had an incentive to sell at least the fixed amount of opium. The shareholders of the corporation also had an incentive to combat smuggling, because this lowered the opium market price. However, the system failed in reducing the smuggling of opium. The non-shareholders did not have a disincentive for their smuggling activities. Furthermore, as time went by, more and more shareholders on the spot returned to the Netherlands. So, there was a decreasing number of shareholders which could participate in anti-smuggling activities. In 1795 a war broke out between the Netherlands and England and the Dutch were cut off from opium supply. In 1798 the *VOC* went bankrupt.

2.2 The opium tax farm

In 1806 a new system of control of the opium business was introduced in Java: the opium tax farm (Diehl (1983), Rush (1990))[6]. The opium tax farm was used by the government as a way to collect taxes without having to set up a sophisticated financial administration. The right to collect taxes in a specific region on behalf of the Dutch government was publicly auctioned. The highest bidder gained the monopoly right to farm taxes in the region involved. The opium tax farm was one of many tax farms that were introduced in the Dutch East Indies. Other examples are the bazaar lease (the right to tax goods offered for sale in markets), the slaughtering of cattle and pigs, fishing and the supply of fishing nets, the sale of arrack and other strong liquors, the practice of certain occupations, the poll-tax on Chinese, the import and cultivation of tobacco, toll bridges, river crossings and sluices, the harvesting of birds' nests, timber from forest, products from the Seribu Islands near Batavia, wayang performances, pawn-shop and gambling-houses (The Siauw Giap (1989)). But, compared to the revenue of the opium tax

[6]From 1811-1816 the British occupied Java. The British governor Raffles tried to abolish or at least reduce the opium consumption but did not succeed. When the Dutch took over in 1816 they again introduced the tax farm system as a source of government revenue.

farm these other farms were peanuts.

The system of opium farms in the Dutch East Indies was not unique. In other areas in colonial Southeast Asia similar systems existed (see for example Trocki (1987, 1990) and Butcher (1983)). Raw opium was imported from British India (Bengal opium) and the Middle East (Levant opium). The government of the Dutch East Indies sold it to the tax farmers, who refined it into the smokeable variety *Candu* and distributed it to local opium retailers. The colonial governments benefited substantially from the opium business. Over the period 1816-1915 the cumulated colonial surplus from the Dutch East Indies was 480 million Dutch guilders, while there were 1080 million guilders of opium revenues. If it had not been for opium, there would have been a colonial deficit of 600 million Dutch guilders (Diehl (1983)).

The idea of farming out opium taxes is basically very simple. One just has to have an auction selling the tax farming right to the highest bidder. Yet, in the early period of the opium tax farm, the institutional structure was changed many times. The main reason for this was that the Dutch government did not have one optimizing criterium but two. First, it wanted to restrict consumption of opium. Second, it wanted to have a lot of revenues from the tax farm, maybe even maximum revenue. A complicating factor was the smuggling of opium. A high opium consumer price would reduce consumption, increase profit per amount sold but decrease the amount sold because high prices would make smuggling very attractive.

In the early years of the tax farm system the import of opium was free. During these years American and British traders introduced opium from the Middle East in the Javanese market (Baud (1853)). In 1824 the system was changed by extending the farm districts and the license period to three years. In 1827 the exclusive right to import opium into Java was given to the Dutch Trading Company (*NHM*) which also got the license to sell opium. The *NHM* did not engage in retail sales but at first let out this right to Chinese subcontractors and later auctioned sub-licenses.

From 1833 onwards the monopoly concession for refining and selling of opium in a specific region was auctioned. Over the period of the tax farm the the rules of the auction were changed several times. In 1873 the tax farming system worked under the rules as described in the next section.

In the second half of the nineteenth century opium consumption increased considerably. The Dutch colonial authorities were content with the increasing opium revenues, but in the Netherlands there was rising discomfort with the latter development. Like in England and the U.S., anti-opium sentiments were partly

stirred by missionaries (Lodwick (1996)). Also important was an open letter to the Dutch king of *Be Ik Sam*, a former tax farmer. In his letter he described the shortcomings of the tax farm system and made suggestions for its improvement. His suggestions however were considered to be too far-going.. Around 1890 the political opium debate in The Netherlands was at its peak. Anti-opium forces organized themselves in an anti-opium association. Among them were at least ten members of Dutch parliament. Many critics were in favor of total prohibition of opium. However, large scale opium consumption had been a reality for many decades. Total prohibition would induce smuggling, which was difficult to control due to the enormous coastlines of the Indian archipelago. "Prohibition means surrounding the East Indies by a cordon", said former director of colonial finance and expert on opium affairs Wiselius (1886), who was known to be a prohibitionist by heart. In stead, a new and more pragmatic system was introduced which gradually replaced the opium tax farm.

2.3 Government monopoly

The new system of opium control introduced in the late nineteenth century was the *opium regie*, a government monopoly on the importation, preparation and distribution of opium. It was supposed to achieve three policy goals: First, reduction of criminality by crushing the power of the mighty opium dealers, ending the corruption and violence caused by opium transactions and reducing illegal opium sale in the regions as well as international smuggling. Second, reducing health risks by guaranteeing a product of constant quality and pureness. Third, reducing opium use.

It were the French who first implemented an *opium regie* in Southeast Asia. They started this regie in Indo-China in 1881[7]. The Dutch studied the weaknesses of the French regie system thoroughly before they introduced a similar system in their own realm. In the French system the colonial government manufactured and distributed opium to wholesale outlets and then licensed local agents to service the retail trade. The Dutch, wanting to eliminate the Chinese from opium trade, also controlled retail opium trade, which they put into the hands of salaried state employees. The *opium regie* intended to eliminate abuses associated with opium farms. Opium tax farmers encouraged opium use by employing hawkers to peddle opium in the villages. Furthermore, opium farm employees received a portion of their wages in opium, so they could increase their income by peddling.

[7]The Japanese had a similar system of government monopoly in Taiwan (Liu, Liu and Chow (1996)).

Opium tax farmers could increase their profits even more by importing illegal opium. The idea of the *regie* was that supply of opium should be unlimited, but to limit consumption the state should sell opium at high fixed prices. Therefore, a strong land- and sea-based opium police was needed to prevent illegal opium from flowing into Java.

In 1893 the law on the *opium regie* was accepted in the Dutch parliament. The *opium regie* was controlled by a government bureau within the Finance Department. The *regie*'s first opium factory started in 1894. In stead of each farmer separately refining his opium there was now a central factory close to the capital Batavia. Now, the quality of opium was uniform throughout Java. The opium factory expanded rapidly. In 1905 it had 630 employees, a number which increased to more than 1000 in 1913. The *opium regie* started as an experiment on the island of Madura near the Javanese coast on September 1, 1894. The experiment proved to be a success, and in 1898 the Dutch government decided to implement the *opium regie* district by district all over Java. Implementation in Java was completed during 1903. It took until 1914 before the *opium regie* was introduced in all parts of the Dutch East Indies.

In the early years of the *opium regie* for opium consumers there was not much difference from the tax farming system. Later on, in the 1910s consumers were registered and starting in 1923 consumers had to obtain a license before they were allowed to buy opium in the government shops.

The *opium regie* operated on the principle of regional differentiation. The main reason for differentiating policy measures along regional lines was that the opium smoking habit did not occur everywhere at the same level. In some regions, like the Islamic regions of West Java, opium smoking was not widespread. If opium smoking was almost absent, the sale of legal opium - if there was any - was stopped, and the use of opium was actually forbidden. In other regions opium smoking was almost as common as nowadays alcohol drinking in Western countries. This was especially the case in regions with substantial Chinese communities, or regions with large estates like the East Coast of Sumatra. The labor force on these agricultural, export-producing estates was to a large degree recruited from other parts of East Asia, and many of these displaced temporary contract workers already were opium smokers on arrival, or else soon afterwards. By and large the Chinese population and contract workers (often overlapping categories) were subject to less strict opium rules than the Indigenous and European parts of the population.[8] The use of opium was widespread among Chinese,

[8]The society in the Dutch East Indies was highly segregated (Fasseur (1992)). In terms of the colonial law one was either European, Native or Chinese. The racial status determined

and the average quantity of opium consumed by Chinese was much higher than the consumption by Indigenous. In 1930 there were about 41 million Indigenous and 600,000 Chinese on Java. There were 77,000 Indigenous opium consumers and 18,000 Chinese opium consumers. Yet, the total annual consumption of Indigenous and Chinese was about the same, both approximately 10,000 kilograms (Van Luijk and Van Ours (1998))

3 From tax farm to government monopoly

3.1 The transition period

The last period of tax farming starts in 1873 when new and simple rules were introduced.[9] Under the system the tax farmer paid a fixed amount for the district-based monopoly rights and had to buy all his raw opium from the Dutch government at a fixed price of approximately 50 guilders per kilogram. The monopoly right was auctioned in every district separately. Usually a Chinese firm ('kongsi') was the highest bidder.[10] A typical contract specified the exclusive right to refine and retail opium in a clearly defined territory, the duration of the contract (from one to three years), the farm fee and the cost of purchasing the opium from the government. Also, the contract specified the maximum amounts of Levant and Bengal opium the farmer would receive as well as a list of all the legal opium stores in the district.[11] The tax farmer was free to set his own price and was allowed to sell opium to any consumer within his district although there was a maximum daily amount for individual consumers. Part of the wage of the farm employees was paid in opium. These employees supplemented their incomes by peddling. To protect his monopoly the farmer hired so called "*mata-mata*", policemen and detectives who routinely paid visits to farm customers who were suspected of buying on the black market. Still, there was a lot of smuggling. According to

where one could live, what taxes one paid, to which laws and courts one was subject and, if found guilty of a crime, how (and with what degree of harshness) one was punished. (Rush (1990)). It was even determined that one should dress according to his own racial group.

[9]Rush (1990) gives an excellent description of the tax farming system and the transition to government monopoly.

[10]Sometimes it was not the highest bidder that got the monopoly right if the Dutch doubted whether the highest bidder was strong enough to meet the term of the contract. If the results of an auction were unsatisfactory and the Dutch sensed a conspiracy between candidate farmers a second public auction was held or confidential bids were accepted.

[11]There were also many illegal opium stores and dens in every district. In 1890 there was an estimated number of 13,000 of these illegal stores and dens on Java. The number of official opium dens was about 1,000.

Rush (1990) at least half of the opium consumed in Java was officially illegal. Smuggling was a major operation which required the participation and cooperation of several individuals and groups: the purchaser himself and his personal clients; trading firms that extended credit, and banks that provided facilities for the secret exchange of money; agents and middlemen who specialized in executing the transfer of opium from wholesaler to purchaser; boatmen and their crews who shipped the opium to its Javanese destinations; and finally the teams of men who brought it ashore and delivered it to its purchaser. Sometimes opium farmers themselves were engaged in smuggling as a way to get cheaper opium, lower their average price and compete with the black market. According to Rush (1990) " The key was controlling both legal and illegal opium. Farmers therefore, while sometimes smuggling themselves, did their utmost to inhibit and undermine smuggling by others. Farmers along the north coast, for instance, employed parapolice personnel at farm expense to patrol the coast and intercept unfriendly clandestine imports, and all farmers employed extensive networks of *mata-mata* to ferret out local black marketeers and ensure that the farm dominated the local market".

In the last decades of the nineteenth century the Javanese economy experienced large economic fluctuations. The early 1880s were prosperous years because of the expansion of commercial agriculture, in particular sugar and coffee. In the second half of the 1880s the economic tide turned, because of bad harvests due to diseases in crops and declining world prices of sugar. The year 1887 was a disastrous year for opium tax farming since 15 of the 19 Javanese farms collected insufficient revenues to pay their monthly farm fee. Despite of the lenient policy by the Dutch government, several opium tax farms went bankrupt in the course of the following years.

3.2 Opium data

As indicated in the previous section, in the course of the year 1894 the *opium regie* was introduced in Madura, an island close to Java. After that in subsequent years in more districts of Java the *opium regie* was introduced (see Appendix 1 for details).

We have gathered our opium data from administrative files. From the tax farming period we have information on the amounts of raw opium delivered by the government to the tax farmer. In the process of refining raw opium some of the opium got lost, so these amounts are not necessarily equal to the amounts consumed. There is also information about the opium sales of the tax farmer to

the opium consumers. However, the latter figure does not seem to be very reliable. In various reports on the matter the Dutch government doubts the revenue figures reported by the tax farmer. For the tax farming period we use the gross amounts of opium. Basically we assume that the opium loss in the refining process is balanced by the tax farmers through adding of dilutions. Since in the refining process no morphine is lost the morphine contents of the raw and the refined opium are about the same (Addens (1938)). In our analysis we assume that the morphine content is determining the narcotic effect of opium and therefore of great influence on the amounts of opium consumed.

For the *opium regie* period we use direct information about opium amounts sold to the consumer (see Appendix 1 for details). We present total opium consumption in Java over the period 1873-1907 in Figure 1. This figure shows that in the years 1874 and 1875 there is a strong increase in total opium consumption on Java from about 70,000 to almost 100,000 kilograms. In the early 1880s there is a sharp decline to about 60,000 kilograms. The development of opium consumption seems to have been influenced by economic conditions. With the introduction of the *opium regie* the opium consumption declines to about 30,000 kilograms per year. This decline continues until the end of the tax farming system. The question we will consider in the empirical section is whether this decline in total opium consumption is caused by the introduction of the *opium regie* or whether other reasons can be found. After 1904 opium consumption increases somewhat.

We also have information about opium consumer prices. Again, for the first years the tax farmer reported this information. However, since the opium consumer price is much easier to check by the government, and as a matter of fact was checked by local government officials, the consumer prices are quite reliable. From the regie period we have information about opium revenues. We calculated average opium prices as the ratio of revenues to quantities. Figure 2 shows the development of consumer opium prices. In the first years, until the beginning of the 1880s opium price falls from about 450 guilders per kilogram to about 350 guilders. In 1884 there is a sharp increase back to 450 guilders. Starting in 1891 there is a gradual increase in the opium price to about 600 guilders by the end of the tax farming system. It is obvious from figure 2 that the average *regie* price is lower than the tax farm price (apart from the period 1896-98 when the average prices are about the same). Since the morphine content of *regie* opium is higher than the morphine content of tax farm opium, this means that there was a substantial decrease in effective opium price. After the transition period the opium price increases, but apart from some fluctuations the price is

approximately constant at about 480 guilders per kilogram.

From a point of view of the economic analysis it is not the nominal but the real opium price that is important. To deflate the opium price we use the price of rice as the best available indicator for the general development of the consumer prices (Creutzberg (1978); see Appendix 1 for details). Figure 3 shows the development of the real opium price (in 1873 guilders per kilogram). Now, there is a big increase in 1884 which coincides with the sharp decline in opium consumption in the same period. This increase is due to both the increase in the nominal price and the decrease of the average consumer prices. After the introduction of the *opium regie* there are strong fluctuations in the real opium price with a downward trend. Apparently, a price decline is at least responsible for the increase in opium consumption after 1904.

It is interesting to look at the price differences between the districts. Figure 4 gives the standard deviation of the district opium prices. As is clear from this figure the price dispersion in the 1870s is quite substantial, with a standard deviation between 150 and 200 guilders per kilogram. In the 1880s and 1890s the standard deviation of the district opium prices is fluctuating around 100 guilders per kilogram. Under the *regie*, prices are harmonized. In fact the opium price was the same in many districts. Therefore, in the beginning of the twentieth century there is a sharp decline in the price dispersion. In the 1920s the opium prices in all districts of Java were equalized.

Obviously, under the tax farm system there was a substantial price dispersion between districts. In some districts opium was much more expensive than it was in other districts. An interesting question is whether these price differences are stable over time. It could be that the ranking of districts from high to low opium price was constant or only slowly changing over time. Table 1 indicates that this is not the case. In this table we present (Spearman) rank-correlation coefficients for annual district opium prices. For every year we ranked the districts from the highest to the lowest opium price. Then we calculated the correlations between the district ranking in a particular year and those of the two subsequent years. For example: the correlation between the district ranking in 1873 and the ranking in 1874 is 0.36, which is not significantly different from zero at a 5% level of significance. Therefore, we cannot reject the null-hypothesis that both rankings are independent. With a few exceptions this is the conclusion we have with respect to all correlations shown in Table 1. Not only was there a wide price dispersion, there were also rapid changes in relative prices so that what was a cheap opium district in one year was not as cheap in the next year.

Apart from information about quantities and prices of opium we are also

interested in information about the smuggling of opium. Rush (1990) provides abundant qualitative information about this phenomenon. We use administrative files from which we gathered quantitative information about smuggling in terms of the number of illegal opium interceptions and the amounts intercepted. Figure 5 presents the evolution over time of the number of interceptions of illegal opium. As is shown, there is a substantial increase in this number in the 1870s. In 1873 there were about 1,500 interceptions, by the end of the 1870s this increased to an annual number of about 7,000 interceptions. The stochastic nature of the number of interceptions is clear from the big fluctuations. By the end of the 1880s there is a major decline in the number of interceptions. In the transition period from tax farming to government monopoly the number of interceptions is substantially lower than before. We do not know what caused this decline. It could be that there was less smuggling. It could also be that the tax farmers were more efficient in combatting opium smuggling. We do know that anti-opium smuggling activities were intensified during the transition period and thereafter. The police force was enlarged in every region where the *regie* was introduced. Figure 6 shows the amounts of intercepted illegal opium. By and large, the pattern is the same as in Figure 5. The amount intercepted is the largest at the end of the 1870s and the beginning of the 1880s, when annually 7,500 kilograms were intercepted. In the transition period and the period after that the amounts intercepted are negligible.

We also have an indication of world market opium prices. For this we use information about the production costs of refined opium produced by the Dutch government. These costs are determined by the production costs and world market prices of opium. Since production costs are low and there are not many fluctuations in production costs, the fluctuations in the opium costs are largely due to fluctuations in the world market prices. Figure 7 shows the evolution of the costs of opium over the period 1873-1907. Again, we use the rice price as a deflator. In the mid 1880s there is a doubling of the real opium costs, which is partly because of the decline in the average consumer prices, and partly due to an increase in world market opium prices. It is remarkable that this increase coincides with the major drop in the amounts of intercepted illegal opium as presented in Figure 6. Maybe the rise in opium costs made it less attractive for smugglers to continue their activities. In the beginning of the 1890s there is a major decrease in the opium costs until the level is about the same as before the increase. The fluctuations in the opium costs later on are largely due to fluctuations in average consumer prices.

4 Empirical analysis

An obvious determinant of opium consumption is its real price which theoretically has a negative effect. Furthermore, real income may have affected opium consumption. As a proxy for this we use real daily wages of coolies working on plantations. This wage is an important indicator of the socio-economic position of the Javanese population (see Appendix 1 for details). As shown in Figure 8 there is a strong increase in real wages in the beginning of the 1880s. This increase is partly due to the decline of the consumer prices, but there is also a substantial nominal wage increase. In the beginning of the 1890s there is a sharp decline in real wages. After that there are big fluctuations in real wages, which mostly have to do with fluctuations in the consumer prices.

Variables related to opium smuggling may also be important determinants of legal opium consumption. We use the annual number of interceptions of illegal opium as an indicator of the size of the illegal opium market. Apart from observed differences between districts there are also many unobserved district differences which we assume to be time invariant. These differences have to do with the economic structure, the structure of the population, the presence of large cities etcetera. To account for these time invariant differences we introduce district fixed effects. Finally, as indicated in the previous section there were big economic fluctuations and there was population growth. To account for the calendar time fluctuations we introduce a set of calendar year fixed effects. We use the following loglinear demand specification:

$$q_{j,t} = \beta_{o,j} + \beta_{1,t} + \beta_2 . q_{j,t-1} + \beta_3 . p_{j,t} + \beta_4 . w_{j,t} + \beta_5 . b_{j,t} + \varepsilon_{j,t} \qquad (1)$$

where q denotes the natural logarithm of the annual opium consumption in kilograms, p is the natural logarithm of the real opium price, w is the natural logarithm of the real wage and b represents the natural logarithm of the annual number of interceptions of illegal opium. Furthermore, j is a subscript for region, t a subscript for time, and ε is the disturbance term. Note that we also introduced the lagged dependent variable as explanatory variable, which enables us to distinguish between short term and long term effects: β_3 represents the short term price elasticity, $\beta_3/(1-\beta_2)$ gives the long term price elasticity, β_4 gives the short term wage elasticity and $\beta_4/(1-\beta_2)$ the long term wage elasticity. In our analysis we distinguish three periods. The first is the pre-transition period until 1895. The second is the period of the early years of the full implementation of the *opium regie* in Java, that is from 1904-1907. Finally, we consider the period of transition.

4.1 Opium tax farm

We start our analysis in the tax farming period, investigating the year from 1875 to 1894, right before the introduction of the *opium regie*. Table 2 shows the estimation results. In the first and the third column of Table 2 the lagged dependent variable is left out. In the third and the fourth column the real wage is left out.

In the first column of Table 2 the estimated price elasticity of opium consumption is -0.23, while the wage elasticity of opium consumption is 0.16. Furthermore, the number of interceptions has a negative effect on the opium consumption. If this number increases with 1 percent, opium consumption declines with 0.1%. We also investigated whether the annual amount of intercepted illegal opium influences the opium consumption, but we did not find such an effect. Probably there is more systematic variation in the number of interceptions, while in the amount intercepted there is a big random component. Neither the number of interceptions nor the quantities intercepted are influenced by the real opium price. Finally, we investigated the possible endogeneity of the opium price by using a Hausman test procedure[12]. We regressed the opium price on a number of instrumental variables[13]. Then we used the residuals from the price-regression as additional right hand side variable in the demand equation. Since the coefficient of this variable was not significant different from zero we conclude that endogeneity of the opium price is not a problem.

The second column Table 2 shows that the lagged dependent variable has a significant effect on current consumption. Since the coefficient of the lagged dependent variable is about 0.5, long term effects are about twice the size of short term effects. The short term price elasticity is -0.15, the long term price elasticity is about -0.3. So, the price elasticities are not very large and are substantially smaller than Van Ours (1995) finds for the opium consumption during the *opium regie* of the 1920s and 1930s. In the second column the coefficient of the wage does not differ significantly from zero. Therefore, we present estimation results in the third and fourth column omitting the wage variable. The estimates of the remaining coefficients are hardly affected by this[14]. All in all, we conclude that

[12]This procedure investigate whether there is a correlation between a right hand side variable and the error term of the regression. If there is a correlation this variable is considered to be endogenous.

[13]As instruments we used the natural logarithm of the lump-sum paid at the auction, the lagged and the twice lagged value of this variable, the lagged and the twice lagged price and the other exogenous variables.

[14]We also investigated whether there was a correlation between the lagged dependent variable and the error term of the regression equation but we found no evidence of such a correlation.

opium consumption was influence by opium price, opium smuggling and lagged opium consumption.

One of the astonishing results in Table 1 is the low price elasticity. The two economic phenomena of an addictive good and a private monopoly have different implications for the elasticity of demand. On the one hand, hard drugs are assumed to be addictive. Addictive goods are assumed to have a small price elasticity i.e. the demand for addictive goods is inelastic. Indeed, this is what we find for opium. On the other hand, a profit maximizing monopoly will charge a price such that the price-quantity combination is in the elastic part of the demand curve. Since the price elasticity is in the inelastic region the monopolist charges too low a price. By increasing the price the tax farmer should have been able to increase profits[15].

There are some explanations for this phenomenon. The first possible explanation of the low market price is the existence of a competitive fringe of smugglers. Since the world market price for opium is far below the price the tax farmer has to pay to the government, the price the tax farmer charges is substantially above the world market price. This creates an incentive for smugglers to enter the opium market. In case the monopolist acts as a price leader and the smugglers are a competitive fringe:

$$\epsilon_p = p.\frac{f'(p)}{f(p)} > p.\frac{f'(p) - g'(p)}{f(p)} > p.\frac{f'(p) - g'(p)}{f(p) - g(p)} = \epsilon_p^* \tag{2}$$

where ϵ_p is the price elasticity of total market demand, $f(p)$ is the market demand curve, $g(p)$ the supply curve of the smugglers and ϵ_p^* is the price elasticity of the demand for legal opium. So, competition forces the price elasticity upwards, reducing the elasticity of market demand.

A problem with this explanation is that we do not observe the market demand because we do not observe the (illegal) supply by the competitive fringe. We only observe the legal opium sold by the monopolist. Therefore, even though the price elasticity of market demand is inelastic, the price elasticity of the observed demand for opium, that is opium sold by a profit maximizing tax farmer should still be in the elastic range. So, a simple model of a price leading tax farmer cannot explain the observation of an inelastic demand for opium.

The second possible explanation of a low price is the model with dynamic limit-pricing (Gaskins (1971)). In stead of myopic maximization a tax farmer may take future competition into account. Then, the optimal pricing strategy

[15]Of course under the particular assumption of a constant price elasticity prices could end up very high.

does not maximize current profits, but will maximize the present value of the profits.

$$V = \int_0^{\infty} (p(t) - c).h(p(t)).e^{-rt}dt = 0 \tag{3}$$

where V is the present value of the tax farmers' profit stream, $h(p) = f(p) - g(p)$ is the residual demand curve, t is an index of time and r is the discount rate of the tax farmer. The rate of entry of new producers will depend on the price set by the dominant producer and the production costs of the new producers. If the production costs of the new producers are higher than those of the price leader, the price leader may charge a "limit price" that is above the competitive market price and will still prevent new producers from entering the market. The optimal price level along the optimal path will be always below the short run profit-maximizing price. Gaskins (1971) also shows that the dominant firm will disappear from the market if it does not have a cost advantage and claims that only in a growing market a dominant firm without a cost advantage can survive. The latter claim has been disputed by Ireland (1972) on the basis of the particular specification of the reaction function in Gaskins' model. An example of the use of the dynamic limit pricing model in a historical context is Carlos and Brown Kruse (1996) who use the dynamic limit pricing model to explain the decline of the Royal African Company because of increased competition by smugglers. There are two reasons why the dynamic limit pricing model is hard to use in case of the opium market. First, tax farmers have a short time horizon since their concession lasts only three years. Second, their cost of producing opium are substantially higher than those of the smugglers.

We conclude that the low price of opium cannot be explained by using simple models of competition between the tax farmers and smugglers. Competition amongst the tax farmers may also have been important. As indicated before there was severe competition between the tax farmers in the sense that each farmer had an incentive to smuggle his own opium to a neighboring district in order to sell it there, thereby undermining the position of his competitor. Such more complex models of competition are beyond the scope of the current paper.

4.2 Government monopoly: the early years

We limit the analysis of the *opium regie* to the period 1904-1907. The main reason to start in 1904 is that this is the first year in which the *opium regie* is present in every district of Java. The main reason to stop in 1907 is that after this year the opium prices are the same in most of the Javanese districts. Table 3 shows

the estimation results for the period 1904-1907. The first column shows that the price elasticity has a value of -1.3, which is quite large (in absolute terms). The effect of the number of interceptions of illegal opium is significantly negative but substantially smaller than during the tax farming period. Wages did not have a significant effect on opium consumption so we did not include the wage variable in the regressions. As in the case of the tax farming period we found no evidence of endogeneity of the opium price.

The second column of Table 3 shows that the lagged dependent variable has a significant effect on current consumption. After the introduction of the lagged dependent variable the short term price elasticity is -1.65, while the coefficient of the number of interceptions of illegal opium is not significantly different from zero. The implied long term price elasticity is -2.5.

We conclude that at the start of the *opium regie* opium prices have a large effect on opium consumption. The illegal opium market has a small negative effect on legal opium consumption. We find no evidence of a significant wage effect.

4.3 The transition period

In 1894 the *opium regie* was introduced in the first district, Madura. We use data starting from 1895, since that is the first full year that the *opium regie* was in practice. In subsequent years the *opium regie* was introduced in the other districts of Java until in 1904 all district were under the new opium regime (see Appendix 1 for the exact timing of events). To investigate whether the regime change affected the opium consumption it is difficult to apply a multivariate demand analysis as the one we just discussed. There is a measurement issue with respect to both the quantity and the price of opium. Therefore, we use the simple "difference in differences" approach presented in Table 4 to get an idea about the effects of the regime switch. The first column of Table 4 presents the change in opium consumption of the districts which are under the *opium regie* for the first year. This change indicates the effect of the change from tax farming to *opium regie*, but also the effect of changing economic conditions. The second column shows the change in opium consumption in those districts that were still under the tax farming regime and thus represents the effects of changing economic conditions. The third column does the same for districts who are under the *opium regie* for at least two years. The fourth column gives the average change for districts under either the tax farming or the *opium regie* regime. So, the fourth column represents the effect of changing economic conditions. If we take the difference

in opium consumption in the fourth column and in the first column then we calculate the separate effect of the change in opium regime. This effect is shown in the fifth column. Averaged over the period 1895-1904 the opium consumption in tax farming districts and districts that were under the *opium regie* regime for more than a year declined with 3.2% per year. The average decline in the first year of the new regime was 38.5%. Therefore, the difference of -35.3% can be attributed to the change from tax farm to *opium regie*.

Table 5 shows the estimation results for the transition period of some simple regressions with growth rates as dependent variables. Here, we test whether the growth of the quantity consumed in the first year of the *opium regie* as compared to the quantity consumed in the previous year (the last year of the tax farm) is different from the similar growth between two years within the tax farm period or within the regie period. The first column shows that the annual growth of the quantities consumed in the years considered was -3.9%, whereas in the first year of the *opium regie* there was an additional decline of 39.8%[16]. This decline is in line with the results of Table 4.

We did similar analyses for the changes in real opium price and the number of interceptions of illegal opium. From the second column of Table 5 it appears that the average opium price during the years considered increased with 2.9% per year. In the first year of the *opium regie* there was an opium price decline of 9.4%[17].

Finally, it appears that the number of interceptions of illegal opium increased with 145% in the first year of the *opium regie*. This reflects the fact that with the introduction of the *opium regie* the policy force was enlarged and the attempts to fight smuggling were intensified. Since we did not find such an effect in the second year of the *opium regie*, the higher level of the number of interceptions holds for all *regie* years under consideration.

4.4 The effects of the change in opium policy

As indicated in Section 3 for the tax farming period we use information about raw opium while for the *regie* period we use information about refined opium. The refining was necessary to produce a smokeable variety of opium. During the process of refining some quantity of opium was lost, but there were no losses of

[16]We also investigated whether there was an additional decline of the quantity of opium in the second year of the *regie*. That would indicate that there was a direct and a lagged effect. We found no evidence of such an effect.

[17]Again, we investigated whether there was an additional decline or an increase of the opium price in the second year of the *regie*, but found no evidence of such an effect.

morphine. Since the tax farmers added dilutions to the refined opium the morphine content of tax farm opium was comparable to that of raw opium. During the *opium regie* less dilutions were added and therefore the morphine content of refined *regie* opium was larger than that of farm opium. In our calculation of the effects of the change in opium policy we have to take the differences in morphine content into account.

The decline in opium price of 9.4% in the first year of the *regie* we found in the previous subsection is the price per kilogram of *regie*-opium as compared to the price per kilogram of tax farm-opium. Since the morphine content of *regie*-opium was higher than the morphine content of tax farm opium this means that there was a substantial price decline in terms of morphine content. If we assume that tax farm opium contained 8% morphine[18] and the price of tax farm opium was 500 guilders per kilogram, then the price of a kilogram tax farm morphine was 6250 guilders. The price of a kilogram of *regie* opium was about 450 guilders per kilogram, so with a morphine content of 12%[19] the price of a kilogram of *regie* morphine was 3750 guilders. In this case the price of a kilogram of morphine went down with 40% at the introduction of the *opium regie*.

An important result of the figures in Tables 4 and 5 is the conclusion that the regime switch caused the quantity of opium purchased to decline with 35-40%. Now, the question is to what extent this decline represents an actual decrease in opium consumption in terms of quantities of morphine consumed. If we normalize the quantity of opium sold to 100 kilograms in the tax farm period and assume that this opium contained 8% of morphine 8 kilograms of morphine was sold. At the introduction of the *opium regie* the quantity of opium decrease with 35% to 65 kilograms, which contained with a 12% morphine content 7.8 kilograms of morphine. So, in this example the introduction of the *opium regie* caused the morphine consumption to decline with 2.5%. This is not very much, but as indicated before we should make a distinction between two separate effects of the regime switch. The first effect is the effect of the price change, the second is the incentive effect, i.e. the effect that retailers of opium no longer have an incentive to get people to use opium. The price effect of course depends on the price elasticity, which we assume to be -0.2, which is quite low. Since the price decline is 40% the price effect is 8%. So, whereas in our example the price decline should have increased consumption with 8%, consumption declined with

[18]Standard quality of opium farm *Candu* was tested by the military pharmacist Haak in preparation of the new *regie*. He found a morphine content of 8% (Haak (1889))

[19]This was the average morphine content of *regie* opium as reported in the Yearly Accounts of the *opium regie*.

2.5%. This means that the total incentive effect is -10.5%. The pure effect of the transition from tax farming to *opium regie* causes the amount of morphine consumed to decline with about 10%.

Of course the outcome of these calculations depends to a large extent on the assumptions with respect to the morphine content of tax farm opium. If the assumed morphine content is higher, the price decline and thus the price effect is smaller, but the total effect is substantially larger. Therefore, the incentive effect increases with the morphine content. Table 6 shows the outcomes of alternative calculations. With a morphine content of farm opium of 9% the incentive effect is -20%, at 10% it is -27% and at 12% it is -37%.

5 Conclusions

In this paper we analyze the effects of a change in opium policy in Java. In the nineteenth century there was a system of tax farms, which were private district-based monopolies. By the end of the nineteenth century a government monopoly on opium was introduced. Under this so-called *opium regie* import, refinement and retailing were fully under control of the government. Our analysis focuses on the effects of this change in opium policy. In our analysis we use annual administrative data for 15 Javanese districts over the period 1873-1907.

From the analysis of the tax farm period we conclude that opium consumption is affected by opium prices and opium smuggling. We also find an effect of lagged opium consumption. So, in economic terms there are short run and long run effects. Long term effects are about twice the size of short term effects. Short term price elasticity is -0.15, long term price elasticity is about -0.3. From the analysis of the start of the regie period we conclude that the *regie* opium prices have a large effect on opium consumption. The illegal opium market has a small negative effect on legal opium consumption.

The information from the transition period enables us to directly investigate the effects of the change in opium policy. The first effect is due to the change in the price. The price per quantity of opium went down, the price per quantity of morphine went down even more because the morphine content of *regie* opium was higher than the morphine content of tax farm opium. The declining price had a positive effect on the consumption of opium of about 5-10%. The second effect is the incentive effect. Tax farmers had an incentive to expand their market. This incentive vanished under the *regie*. We estimate the negative incentive effect on the consumption of opium to be about 10-25%.

What are the lessons from opium history for present-day drug policy? First,

we conclude that the demand for drugs is sensitive to the price of drugs. If legalization of drugs lowers the price of drugs this will stimulate consumption. However, since there probably are many small consumers that are rather recreational users rather than drug addicts the welfare effects will be limited. Furthermore, we find that if government takes over the drug business, this has a substantial negative effect on drug use because of the incentive effect. All in all, we think that a policy of controlled legalization of drug use can be more effective in controlling drugs and reducing drug consumption than a policy of prohibition is.

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Appendices

1 Details on the data

The data were published in the yearly 'Accounts of the Opiumregie', 1915-1938 and the Colonial Reports, 1873-1940. During the last years of the opium tax farm, data were collected for 22 districts. During the first years of the *opium regie*, 18 districts were distinguished. We were able to combine the information from the different data sources into one consistent dataset in which the following 15 districts are distinguished: Batavia (including Banten, Krawang and Priangan), Ceribon, Pekalongan (including Tegal), Semarang (including Japara), Rembang, Surabaya, Pasuruan (including Probolinggo), Besuki, Banyumas, Kedu (including Bagelen), Yogyakarta, Surakarta, Madiun, Kediri, Madura. In the Western part of Java, in Bantam and Priangan opium farms were not allowed although there was a handful of legal outlets (Rush (1990)). During the *opium regie* opium was sold in these districts.

The first year of the *opium regie* was:
- 1895 for Madura (actual start September 1, 1894)
- 1896 for Pasuruan, Besuki
- 1899 for Surabaya
- 1901 for Madiun, Kediri
- 1902 for Semarang, Rembang
- 1903 for Batavia, Djokja, Surakarta
- 1904 for Ceribon, Pekalongan, Banyumas, Kedu

1.1 Quantities

In international treaties raw or "soft" opium is defined as "the spontaneously coagulated juice, obtained from the capsules of *Papaver somniferum L.*, which has only been submitted to the necessary manipulations for packing and transport, whatever its content of morphine". Smoke opium is defined as "the product of raw opium, obtained by a series of special operations, especially by dissolving, boiling, roasting and fermentation, designed to transform it into an extract suitable for consumption". During the process of preparing smoke opium about 40% of the raw opium is lost.[20] However, because of special precautions in the production

[20]From colonial reports and reports on the opium factory we derive that the percentage of refined opium out of raw opium increased from about 53% in 1894 to about 63% in 1907. In subsequent years apart from fluctuations this percentage was about constant.

process no morphine was lost. Therefore, the morphine content of smoke opium can be substantially higher than the morphine content of raw opium (Addens (1938)). Smoke opium made by the *regie* factory had a morphine content of 10-13%, with an average of 12%. Tax farm opium had a lower morphine content because the tax farmers diluted their opium. We assume that tax farm opium had a morphine content between 8 and 10 %.

1.2 Prices

The value of opium is determined by the morphine content (Addens (1938)). Since the morphine content of *regie* opium was substantially higher than the morphine content of tax farm opium the prices during both regimes are difficult to compare. To get an impression about the meaning of the opium price for the consumer we need real prices in stead of nominal prices. Previous research (Polak (1943)) indicates that in the period 1921-1939 the costs of living are highly correlated with the price of rice. We assume that this was also the case in the period 1873-1907 and we use the price of rice as an indicator for the costs of living, i.e. the average consumer price level. Figure A1 presents the evolution of the rice price over the period 1873-1907. It is obvious that there are large fluctuations from year to year. Apart from that there is a major decline in the beginning of the 1880s when the price drops more than 30%.

1.3 Wages

Dros (1992) gives an overview of daily wages of colies employed by plantations in Java, distinguished by district. He derived this information from various Colonial Reports starting with the year 1875. We use information for the period 1875-1907. Dros gives no single wage but the highest and lowest daily wages respectively. Sometimes these figures diverge considerable, e.g. from 25 to 80 cents daily. The majority of the workers was probably nearer to the lower end than to the higher end of the sale. The average of the highest and the lowest wage is no correct representation of the average wage. However, since we have no information about the distribution of wage earners we take the average and assume that changes in this average are informative about changes in the true average daily wage. The wages of coolies are important in two respects. First, a large share of the population was working in the agricultural sector. According to the 1878 Census 82% of the male labor forces was mainly employed in agricultural pursuits. According to the 1905 Census this was even 85% (Dros (1992)). Second, opium consumption was to a large extent located in the group of coolies.

Table 1 Rank-correlation coefficients for price levels during tax farm period; 1873-1894[a)]

Year t	*Year t+1*	*Year t+2*	*Year t*	*Year t+1*	*Year t+2*
1873	0.36	-0.16	*1884*	-0.02	0.33
1874	0.02	**0.48**	*1885*	-0.20	-0.11
1875	-0.18	0.05	*1886*	0.33	-0.04
1876	**0.82**	0.16	*1887*	**-0.59**	-0.32
1877	0.35	-0.22	*1888*	0.13	-0.39
1878	0.20	-0.36	*1889*	-0.14	-0.31
1879	0.25	0.25	*1890*	-0.19	0.03
1880	0.32	**0.63**	*1891*	0.15	-0.31
1881	0.30	0.34	*1892*	0.60	0.63
1882	**0.82**	0.00	*1893*	0.19	-
1883	0.20	0.14			

[a)] Bold figures are correlations that differ from 0 at a 5% level of significance

Table 2 Estimation results tax farming period, quantities of opium; 1874-1894[a)]

p	-0.26 (3.5)	-0.14 (2.1)	-0.25 (3.4)	-0.13 (2.0)
w	0.18 (2.2)	0.10 (1.4)		
b	-0.10 (4.6)	-0.05 (2.8)	-0.09 (4.3)	-0.05 (2.6)
q_{-1}		0.51 (9.2)		0.52 (9.4)
R^2	0.927	0.944	0.926	0.945

[a)] Ordinary Least squares, included in the regressions are district fixed effects and calendar year fixed effects; t-values in parentheses; R^2 is corrected for degrees of freedom; number of observations = 300

Table 3 Estimation results *opium regie* period, quantities of opium; 1904-1907[a)]

p	-1.31 (3.3)	-1.66 (4.4)
b	-0.04 (3.1)	-0.02 (1.3)
q_{-1}		0.33 (2.8)
R^2	0.995	0.996

[a)] Ordinary Least Squares, included in the regressions are district fixed effects and calendar year fixed effects; t-values in parentheses; R^2 is corrected for degrees of freedom; number of observations = 60 (56 in equations with a lagged dependent variable)

Table 4 Opium quantities; annual growth in %; 1895-1904 (number of districts)

	Break (a)	*Tax farm* (b)	*Regie* (c)	(b)+(c)	*Effect policy* (a)-(b)-(c)
1895	6.6 (1)	11.2 (14)	-	11.2 (14)	-4.6[a)]
1896	-56.3 (2)	-15.3 (12)	-11.8 (1)	-15.0 (13)	-41.3
1899	-22.1 (1)	3.3 (11)	0.3 (3)	2.7 (14)	-24.8
1901	-29.7 (2)	7.3 (9)	-8.0 (4)	2.6 (13)	-32.3
1902	-57.9 (2)	-12.3 (7)	-13.3 (6)	-12.8 (13)	-45.1
1903	-34.5 (2)	-30.8 (4)	-6.9 (8)	-16.1 (12)	-18.4
1904	-39.7 (5)	-	5.7 (10)	5.7 (10)	-45.4
Average	-38.5 (15)	-2.8 (58)	-3.8 (32)	-3.2 (90)	-35.3

[a)] The figure for 1895 underestimates the decline because the *regie* was already introduced September 1, 1894.

Table 5 Estimates of the annual growth of various opium indicators; 1895-1904[a)]

	$q - q_{-1}$	$p - p_{-1}$	$b - b_{-1}$
trend	-0.039 (2.3)	0.029 (2.3)	-0.110 (1.2)
t^*	-0.398 (9.0)	-0.094 (2.8)	1.450 (5.9)
R^2	0.435	0.064	0.246

[a)] R^2 is corrected for degrees of freedom; ssr=sum of squared residuals, t^* is the first year of the opium regie ; number of observations = 105

Table 6 Calculated effects of the change in opium policy, under different assumptions with respect to the morphine content of farm opium (%)[a)]

Morphine (a)	*Price change* (b)	*Price effect* (c)=-0.2*(b)	*Total effect* (d)	*Incentive effect* (d)-(c)
8	-40.0	+8.0	-2.5	-10.5
9	-32.5	+6.5	-13.5	-20.0
10	-25.0	+5.0	-22.0	-27.0
12	-10.0	+2.0	-35.0	-37.0

[a)] Assumptions: Farm opium = 500 guilders/kilogram; Regie opium = 450 guilders/kilogram; morphine content regie opium = 12%; price elasticity = -0.2; effect policy change in terms of kilograms of opium = -35%.

Figure 1 Opium consumption; 1873-1907 (1000 kilograms/year)

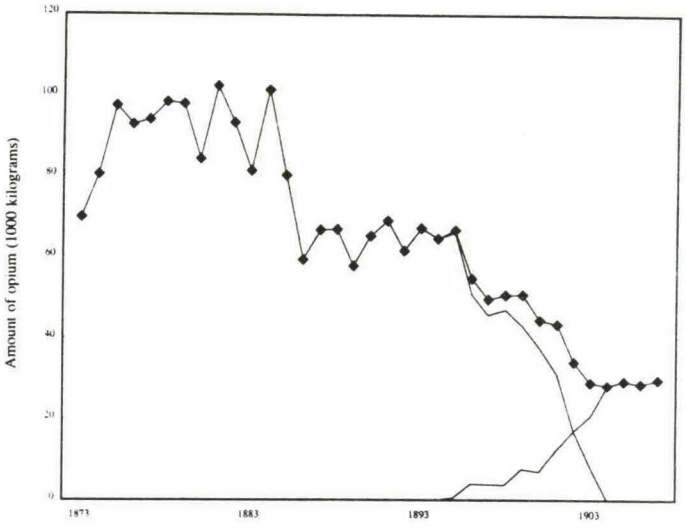


Figure 2 Opium price; 1873-1907 (Dutch guilders/kilogram)

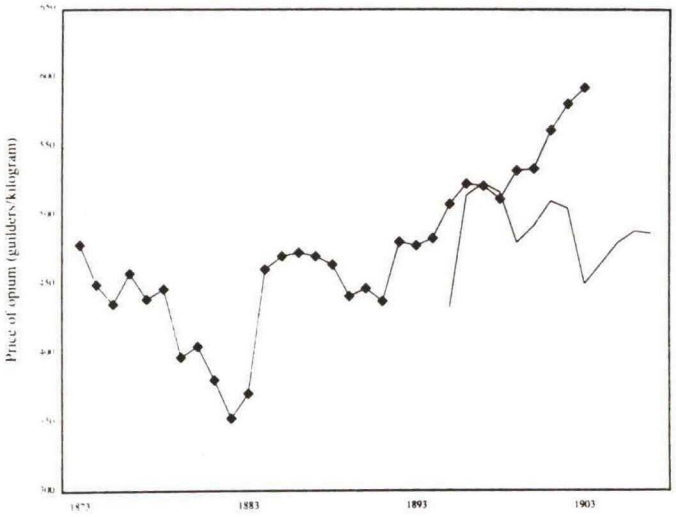


Figure 3 Real opium price; 1873-1907 (1873 Dutch guilders/kilogram)

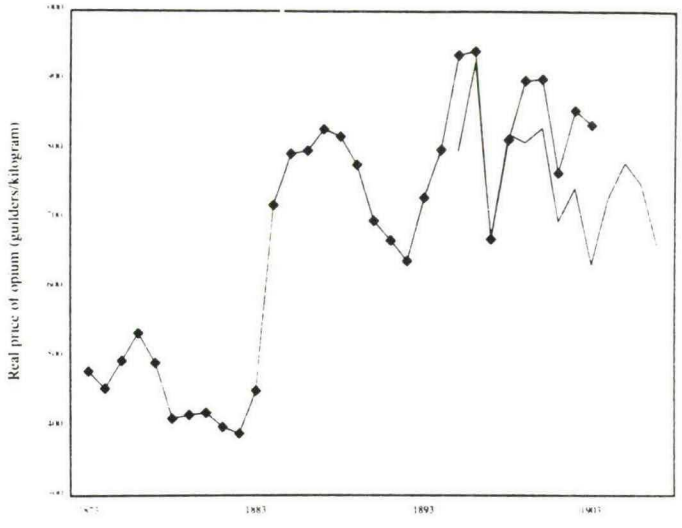


Figure 4 Standard deviation of district opium prices; 1873-1907 (Dutch guilders/kilogram)

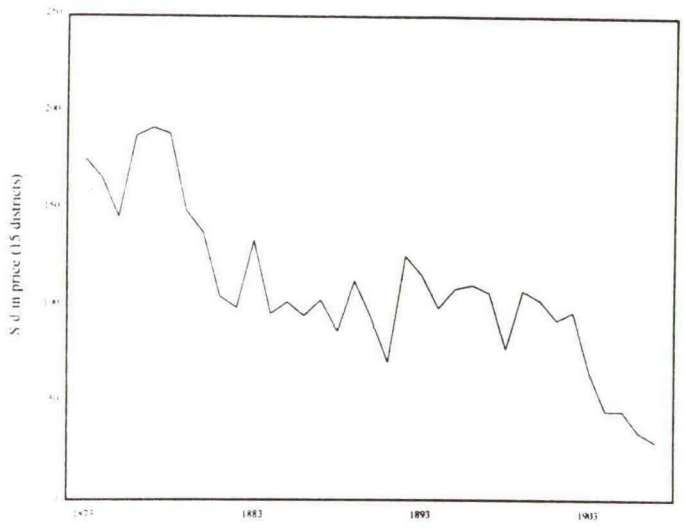


Figure 5 Interceptions of illegal opium; 1873-1907 (1000)

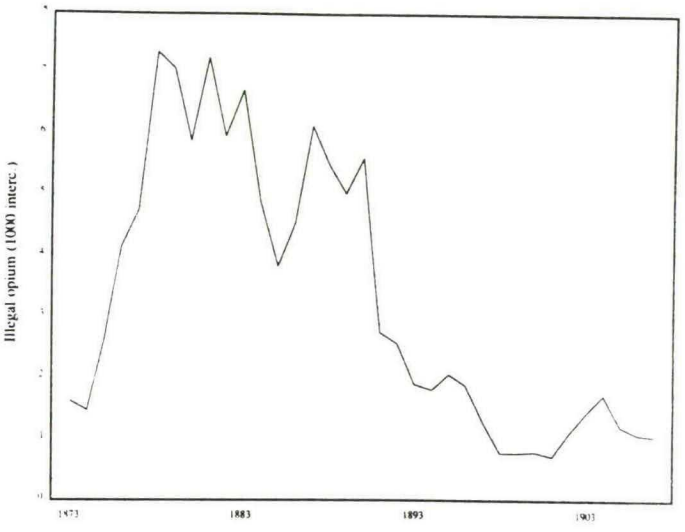


Figure 6 Intercepted illegal opium; 1873-1907 (1000 kilograms)

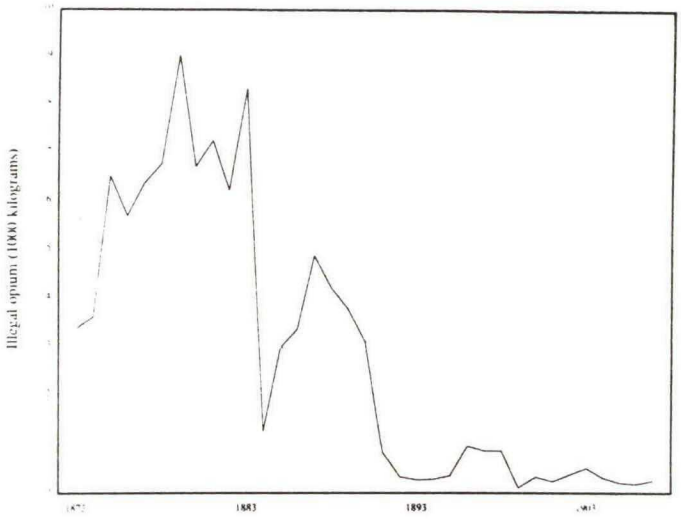


Figure 7 Real costs of imported opium; 1873-1907 (1873 Dutch guilders/kilogram)

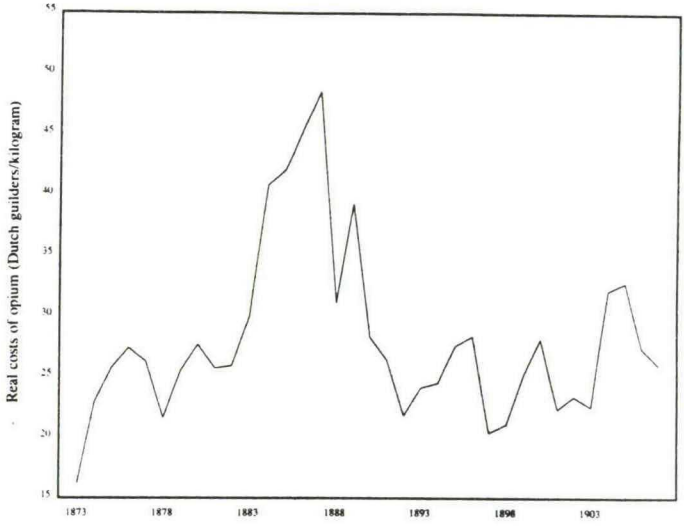


Figure 8 Real wages of coolie workers; 1875-1907 (1875 Dutch cents per day)

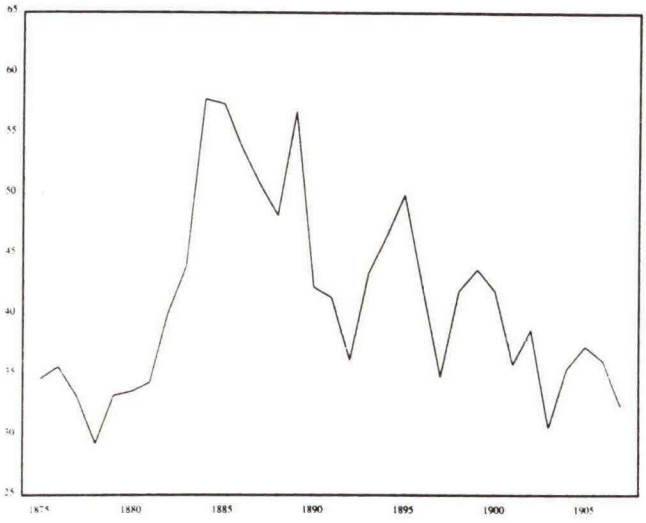
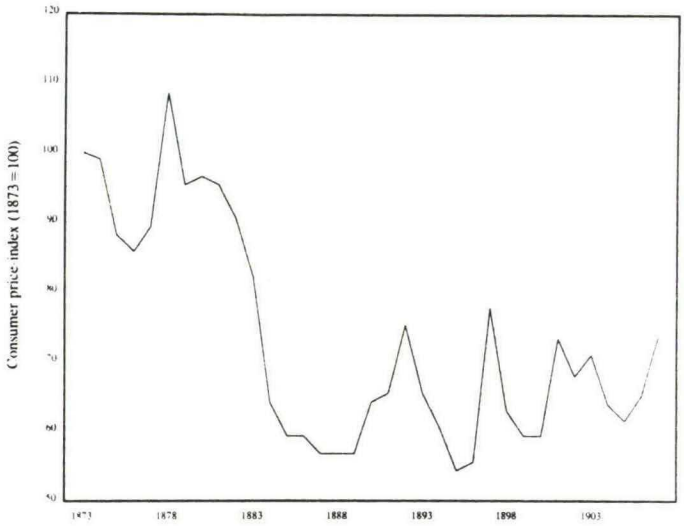


Figure A1 Rice prices; 1873-1907 (index 1873=100)



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