

Sugar Production and Trade in Dutch Colonial Taiwan*

Hui-wen Koo**

ABSTRACT

This paper examines Taiwan's sugar industry in the Dutch colonial era. Primary data on the Han population, area of cultivated land, sugar production and exports to markets around the world were extracted from original files of the Dutch East India Company. Analysis reveals that it was the demand from the Netherlands that motivated sugar production in Taiwan. However, following the end of the Brazilian rebellion in 1654, Amsterdam was glutted with sugar from Brazil, and the Dutch lost interest in sugar from the East Indies. Persia, Japan and China then became main markets for Taiwan's sugar. In the early period, the profit margin of Taiwan's sugar exports to the Netherlands exceeded 400%, much larger than that of spices or pepper. On the other hand, natural hazards in Taiwan caused large fluctuations in farmers' income. Even in the best years, a Taiwanese farmer earned less than one third of a Dutch hod carrier, though it far exceeded what their counterparts in China could make.

Keywords: Dutch Colonial Taiwan, Sugar in the Mid-17th Century, Cross-Country Income Comparison

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** Professor, Department of Economics, National Taiwan University

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Sugar was high-priced in the early 16th century Europe and served as a symbol of power. Lavish *soteltes* (subtleties), sugar sculptures of buildings, animals, and even tablewares, were arranged on the noble's feast table to arouse admiration from his guests. Sugar became affordable to the middle classes by the mid-16th century. Once conquering taste buds, it became a culinary necessity and new recipes for sugary desserts further promoted its popularity. In the mid-17th century, England, France, the Netherland, Portugal and Spain fought in the New World to found or to defend their sugar colonies.¹ It was in this background that the Dutch East India Company (*De Vereenigde Oost-Indische Compagnie*, or VOC) started its rule in Taiwan in 1624.

Aborigines were the main inhabitants then in Taiwan, and they were engaged in hunting and simple farming. So the original object of the VOC to take Taiwan was not to found a sugar colony, but to use it as an entrepot to trade with China. In the beginning, the business fell well off expectation. Only after repeated negotiations with officials in Fukien Province, did Chinese imports take off in 1630, and the important cargo consisted of silk, porcelain and sugar.²

Taiwan Governor, Hans Putmans, expressed in 1635 that continuous purchases of sugar from China had caused a considerable increase in the price. So two years ago, they had fetched sugarcane from China and lent Chinese residents

¹ Eddy Stols, "The Expansion of the Sugar Market in Western Europe," in Stuart B. Schwartz, ed., *Tropical Babels: Sugar and the Making of the Atlantic World, 1450-1680* (Chapel Hill and London: The University of North Carolina Press, 2004), pp. 237-288; Elizabeth Abbott, *Sugar: A Bittersweet History* (London and New York: Duckworth Overlook, 2008), pp. 6, 22-23, 37, 46-47.

² J. Leonard Blussé, M. E. van Opstall, Ts'ao Yung-ho, Chiang Shu-sheng, and W. Milde, eds., *De Dagregisters Van Het Kasteel Zeelandia, Taiwan 1629-1662* (abbreviated hence *DZ*), *Deel I: 1629-1641* (The Hague: Martinus Nijhoff, 1986), pp. 3, 24, 65, 70.

cattle and money to plough the land and to produce sugar in Taiwan. The result of this experiment was satisfactory.³ Because sugar production was labor intensive, to make this experiment into a profitable business, the VOC needed to attract more Chinese farmers to Taiwan. Across the Taiwan Strait, farmers in Fukien were experienced sugar producers who cultivated sugarcane throughout the history in the Philippines, Indonesia, Vietnam, Thailand, Cambodia, Sri Lanka, and even Hawaii and Cuba.⁴ It was the Company's keen interest to recruit these farmers to Taiwan. A hospital was built to take care of the Chinese who fell sick. And to effectively protect Chinese farmers whose crops had been set on fire by villagers of Mattauw, Putmans himself led a punishing expedition to Mattauw in 1635 and burnt down its whole village.⁵ Prominent overseas Chinese merchants also joined to recruit Fukien farmers to Taiwan. So Bing Kong, the official Chinese head in Batavia relinquished his captaincy and moved to Taiwan in 1636 to become a broker of migrants.⁶

In 1639, seven Chinese leaders in Taiwan received free land from the Dutch who instructed in details how many sugarcanes along with other crops such as rice, tobacco, indigo, ginger should be planted. The complete harvest would be purchased by the Dutch at a price fixed in advance.⁷ Free land, however, did not imply an easy profit. A wealthy Chinese merchant, Hambuan, once complained that in the first two years an enormous amount had been spent on cultivating land and setting up a new sugar mill, and the expenses turned out to be 500-600 reales more than he originally had estimated.⁸

³ Leonard Blussé, Natalie Everts, and Evelien Frech, eds., *The Formosan Encounter -- Notes on Formosa's Aboriginal Society: A Selection of Documents from Dutch Archival Sources, Vol. 1: 1623-1635* (Taipei: Shung-Ye Museum of Formosan Aborigines, 1999), pp. 227, 230, 267; Shaogang Cheng, *De VOC en Formosa, 1624-1662* (Taipei: Linking Publishing Co., 2000), p. 145.

⁴ David Bulbeck, Anthony Reid, Lay Cheng Tan, and Yiqi Wu, compiled, *Southeast Asian Exports since the 14th Century: Cloves, Pepper, Coffee, and Sugar* (Leiden, The Netherlands: KITLV Press; Australia: Research School of Pacific and Asian Studies, ANU; Singapore: Institute of Southeast Asian Studies, 1998), pp. 107-109; Kenneth Pomeranz and Steven Topik, *The World that Trade Created: Society, Culture, and the World Economy, 1400 to the Present* (Armonk and London: M. E. Sharpe, 2006, 2nd edition), p. 10.

⁵ VOC 1114, f.11, (VOC here refers to the VOC archives stored in The National Archive in The Hague and 1114 is the inventory number of the document. The same applies to other references below.) letter from Hans Putmans to Camer Amsterdam, Tayouan, 28 October 1634; *DZ, Deel I: 1629-1641*, pp. 200-201.

⁶ B. Hoetink, "So Bing Kong: Het Eerste Hoofd der Chineezten te Batavia (1619-1636)," *Bijdragen tot de Taal-, Land- en Volkenkunde van Nederlandsch-Indië* (The Hague) 73: 3/4 (Jan. 1917), pp. 344-415.

⁷ VOC, 1131, f.744; Pol Heyns, *Economy, Land Rights and Taxation in Dutch Formosa*, trans., Wei-chung Cheng (Taipei: Appleseed Publishing Co., 2002), pp. 59-60.

⁸ VOC 1120, 264, report from Taiwan Governor, Hans Putman, to Batavia, 7 October, 1636.

How successful was the Company's immigration plan and how did its sugar enterprise turn out in Taiwan? This paper makes use of the rich Dutch sources to address these questions. In the following, after describing briefly the contemporary Chinese sugar production technology, we shall study the Chinese population, farm land area and sugar output in Taiwan. Attention is then turned to markets for Taiwan's sugar, profits so derived and the profit division between the Dutch and the Chinese farmers. The final section concludes.

1. Sugar Production

Only cane sugar was produced in Taiwan. Cane was planted between December and April of the following year and harvested about a year later.⁹ The Dutch sources do not provide information about how sugar was produced, but since this technology was introduced by the Chinese to Taiwan, sugar production depicted by the contemporary Chinese writer, Song Ying-hsing, should provide us with a good idea about the production process. According to Song, a sugar mill driven by cattle consisted of two vertical wooden rollers between which cane was inserted and crushed for juice. Crushing needed to be repeated three times to fully extract juice. Lime was then added to juice to remove its impurities. Finally, with bagasse used as fuels, juice was boiled until it became very sticky. The cooked syrup would be kept in barrels and 65 percent of the total sucrose would crystalize while 35 percent of sucrose remained as molasses.¹⁰

To provide cattle to drive sugar mills, the Dutch bred cattle in Taiwan and according to Taiwan Governor Hans Putmans, with an initial size of 38, in 1635 its population already increased to 360. The Chinese were also encouraged to bring their own cattle from across the Strait to mate with the Company's cattle.¹¹ Chinese became especially enthusiastic to do so after Ming China fell in the hand of Qing, i.e. after 1644. For instance, on 1645.4.20 alone, nine junks carried 61

⁹ VOC 1164, 373v, letter from Overtwater to van der Lijn in Batavia, Tayouan, 24 September, 1647.

¹⁰ Ying-hsing Song, *T'ien-Kung K'ai-Wu: Chinese Technology in the Seventeenth Century*, English trans., E-tu Zen Sun and Shiou-chuan Sun (University Park: Penn State University Press, 1966); J. L. Blussé, W. E. Milde, Ts'ao Yung-ho, and N. C. Everts, eds., *De Dagregisters Van Het Kasteel Zeelandia, Taiwan 1629-1662* (abbreviated hence *DZ*), *Deel III: 1648-1655* (The Hague: Martinus Nijhoff, 1996), p. 43.

¹¹ VOC 1116, 373r, report from Taiwan Governor, Hans Putman, to Batavia, 19 September, 1635.

cattle to Taiwan.¹²

In the harvest season, it took a lot of labor to reap and help with sugar production. When mills were short of hands, part of cane-field remained unreaped. To avoid such a loss, the Dutch provided loans to sugar producers to hire sufficient labor in the harvest season. In some years, instead of cash, pepper, a popular commodity in China, was loaned to sugar producers.¹³

The Dutch provision was only limited to cattle and loans, and the Chinese needed to import all apparatus for sugar production and packaging. Time and again, in their diaries, the Dutch recorded sugar mills, large sugar-pans, sugar jars, chests and planks for sugar-chests brought by the Chinese junks to Taiwan.¹⁴ Tonio Andrade coins such a division of work between the Dutch and the Chinese as their co-colonization of Taiwan.¹⁵

2. Chinese Migration and Agriculture Development in Taiwan

(1) Population

Severe droughts in the first half of the seventeenth century caused a long-term famine in China. People suffering hunger formed groups of bandits to plunder government barns. The one led by Li Zicheng even occupied the capital and overthrew the Ming Dynasty in 1644.¹⁶ In this turbulent time, for people in Fukien, Taiwan across the Strait, a virgin land recently becoming under the Dutch

¹² J. L. Blussé, W. E. Milde, Ts'ao Yung-ho, and N. C. Everts, eds., *De Dagregisters Van Het Kasteel Zeelandia, Taiwan 1629-1662* (abbreviated hence *DZ*), *Deel II: 1641-1648* (The Hague: Martinus Nijhoff, 1995), p. 378.

¹³ Hui-wen Koo, "Weather, Harvests, and Taxes: A Chinese Revolt in Colonial Taiwan," *The Journal of Interdisciplinary History* (Cambridge) 46: 1 (Summer 2015), pp. 47-49 and sources cited there.

¹⁴ For instance, see *DZ, Deel II: 1641-1648*, pp. 366, 385; *DZ, Deel III: 1648-1655*, p. 145; J. L. Blussé, N. C. Everts, W. E. Milde, and Ts'ao Yung-ho, eds., *De Dagregisters Van Het Kasteel Zeelandia, Taiwan 1629-1662* (abbreviated hence *DZ*), *Deel IV: 1655-1662* (The Hague: Martinus Nijhoff, 2000), p. 75.

¹⁵ Tonio Andrade, *How Taiwan Became Chinese: Dutch, Spanish, and Han Colonization in the Seventeenth Century* (New York: Columbia University Press, 2008), Ch. 6.

¹⁶ Both scientists and historians start to attribute the ending of Ming Dynasty to the severe weather at the end of the little ice age. See Kenneth J. Hsu, *Climate Made History*, Chinese trans., His-an Kan (Taipei: Linking Publishing Co., 2012), pp. 8-33; Brian Fagan, *The Little Ice Age: How Climate Made History, 1300-1850* (New York: Basic Books, 2000); Geoffrey Parker, "Crisis and Catastrophe: The Global Crisis of the Seventeenth Century Reconsidered," *The American Historical Review* (Oxford) 113: 4 (Oct. 2008), pp. 1053-1079.

rule, offered a prospect of a better life.

The VOC's records give us some idea about the number of the Chinese migrants over time. The pioneering work by Chiang Shu-shen uses poll tax data to infer the Chinese population in Taiwan and his data start in 1640 when the Dutch launched this tax on Chinese migrants.¹⁷ Though sporadic population estimates by the Dutch before 1644 are available, such estimates lack consistency and hence are ignored here.¹⁸ At the beginning, the monthly poll tax rate was 0.25 real per head.¹⁹ By 1654, it was increased by 1/6 times.²⁰ Theoretically, dividing the poll tax revenue by the tax rate of the same year gives us an estimate of the Chinese population. The complication comes in when in August 1653, the Company decided to farm out tax collection each year in an auction to the highest bidder.²¹ Considering the cost to collect tax, the auction winner must have bid less than his expected tax revenue. Hence to calculate the population with the bid, which was part of the tax revenue to turn in, will yield an underestimate. Other factors also contribute to an underestimate. For instance, to promote agricultural expansion, the Dutch would waive Chinese farmers' tax in the remote area.²² To encourage migration of female Chinese to Taiwan, in the early period, the poll tax was waived for the female. Only later in December 1652, when the Dutch needed to finance construction of a new castle, did they start to tax the female.²³

Despite all these difficulties, poll tax data give us a good proxy about the Chinese population. Figure 1 depicts population from 1640 to 1661. A few adjustments are made to Chiang's results. For instance, we consider it not

¹⁷ Shu-shen Chiang, "Population Changes in Dutch Colonial Taiwan," presented in *International Conference on Belief in Matsu* held by Beigan Chao-Tien Temple (1997).

¹⁸ In 1633, Taiwan Governor Hans Putmans estimated 700 to 800 Chinese in Taiwan. (VOC 1113, f.693) In 1638, Governor-General in Batavia reported that about 10,000 to 11,000 Chinese resided in the Company's territory in Taiwan. See W. Ph. Coolhaas, ed., *Generale Missiven van Gouverneurs-Generaal en Raden aan Heren XVII der Verenigde Oostindische Compagnie* (abbreviated hence *GM*), *Deel I: 1610-1638* (The Hague: Martinus Nijhoff, 1960), p. 708. However, it was realized two years later when poll tax was collected that there were only 3,568 Chinese residents.

¹⁹ Shaogang Cheng, *De VOC en Formosa, 1624-1662*, p. 212.

²⁰ VOC 1206, f.233r, accounts of Formosa by Nicolaas Verbuch, Batavia, 10 March 1654.

²¹ VOC 1197, f.788v, letter from Cornelis Caesar to Joan Maetsuijcker, Tayouan, 24 October 1653.

²² *DZ, Deel III: 1648-1655*, p. 334.

²³ VOC 1194, ff.148-149, letter from Nicolaas Verbuch to Carel Reniersz., Tayouan, 15 November 1652, indirectly cited from *DZ, Deel III: 1648-1655*, p. 294.

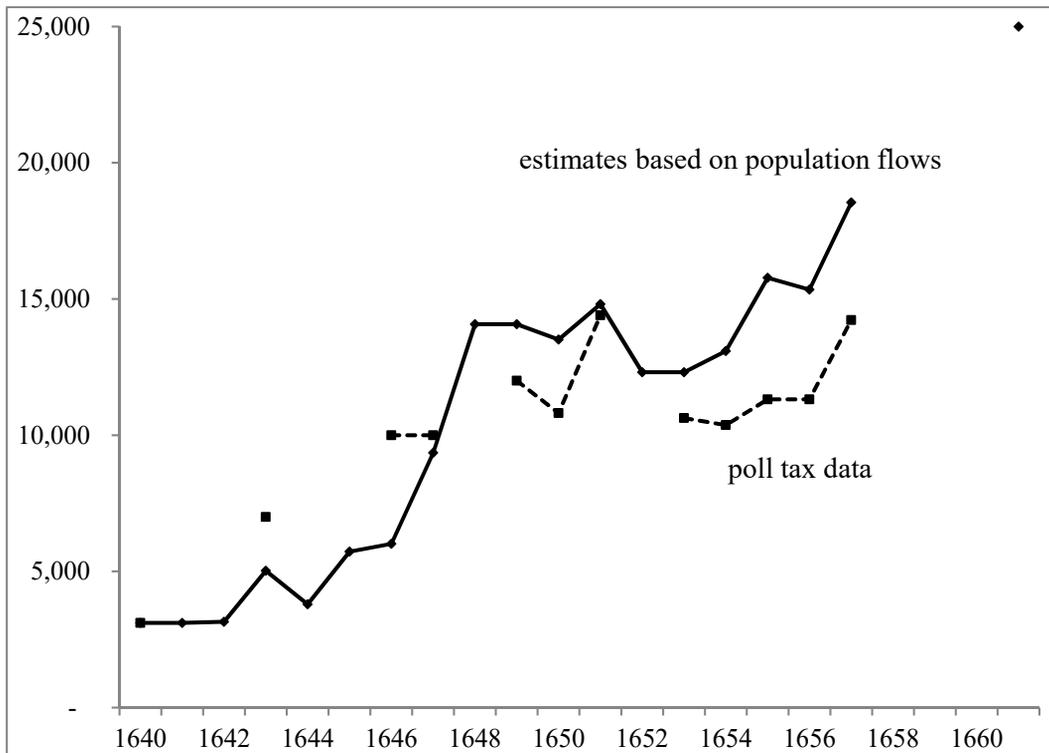


Figure 1. Estimated Chinese Population: 1640-1661

Note: See table 1 in the appendix for data.

to use the winning bid in May 1656 to estimate the population of that year. One month after the auction, Koxinga (a local ruler of Fukien who defeated the Dutch in Taiwan later in 1662) announced he would ban traffic across the Taiwan Strait and ordered residents in Taiwan to return to China in 100 days.²⁴ This caused some Chinese departure. Moreover, in October of the same year, a flood during a typhoon caused Chinese casualties ranging between 800 and 1,000. All these factors made Chinese population much lower than what the auction bidders had originally expected. In fact, in answer to the winning bidder's petition, the Dutch agreed to adjust the winning bid downwards from 3,990 reales to 3,300 reales.²⁵ While Chiang uses the original bid to estimate the population in 1656, we use the adjusted one. For the population in 1657, Chiang changes to use some other

²⁴ *DZ, Deel IV: 1655-1662*, pp. 80-81.

²⁵ VOC 1218, f.468v, letter from Frederick Coyett to Joan Maetsuijcker, Tayouan, 27 December 1656; Shu-shen Chiang, "Population Changes in Dutch Colonial Taiwan," pp. 20-21.

method for estimation. To present the data in a consistent manner, we stick to the winning bid of that year.²⁶

To have a robust check on the above estimation, we adopt a second approach which makes use of the number of Chinese arrivals and departures meticulously recorded in the Dutch diaries. Let N_t , A_t , D_t be the initial population, the number of new arrivals and the number of departures in year t , the population at the beginning of year $t+1$ could be calculated as follows:

$$N_{t+1} = N_t + A_t - D_t$$

From the poll tax data, the Chinese population in 1640 was 3,122. With this as an initial value, population in later years could be calculated in a recursive manner by applying the formula above. The result is also presented in figure 1. When the diaries are missing, we assume the net flow to be zero. In this case, population in adjacent years will be shown leveled such as from 1640 to 1642. An exceptional treatment is made for 1652, the diary of which year is completely missing. Because a large revolt took place in September 1652, and around 2,500 Chinese were killed,²⁷ we assume the Chinese population dropped by 2,500 that year. The diaries are missing from March 1658 to February 1661. According to the last Taiwan Governor, Frederic Coyet, a large number of Chinese migrated to Taiwan between 1658 and 1659, and at the end of the Dutch era, the Chinese able-bodied men reached 25,000.²⁸ Apparently the net flows in this period are not zero, so figure 1 does not provide any number for these years and only marks the population in 1661 as Coyet suggested.

As seen in figure 1, results by both approaches suggest a fast population growth between 1644 and 1648 and after 1654. On the other hand, the male population of Fukien Province in 1661 was about 1.46 million. So only 2% of them chose to settle in Taiwan. Even when we restrict our attention to Ch'üan

²⁶ There is another minor difference between this paper and Shu-shen Chiang, "Population Changes in Dutch Colonial Taiwan". While Chiang, Shu-shen considers the tax of 3,890 reales between September 1640 and February 1641 to be a revenue for 6 months, and estimates the population to be 2,593 ($= [3,890/6]/0.25$), we find in J. A. van der Chijs, ed., *Dagh-register Gehouden int Casteel Batavia vant Passerende daer ter Plaetse als over Geheel Nederlands-India* (abbreviated hence *DB*), 1640-1641 (The Hague: Martinus Nijhoff, 1887), p. 266 that this is actually a revenue for 5 months. So we recalculate the population in 1640 to be 3,112.

²⁷ Hui-wen Koo, "Weather, Harvests, and Taxes: A Chinese Revolt in Colonial Taiwan," pp. 39-59.

²⁸ Frederik Coyet, *Neglected Formosa* (trans. from *t Verwaerloosde Formosa*), ed., Inez de Beauclair (San Francisco: Chinese Materials and Research Aids Service Center, 1975), pp. 20-21.

Chou Fu and Chang Chou Fu, two prefectures in Fukien that were closest to Taiwan, the population of these two prefectures already reached 183 thousand in 1644 and 241 thousand in 1571, respectively,²⁹ of which migrants to Taiwan accounted for a mere 6%. So migrants to Taiwan were a small minority whose social and economic background could differ largely from the general Fukienese population. We expect that except for a few Chinese migrants' leaders, most migrants came from the poorest bottom 6% whose opportunity cost to move was the lowest. This conjecture is supported by a statement by the Governor-General in Batavia (the VOC's Asian headquarter; nowadays Jakarta), Hendrick Brouwer, who once reported that the migrants to Taiwan were a large number of poor Chinese.³⁰

(2) Farm Land

At the latest in 1644, the Company surveyed the farm land area in Saccam, the most important agricultural area then in Taiwan. The surveyors stayed in Taiwan till the end of the Dutch era, and some of them even helped Koxinga to measure land. Unfortunately, most of the original survey reports are missing, and only the reports of 1647, 1650 and 1654-1656 survived.³¹ To have a full picture of the land development, we complement the survey reports with data found in diaries and the Company's correspondence.³² The result is presented in figure 2.

²⁹ Fu Chien Shêng Ch'ing Tzu Liao K'u [Database of Fukien Province's State of Affairs] at the following website: <http://www.fjsq.gov.cn>, accessed 15 November, 2012.

³⁰ W. Ph. Coolhaas, ed., *Generale Missiven van Gouverneurs-Generaal en Raden aan Heren XVII der Verenigde Oostindische Compagnie* (abbreviated hence *GM*), *Deel II: 1639-1655* (The Hague: Martinus Nijhoff, 1964), pp. 519-520.

³¹ *DZ, Deel II: 1641-1648*, p. 318; Philippus Daniel Meij van Meijenstein, *The Diary of Philippus Daniel Meij van Meijenstein*, trans., Shu-shen Chiang (Taipei: Echo Publishing, 2003), pp. 50-51; VOC 1164, f.412, land survey report, Tayouan, September 1647; VOC 1176, f.791-792, land survey report; VOC 1207, f.724, land survey report, 1654; VOC 1213, f.553, land survey report, 1655; VOC 1218, f.458, land survey report, 1656; Takashi Nakamura, "Agriculture and Its Promotion in Dutch Colonial Taiwan," in Kaim Ang and Wu Micha, eds., and trans., *Research on Taiwanese History under the Dutch Rule, Vol. 1: Overview and Industry* (Taipei: Daw-Shiang Publishing, 1997), pp. 56-59.

³² For 1648, we only found the taxable rice fields. The area of tax-free rice fields remains unknown. Sources for figure 2 other than land survey reports include J. de Hullu, ed., *Dagh-register Gehouden int Casteel Batavia vant Passerende daer ter Plaetse als over Geheel Nederlandts-India, 1644-1645* (The Hague: Martinus Nijhoff, 1903), p. 173; VOC 1160, f.162, letter from Francois Caron to Cornelis van der Lijn, Tayouan, 31 January 1646; VOC 1182, f.99, report by Willem Verstegen, Batavia, 20 January 1652; Pieter van Dam, *Beschryvinge van de Oostindische Compagnie, Vol. 2: 1* (The Hague: Martinus Nijhoff, 1931), p. 712; Frederik Coyet, ed., Inez de Beauclair, *Neglected Formosa*, p. 25.

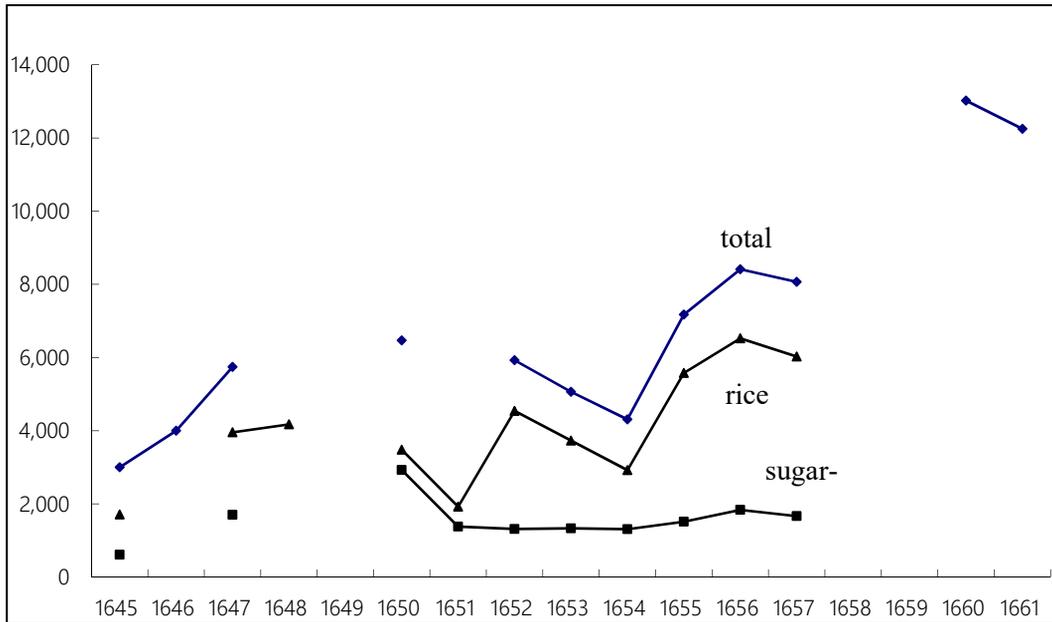


Figure 2. Farm Land (morgen): 1645-1661

Note: See table 2 in the appendix for data.

Rice and sugarcane were the main crops which accounted for 98% of total farm land. Other crops included potato, fruit trees, beans, oilseeds, indigo, hemp etc. To develop a sugar industry in Taiwan, the Company could not afford to ignore rice as a rivalry crop to sugarcane. Considering the good market for rice in 1648, Taiwan Governor, Pieter Anthonisz. Overtwater, raised the purchase price of sugar from 3-4.25 reales per picul (=125 pounds; 100 catties) in the previous year to 5.25-5.75 reales per picul.³³ Governor-General in Batavia, Cornelis van der Lijn, suggested to raise the sugar price further to encourage the Chinese to plant sugarcane. He was afraid that the Chinese would switch to more profitable crops like rice or beans, and sugar production in Taiwan would then come to a full stop.³⁴

Between 1650 and 1654, the farm land decreased. It echoes the decrease of

³³ The conversion rate between a picul and a pound varied across places. The weight of one picul ranged from 120 to 125 pounds. Though in most places one picul weighed 125 pounds, in Taiwan and Batavia, it weighed 122 pounds. Since this paper deals with sugar markets world-wide, we choose the most common conversion rate. For details, see Marc Kooijmans and Judith Schoonveld-Oosterling, *VOC-Glossarium: Verklaringen van Termen, Verzameld uit de Rijks Geschiedkundige Publicatie die Betrekking Hebben op de Verenigde Oost-Indische Compagnie* (Den Haag: Instituut voor Nederlandse Geschiedenis, 2000), p. 91.

³⁴ Shaogang Cheng, *De VOC en Formosa, 1624-1662*, pp. 302-303.

population depicted in figure 1. The Dutch reported once in 1651 that many Chinese landlords fell into poverty. Being unable to pay up their debts, some of them fled on ships, and others were arrested and imprisoned. This caused the farm land to decrease significantly.³⁵ The Chinese revolt in 1652 and the resultant casualties must also have affected agriculture adversely. On the other hand, the farm land had a substantial growth from 1654 to 1660 in tandem with the population growth depicted in figure 1.³⁶

3. Sugar Production and Its Exports

The sugar output was regularly reported by the Governor-General to the Company's directors of the board in Amsterdam (or Gentlemen Seventeen), and can be easily compiled from the Governor-General's reports, *Generale Missiven*. On the other hand, we do not find consistent reports of exports, and have to work out a different research strategy for export data. At that time, Taiwan's sugar was exported to the Netherlands, Persia, Japan and China. Because the accounting books (*Negotie Journalen*) in the Japan Factory are well in order, we could use import records kept in Japan to study the export of Taiwan's sugar there.³⁷ For other markets, we consult ship invoices (*facturen*), diaries and correspondence.³⁸

³⁵ VOC 1183, f.853, letter from Willem Versteegen to Carel Reniers, Tayouan, 24 October 1651; *DZ, Deel III: 1648-1655*, pp. 269-270.

³⁶ The significant increase of farm land from 1657 to 1661 should have had nothing to do with a planned expansion of cane cultivation because from figure 3 of this paper, sugar outputs did not have a corresponding increase.

³⁷ Similar attempts are made by Yoko Nagazumi, "Formosan Trade in the Seventeenth Century: With Dutch Sources," trans., Shih-feng Liu, in Shi-yeoun Tang, ed., *Essays in Chinese Maritime Development History, Vol. 7: 1* (Taipei: Sun Yat-Sen Institute for Social Sciences and Philosophy, Academia Sinica, 1999), pp. 37-57; Keisuke Yao, "Two Rivals on an Island of Sugar. The Sugar Trade of the VOC and Overseas Chinese in Formosa in the Seventeenth Century," in Leonard Blussé, ed., *Around and about Formosa: Essays in Honor of Professor Ts'ao Yung-ho* (Taipei: Ts'ao Yung-ho Foundation for Culture and Education; SMC publishing Co., 2003), pp. 129-149, but they did not make use of ledgers (*Grote Boeken*). This paper uses ledgers in addition to *Negotie Journalen* to ensure accuracy, and there is some minor difference between our data and theirs.

³⁸ Similar research attempts have been made before. We check through all literature and compare our results with theirs to make sure better and more complete data are presented here. The previous literature includes Seiichi Iwao, "Exports of Sugar and Tea from Taiwan to Persia Three Hundred Years Ago," *Nan Pou Do Ku (Local Customs in the South)* (Taipei) 2: 2 (Apr. 1933), pp. 9-28; Shaogang Cheng, "Chinese Sugar Production and Its Trade in the First Half of the Seventeenth Century," *Journal of Chinese Social and*

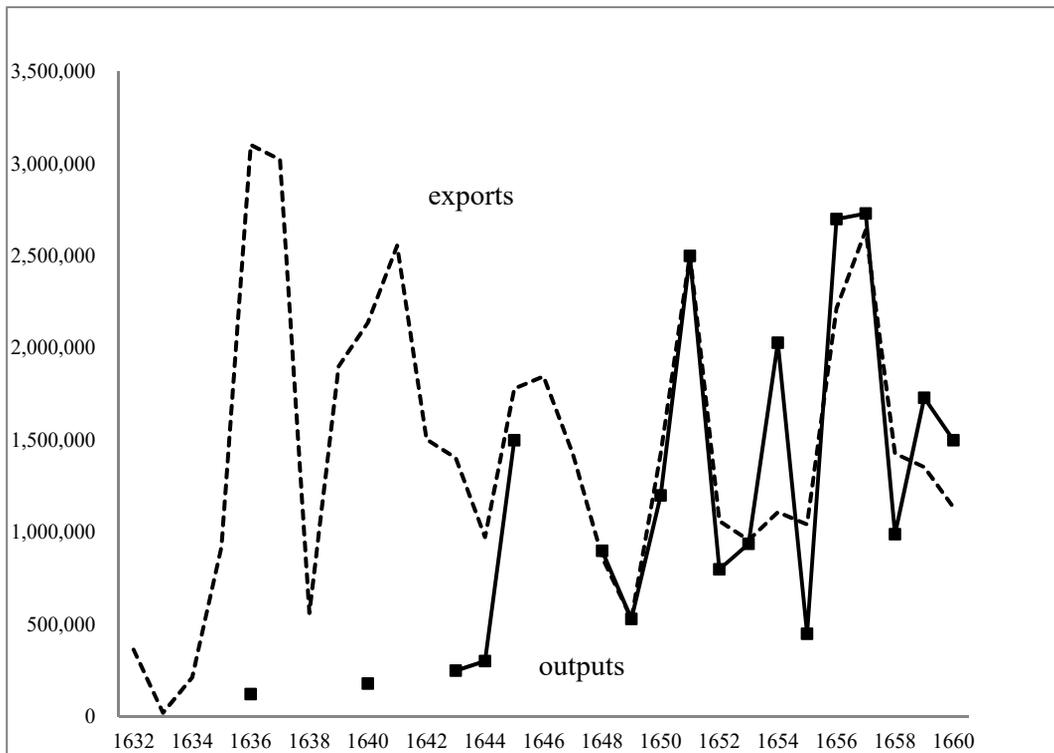


Figure 3. Sugar Outputs and Exports (catties): 1632-1660

Sources: See table 3 in the appendix.

Admittedly, exports compiled in this way may have errors when a shipping invoice is missing and the associated exports are not mentioned in other existing documents. However, since our export data trace closely the output data, the result is to a certain extent reliable.

Figure 3 depicts outputs and exports. The output data show an increasing trend with a lot of zigzags, thanks to natural hazards like droughts, frost and locusts. Reports of locusts were made between 1653 and 1655. The hazard was the most severe in 1654 when locusts covered the sky and it became dark in the daylight. All the tips of cane were eaten up by locusts and both the Dutch and the Chinese offered prize money to catch locusts. This yielded an abnormally low sugar output in 1655.³⁹

Economic History (Xiamen) 1994: 2 (1994), pp. 29-46; Wei-sheng Lin, "Taiwan's Sugar Trade in Dutch Colonial Era," in Su-chuan Chan, Lung-chieh Chang, and Shu-min Chung, eds., *Conference Proceedings: Celebration of Mr. Ts'ao Yung-ho's Eightieth Birthday* (Taipei: Lexis Book, 2001), pp. 7-29.

³⁹ *DZ, Deel IV: 1655-1662*, pp. 341, 354-355.

In the early years, outputs were much smaller than exports. It implies that the Company still relied heavily on the Chinese sugar for a re-export. In 1645, sugar output increased to such a high level that almost satisfied the trading needs of the Dutch. The Chinese merchants were advised not to send in any more sugar futilely because their sugar would be refused and returned.⁴⁰ In the same year, the Chinese started to export cane juice to China, but sugar itself was, for the time being, restricted to be the Company's trading good.

4. Markets

Figure 4 decomposes sugar exports to different markets. Considering the heavy transportation cost in the 17th century, one would imagine that sugar, the bulky good, would not be sent far away. But contrary to our intuition, before the mid-1650s, the export quantity increased with distance. The Netherlands was the

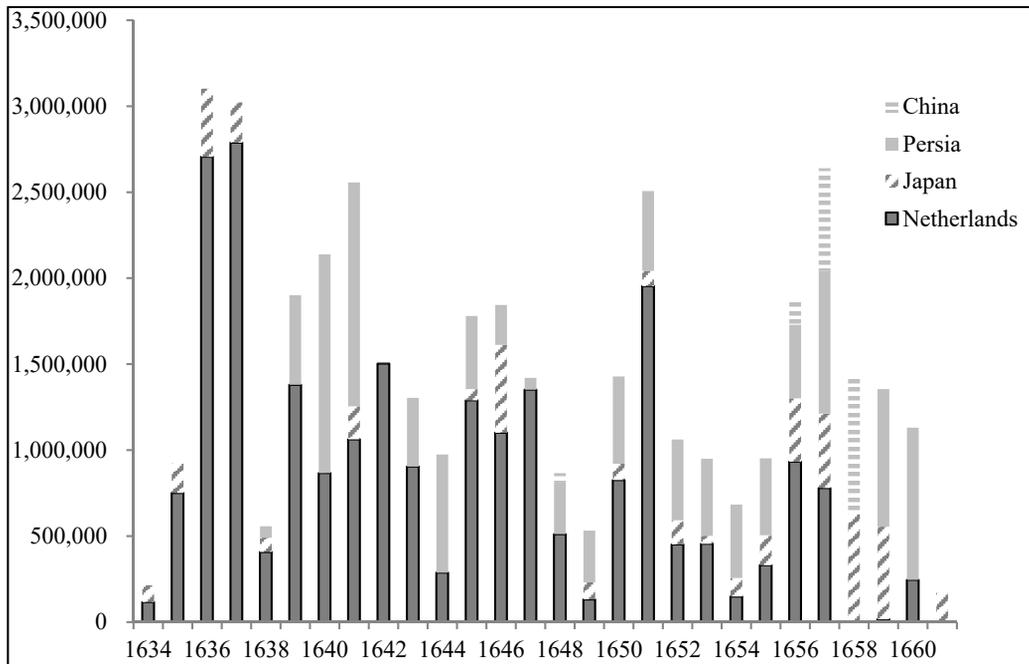


Figure 4. Sugar Exports to Different Markets (cattiees)

Sources: See table 3 in the appendix.

⁴⁰ VOC 1149, ff.842-843, letter from Francois Caron to Cornelis van der Lijn, Tayouan, 25 October 1645.

most important market for Taiwan's sugar. Persia came as the second, Japan the third, and from 1656 onwards, after Gentlemen Seventeen lost interest in Taiwan's sugar, a large amount was shipped to China. That is, the sugar trade between Taiwan and China changed directions.

This result pretty much reflects the relative magnitude of demand from different markets. Each year, the VOC's factories, colonies and the headquarter in Amsterdam sent to Batavia lists of goods (*eijzen*) that they demanded from other places. There was a time lag between the time the order was placed and the time the cargo finally arrived. For instance, in August 1648, considering the concurrent market in Europe, Gentlemen Seventeen sent out an order for goods to be shipped home in 1650. Figure 5 depicts such demands for Taiwan's sugar from different markets, and the data for year t refers to the amount to be received in year t . Before the mid-1650s, demand from the Netherlands outweighed all other places, Persia was the second important market to Taiwan, and compared to them, demand from Japan was negligible except in the mid-1630s.

We have to clarify that demand from the Netherlands was meant for sugar from the East Indies in general. However, in most of the time, it simply meant sugar from China and Taiwan. For instance, in September 1637, observing a high price of sugar in Amsterdam, Gentlemen Seventeen asked for unlimited quantities of the best Chinese white candy sugar, loaf-sugar (*broodsuyckeren*) and powder sugar. If the supply from China was sufficient, it was advised that sugar from Bengal and Bantam should not be sent over because their prices were much higher and their quality was lower, and the brown sugar from Siam was asked not be sent at all.⁴¹ Similarly in other years, it was often specified that the demand was meant for sugar from China and Taiwan. The exceptional case was from 1661 to 1663 when white powder sugar from Taiwan and Batavia was both asked for.⁴² So by and large, the Dutch demand for Asian sugar depicted in figure 5 mainly reflects demand for sugar from China and Taiwan.

Figures 4 and 5 do not match perfectly. Sometimes the shipment fell short of the demand. This could be due to insufficient output, or shipping capacity

⁴¹ J. J. Reesse, *De Suikerhandel van Amsterdam, van het Begin der 17de Eeuw tot 1813: een Bijdrage tot de Handelsgeschiedenis des Vaderlands, Hoofdzakelijk uit de Archieven Verzameld en Samengesteld* (Haarlem: J.L.E.I. Kleynenberg, 1908), p. 161.

⁴² The VOC lost Taiwan in 1662, and the demand for Taiwan's sugar afterwards seemed senseless, but when placing the order in September, 1661, Gentlemen Seventeen was not aware of the approaching crisis in the East Indies.

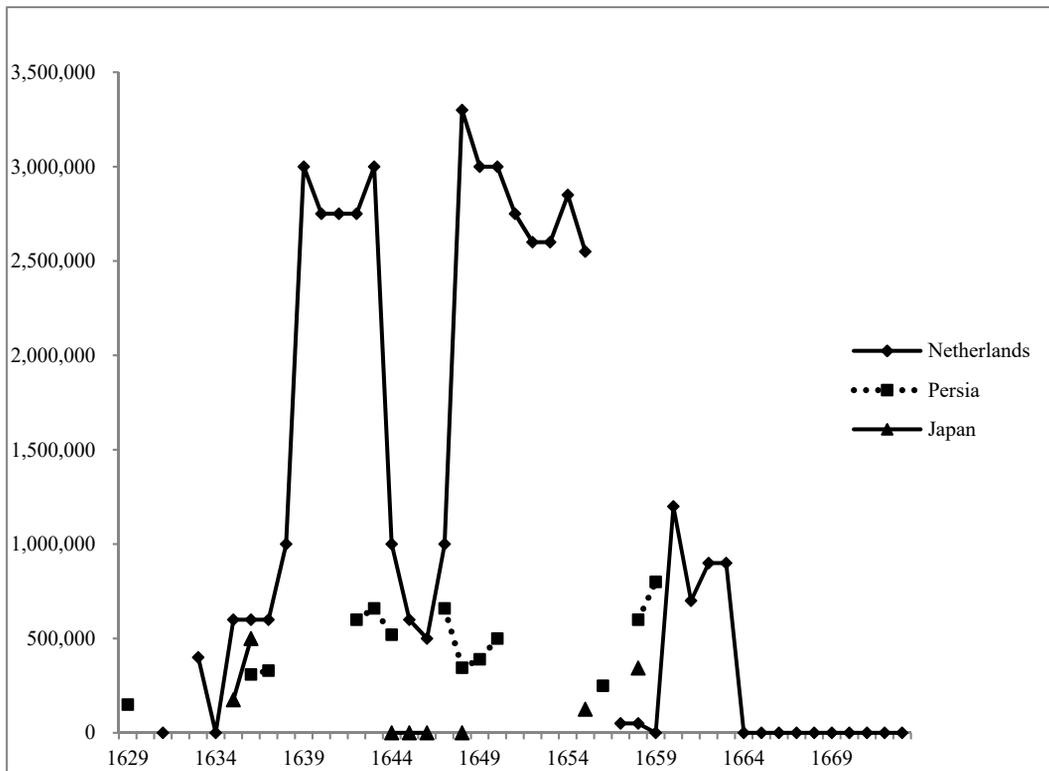


Figure 5. Demand for Sugar from Taiwan and China (pound)

Note: (1) The time lags between the time the order was placed and the time the cargo was expected to arrive differed among these markets. In year t , Persia and the Netherlands would place their demand for goods to arrive in year $t+1$ and $t+2$, respectively. In the figure, the data point for 1648 means sugar expected to receive in 1648. The same applies to other years. (2) For those years when unlimited quantity of powder sugar was asked for, we assume the demand to be 3 million pound, a little higher than the maximum of demand for powder sugar in other years which was 2.75 million pound.

Sources: See table 4 in the appendix.

constraints. For instance, in 1646, sugar exported to Persia was less than half of the amount of the previous year, and it did not fulfill the demand of Persia Factory. According to Taiwan Governor, Pieter Anthonisz. Overtwater, the supply was bountiful, but because copper from Japan also needed to be forwarded to Persia, there was not enough cabin room to carry all the sugar. Actually, the Company decided to build a new warehouse that year in Taiwan to store unshipped sugar and deerskins.⁴³ On the other hand, when there was extra sugar, Taiwan Governor

⁴³ VOC 1163, f.297, letter from Pieter Anthonisz. Overtwater to Wolbrandt, Tayouan, 29 November 1646; *DZ, Deel II: 1641-1648*, p. 535.

would attempt to force sales to other factories. For instance, while only 1,000 picul sugar was demanded by the Japan Factory for 1656, Taiwan Governor, Cornelis Caesar, sent 3,688 piculs instead, because he thought that sugar lying vainly in warehouse did not contribute to accumulation of capital.⁴⁴ Such a scheme did not always work out. When the ship *Sperwer* carried 920 picul sugar to Japan in 1653, because it exceeded the requested shipment, the cargo was refused and returned to Taiwan and then sent to Persia and Surat instead.⁴⁵

Despite the discrepancies between figure 4 and figure 5, exports are still related to demands by and large, and we could try to understand sugar trade in different markets based on the demands depicted in figure 5. The trade theory dictates that the larger the difference between trading parties' preferences or production capabilities, the larger benefit will be obtained from the trade. It follows that the place most far away from the sugar production site has the keenest interest in procuring sugar. The theory helps explain the relative strength in demand depicted in figure 5.

The Company did not have a monopoly in any of these markets. Figure 6 depicts the amounts of sugar shipped to Japan by the VOC and the Chinese junks. Apparently, Chinese merchants played a more dominant role in Japan's sugar market. Besides sugar from China, they also imported sugar from Cochin China, Quinam and Siam.⁴⁶ Taiwan's sugar hence had to compete in Japan with sugar from China and Indochina. The Dutch always had to speculate about the supply by the Chinese to predict the sugar price in Japan. The guess sometimes went astray. For instance, in 1656, based on his intelligence report that the sugar price in China went high as 12 tailen per picul,⁴⁷ Taiwan Governor, Cornelis Caesar,

⁴⁴ VOC 1213, f.462, letter from Leonard Winninx to Cornelis Caesar, Nagasaki, 19 October 1655; VOC 1218, f.4, letter from Cornelis Caesar to Joan Maetsuijcker, Tayouan, 20 November 1656.

⁴⁵ VOC 1197, f.783, letter from Cornelis Caesar to Joan Maetsuijcker, Tayouan, 24 October 1653.

⁴⁶ Leonard Blussé and Cynthia Viallé, trans. and eds., *The Deshima Dagregisters: Their Original Tables of Contents* (abbreviated hence *DD*), *Vol. XI: 1641-1650* (Leiden: Leiden Centre for the History of European Expansion, 2001), pp. 169, 234; Leonard Blussé and Cynthia Viallé, trans. and eds., *The Deshima Dagregisters: Their Original Tables of Contents* (abbreviated hence *DD*), *Vol. XII: 1650-1660* (Leiden: Centre for the History of European Expansion, 2005), p. 105.

⁴⁷ Before 1666, VOC's employees at Japan factory converted 1 tail to 57 Dutch stuivers (=0.05 guilder). After that, they were instructed to convert 1 tail to 70 stuivers, but at the same time, the Chinese tail was considered to be worth 80 stuivers. See Marc Kooijmans and Judith Schoonveld-Oosterling, *VOC-Glossarium: Verklaringen van Termen, Verzameld uit de Rijks Geschiedkundige Publicatie die Betrekking Hebben op de Verenigde Oost-Indische Compagnie*, p. 112.

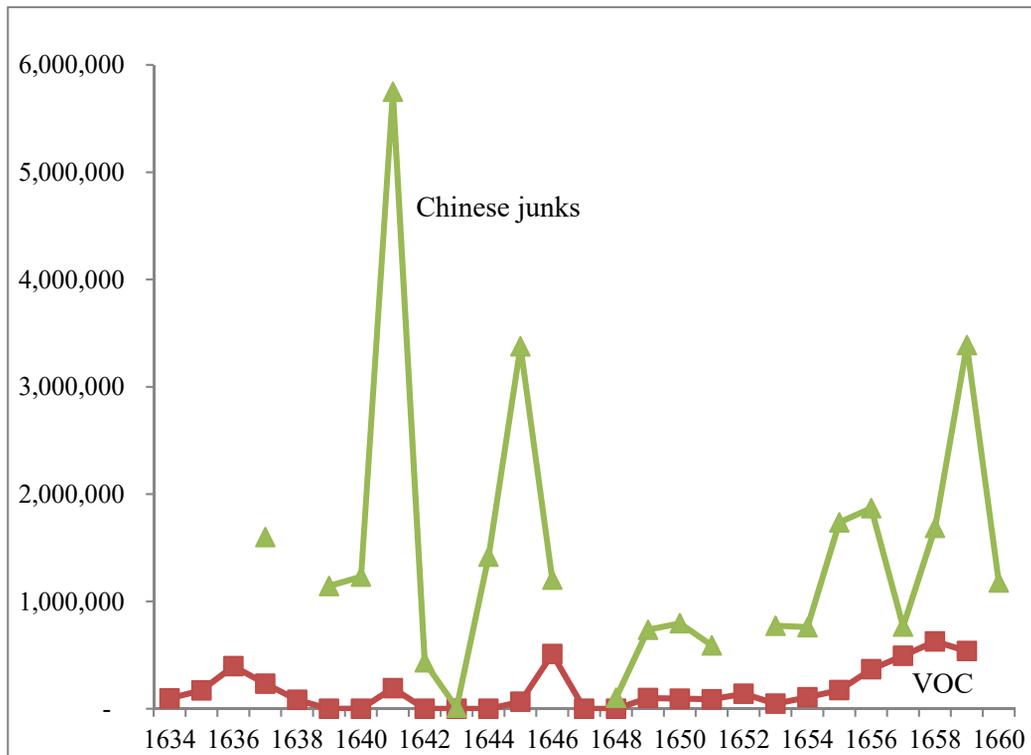


Figure 6. Sugar brought to Japan by the VOC and the Chinese (cattie)

Sources: See table 5 in the Appendix.

concluded that not much of Chinese sugar would be sent to Japan and hence delivered 3,688 picul Taiwan's sugar to Japan with an expectation of a high price there. It turned out that Fukienese merchants dispatched 25 junks carrying 18,000 picul sugar to Japan that year, and the sugar price ended up in the range of 6.71-8.36 tailen per picul instead.⁴⁸

In Persia, the Dutch faced competition from private English merchants as well as from Indian and other Asian traders.⁴⁹ Supplies by other merchants would

⁴⁸ Shaogang Cheng, *De VOC en Formosa, 1624-1662*, p. 455; VOC 1218, f.110, resolution, Tayouan, 26 June 1656; VOC 1218, ff.370, 380, 383, letters from Cornelis Ceasar to Joan Boucheljon, Tayouan, dated on 8 July, 24 August and 21 October 1656, respectively.

⁴⁹ Om Prakash, *The Dutch East India Company and the Economy of Bengal, 1630-1720* (Princeton, N.J.: Princeton University Press, 1985), p. 175; K. N. Chaudhuri, *Trade and Civilization in the Indian Ocean: An Economic History from the Rise of Islam to 1750* (Cambridge: Cambridge University Press, 1985), pp. 207-208, points out that by the 10th century, many regions of Islam were fully integrated into a structure of distant economic exchange, and Middle Eastern port-towns received a substantial volume of imports from the coastal regions of India.

check the demand for Taiwanese sugar. In 1640 and 1641, sugar exported from Taiwan to Persia amounted to about 13,000 piculs in a year. It dropped suddenly to 10 piculs in 1642, due to a decrease in the demand from Persia. Taiwan Governor, Paulus Traudenius, wrote in 1642 to the Company's employee in Persia, Solbrant Geleijnsz., to complain about the decrease in demand and wished it to increase to the previous level in the future.⁵⁰ The demand did increase, but Taiwan never exported sugar to Persia at the same level of the early 1640s. Aside from competition that the Dutch faced, the Company itself also decided to send Persia sugar from other places than Taiwan. For the period from 1647 to 1649, Persia Factory's demand for Bengal's sugar even exceeded its demand for Taiwan's sugar. In the following, we shall focus on the most important market, the Netherlands, and study how fluctuations of its demand affected sugar production in Taiwan.

Before the Company occupied Taiwan, Gentlemen Seventeen already expressed their interest in sugar in the East Indies. They once ordered in 1616 that ships idle in Asia should return to the Netherlands and carry home sugar or other goods at hand.⁵¹ In 1619, they asked for candy sugar in the East Indies if the price was reasonable. On the other hand, powder sugar was considered as a ballast. If there was good white powder sugar, the ship was suggested to be completely ballasted with sugar (rather than stone). And sugar must be placed at the bottom, otherwise when it melted and dripped, other goods became spoilt.⁵²

Gentlemen Seventeen's interest in sugar from the East Indies was closely related to the sugar price they observed in Amsterdam. For instance, in 1637, when asking for 25,000-30,000 picul Asian sugar, they explained clearly that the large demand was due to an increase in local sugar price of 0.175 guilder per pound. To understand their demand over time, we depict prices of Brazilian white sugar in Amsterdam in figure 7.

The figure shows a surprising result that the sugar price in Amsterdam was high during the period that the Dutch West India Company (*West-Indische*

⁵⁰ VOC 1146, f.758, letter from Paulus Traudenius to Wollebrandt Geleijnszen, Tayouan, 12 November 1642.

⁵¹ J. J. Reese, *De Suikerhandel van Amsterdam, van het Begin der 17de Eeuw tot 1813: een Bijdrage tot de Handelsgeschiedenis des Vaderlands, Hoofdzakelijk uit de Archieven Verzameld en Samengesteld*, p. 160.

⁵² Pieter van Dam, *Beschryving van de Oostindische Compagnie, Vol. 1: 2* (The Hague: Martinus Nijhoff, 1929), p. 134.

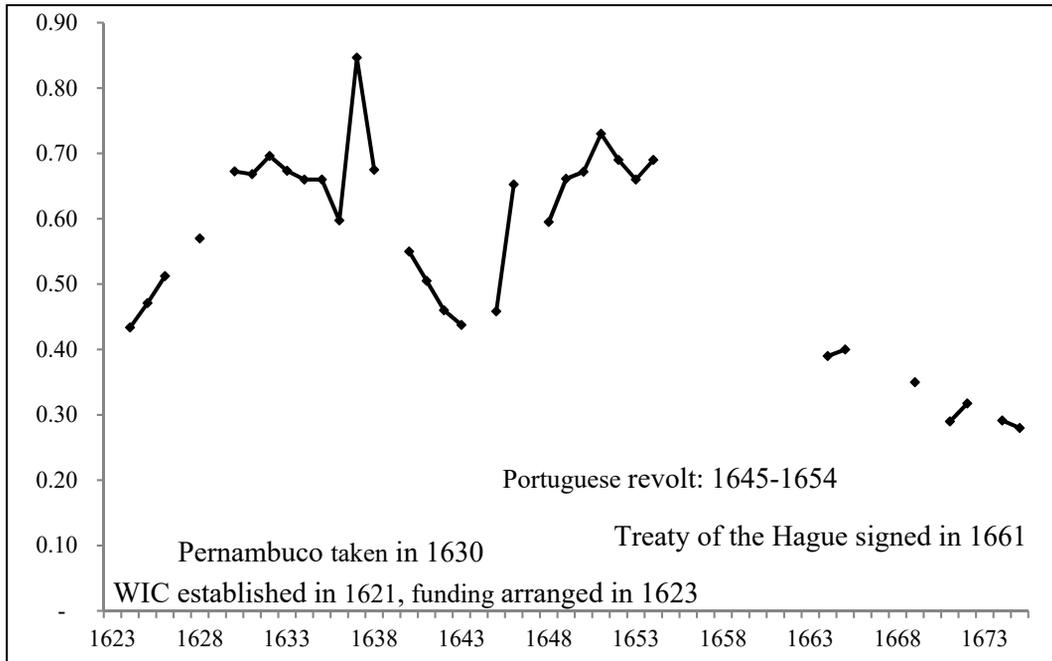


Figure 7. Prices of Brazilian White Sugar in Amsterdam (guilders/pound)

Sources: (1) See table 6 in the appendix for the data. (2) The historical events are cited from Wikipedia (Dutch West India Company and Dutch Brazil) and Leslie Bethell, ed., *Colonial Brazil* (Cambridge; New York: Cambridge University Press, 1987), p. 95.

Compagnie or WIC) occupied Brazil. To fight for its independence, the Netherlands started the eighty-year war with Spain in 1568. A truce for twelve years was signed in 1609. Because Portugal and Spain were allies, during the truce, the Dutch was allowed to trade with the Portuguese Brazil. When the truce ended in 1621, the WIC was established and one of its main objects was to continue obtaining sugar from Brazil. After raising funds in 1623, the WIC sent out a large fleet next year to invade Brazil. In 1630, it successfully took the most important place to produce sugar: Pernambuco, and after a series of successful battles, the Dutch occupied more than half of contemporary Brazil. Following the WIC's plan, after its invasion of Brazil, sugar supply at home should have increased and the sugar price should have decreased. However, invading Brazil did not bring down the sugar price at home. On the contrary, the sugar price started to increase after a series of military successes. In the period from 1624 to 1637, the price of Brazilian sugar doubled in Amsterdam. This is because during the period of the Dutch invasion, the burning of sugarcane field and sugar mills by both invaders and resisters put more

than one third of sugar mills in the region of Pernambuco out of operation.⁵³

Though the sugar price dropped after 1637 when the situation in Brazil stabilized, it increased again when the Portuguese sugar planters in Brazil revolted against the Dutch in 1645. The Dutch surrendered in 1654, and the peace treaty was not signed till 1661 in the Hague when the Netherlands formally ceded Brazil and Portugal paid an indemnity in return.⁵⁴ Ironically, the sugar price dropped after the Dutch surrendered and peace was restored in Brazil.

So, to our surprise, the establishment of the WIC and its invasion of Brazil did not bring a blow to sugar production in the East Indies. On the contrary, it stimulated demand for Taiwan's sugar. However, after the WIC's surrender, in 1655, Gentlemen Seventeen ordered merely 400 picul candy sugar from Batavia. Powder sugar was asked not to send any more unless it could not be sold in the East Indies. They also considered the purchase price of Taiwan's sugar too high, and asked to lower it to no more than 5 reales per picul.⁵⁵ In 1656, Gentlemen Seventeen again asked not to send any more sugar unless necessary. It was because the sugar price at home was very low as the market was full of sugar from Barbado, Caribbean Islands and Brazil.⁵⁶

5. The Company's Profit and Chinese Farmers' Income

(1) Prices

To understand the profitability of Taiwan's sugar, we have to first study both its sale price and its purchase price. The purchase price could be recovered in a systematic manner from the import records in the accounting books kept by

⁵³ Stuart B. Schwartz, "A Commonwealth within Itself: The Early Brazilian Sugar Industry, 1550-1670," in Stuart B. Schwartz, ed., *Tropical Babylons: Sugar and the Making of the Atlantic World, 1450-1680*, p. 166.

⁵⁴ Wikipedia: Dutch West India Company and Dutch Brazil.

⁵⁵ VOC 103, f.635, resolution in Amsterdam, 2 November 1655.

⁵⁶ VOC 104, ff.97-98, resolution in Amsterdam, 7 October 1656. For similar discussion, see Kristof Glamann, *Dutch-Asiatic Trade, 1620-1740* (The Hague: Martinus Nijhoff, 1958), pp. 157-159; Wei-sheng Lin, "Taiwan's Sugar Trade in Dutch Colonial Era," p. 20. Their source is J. J. Reesse, *De Suikerhandel van Amsterdam, van het Begin der 17de Eeuw tot 1813: een Bijdrage tot de Handelsgeschiedenis des Vaderlands, Hoofdzakelijk uit de Archieven Verzameld en Samengesteld*, p. CXIII.

the Japan Factory. On the other hand, the sales records in these accounting books give us the sale price of Taiwan's sugar in Japan.

Kristof Glamann compiles the sale price of sugar from the East Indies in Amsterdam.⁵⁷ It is the auction price of sugar when the Company sold cargoes in public at the arrival of their ships. For instance, in September 1632, all imported Chinese sugar was sold by the Company to a single buyer, Jan van Hoorn, at the price of 21 groot per pound.⁵⁸ Because Glamann's data are only up to 1637, to understand the sugar market in Amsterdam in the later period, in figure 8, we present the price of Brazilian sugar along with the price of sugar from the East Indies. In most of the overlapping period, Brazilian sugar seemed to fetch a higher price. But that does not imply sugar from the East Indies was cheaper, because the Brazilian sugar price was cited from Posthumus, N.W. who reported the monthly prices at the Amsterdam Produce Exchange,⁵⁹ while the East Indian sugar price was the auction price bid at ships' arrival. We expect that when the above mentioned Jan van Hoorn resold his sugar at the Produce Exchange, he would charge a price higher than his bid at the auction.

The sale price of Taiwan's sugar in Persia could be found in the price currents (*prijs-couranten*) prepared by the Company's local employees. The reports also showed prices of sugar sent by the Company from other places like Bengal, Lahore and Agra. To keep our presentation compact, we only show prices of sugar from Taiwan. There is a significant difference between the price reported at Gamron, a port, and the price reported at the inland capital, Spahan. Because data at Gamron are more complete, we choose to present prices at Gamron.⁶⁰

Figure 8 summarizes prices in all markets. It is clear that Taiwan's sugar fetched the highest price in the Netherlands and the lowest price in Japan. It explains why before the Brazilian revolt was over, the Netherlands was the most important market to Taiwan and Japan was the least important one as demonstrated in figure 4.

⁵⁷ Kristof Glamann, *Dutch-Asiatic Trade, 1620-1740*, pp. 153-154. His source is VOC 101.

⁵⁸ VOC 7346 (no folio number), resolution in Amsterdam, 28 September 1632. 1 groot = 0.5 stuiver.

⁵⁹ N. W. Posthumus, *Nederlandsche Prijs-geschiedenis, Deel I: Goederenprijzen of de Beurs van Amsterdam, 1585-1914; Wisselkoersen te Amsterdam, 1609-1914* (Leiden: E. J. Brill, 1943).

⁶⁰ The prices in 1624 and 1625 are indirectly cited from Pieter van Dam, *Beschryvinge van de Oostindische Compagnie, Vol. 2: 3* (The Hague: Martinus Nijhoff, 1939), p. 344. He did not explicitly state which markets he referred to. Since the VOC established its first factory in Persia in 1623 in Bandar Abbas which was close to Gamron [Arnold T. Wilson, *The Persian Gulf: An Historical Sketch from the Earliest Times to the Beginning of the Twentieth Century* (Oxford: Clarendon Press, 1928), p. 160], we assume van Dam referred to sugar prices in Gamron.

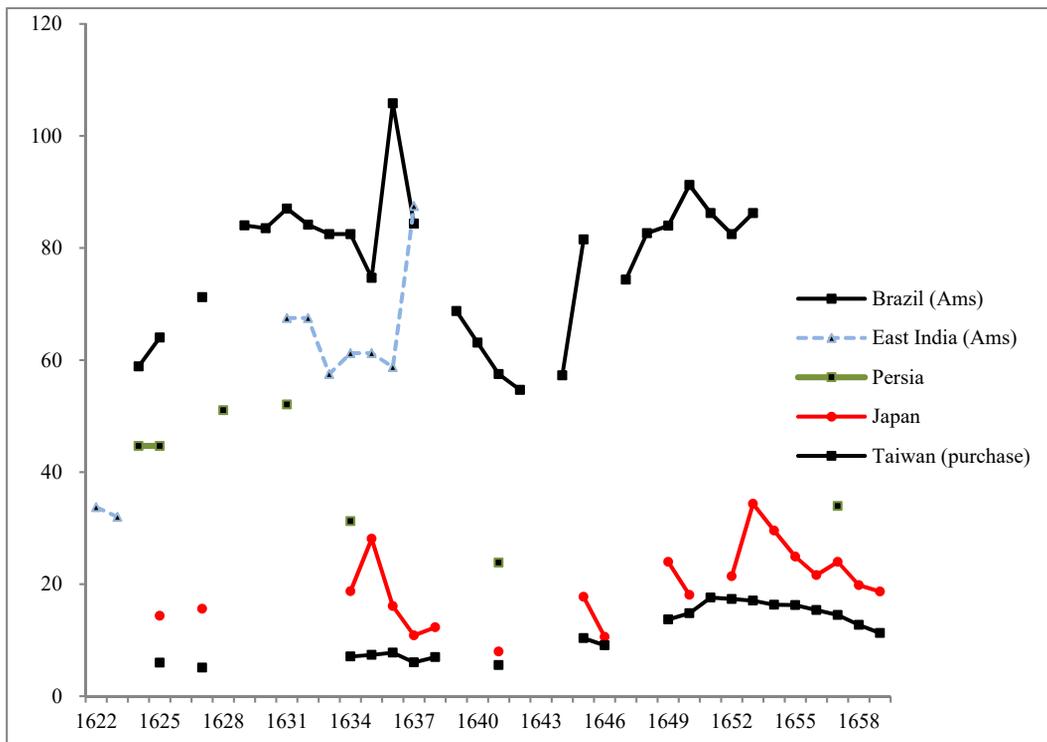


Figure 8. Sugar Prices (guilders/picul)

Note: The Persian prices were expressed in local currencies. We use the following exchange rates to convert them: 1 mamoe dijs = 8 stuijver = 0.4 guilder; 1 oury = 10 mamoe dijs; 1 larijn = 10 stuijver = 0.5 guilder.

Sources: See table 6 in the appendix.

(2) Profits

The data in figure 8 provide us a basis to assess profits of Taiwan’s sugar to the Company. The Company itself calculated a gross margin (*rendement, advance*) in the following simple manner:

$$\text{gross margin} = \frac{S-M}{M}, \tag{1}$$

where *S* stands for sales revenue and *M* stands for a commodity’s cost as recorded in the invoice (*factur*). The simple formula is criticized for not taking into account the transportation cost, the inventory cost, the operating cost of factories and

depreciation of ships.⁶¹ But to make our calculation comparable to the Company's limited records, we first use this simple formula to calculate the gross margin, and then consider how to estimate other ignored costs to derive a better margin. Suppose that the purchased sugar could be all sold out, and there was no loss of sugar in transportation. Formula (1) could then be expressed as follows:

$$\text{sugar's gross margin} = \frac{P_s * q - P_M * q}{P_M * q} = \frac{P_s - P_M}{P_M} = \frac{P_s}{P_M} - 1, \quad (2)$$

where P_s and P_M stand for sugar's sale price and purchase price, respectively; and q stands for the trading quantity.

After plugging data in figure 8 into formula (2), from 1634 to 1636, the gross margin of sugar from Taiwan in the Netherlands was between 696% and 1,023%.⁶² From 1625 to 1641, the gross margin in Persian was between 323% and 645%.⁶³ From 1625 to 1659, the gross margin in Japan varied wildly between 22% and 281%.

The gross margin in China has to be calculated in a different manner. Because the Company could not directly sell to China, it relied on Chinese merchants as middlemen. The receipts it had from Chinese merchants included sales revenue and export duties. For instance, in November 1656, Taiwan Governor and his Council decided that Chinese merchants could purchase brown sugar from the Company at the price of 5 reales per picul, and had to pay another 0.5 real per picul when exporting. White sugar which was of a better quality was not allowed to be shipped to China.⁶⁴ From the accounting records kept at the Japan Factory, the purchase price of Taiwan's sugar in 1656 ranged from 4.25 to 6.375 reales per picul. If the purchase price of brown sugar was 4.25 reales per picul, then the gross margin of sugar indirectly sold to China in 1656 was 29% ($= (5+0.5-4.25)/4.25$).

⁶¹ Kristof Glamann, *Dutch-Asiatic Trade, 1620-1740*, pp. 260-261; Ryuto Shimada, *The Intra-Asian Trade in Japanese Copper by the Dutch East India Company during the Eighteenth Century* (Leiden; Boston: Brill, 2006), p. 34.

⁶² We consider a one year time lag between purchase and sale. When calculating the gross margin for 1634, we consider the sugar was purchased in 1634 in Taiwan, and sold later in 1635 in Amsterdam.

⁶³ Theoretically, we should also consider a one year time lag for Persia. However, in our limited data set, there is no pair of Taiwan's purchase price and Persia's sale price that have exactly a one year lag. We are forced to use the purchase price and the sale price of the same year. So long as Taiwan's purchase price did not change drastically in two consecutive years, the error of our estimate is limited.

⁶⁴ VOC 1218, f.112r, resolution in Tayouan, 26 June 1656.

The calculation above certainly yields an overestimate of the profit because it ignores costs other than sugar's purchase prices. Fortunately, the accounting books kept by the Japan Factory shed some light to other costs incurred. Starting in 1649, the accounting books showed the cost of sugar chests (*kisten*) and from 1655 onwards, it included costs other than chests as well (*onkosten*). We assume these other costs refer to operating costs, e.g. personnel cost, associated with transactions of sugar. How to decide a fair transaction cost was always a challenge to accountants. In 1655, the Company took 3% of the sum of sugar's purchase price and costs of sugar chests as *onkosten*. The ratio then decreased to 1.5% in 1656 and 1% in 1658. For those years that the accounting books showed costs of chests and *onkosten*, the average cost of chest per picul sugar was 1.32 guilders and the average *onkosten* per picul sugar was 0.24 guilder. We shall use their sum, 1.56 guilders per picul, as the handling cost.

We do not find any accounting records about the transportation cost. However, in 1636, Gentlemen Seventeen once made an estimate of it. They considered to send a ship to Batavia to bring back 450,000 pound sugar in 20 months. 15% of sugar was estimated to be lost on the way. The crew's fee, provisions, and the ship's depreciation were estimated to amount to 30,000 guilders.⁶⁵ Suppose this was meant for costs of a round trip, then to ship sugar from the East Indies to Amsterdam would cost 4.17 ($= (30,000/450,000) * 125/2$) guilders per picul. We further assume transportation costs increase proportionally in distance. Considering the port to port distance between Taiwan and Nagasaki, Bandar Abbas and Amsterdam (via Batavia),⁶⁶ respectively, we calculate the transportation costs to be 0.31, 1.83 and 4.86 guilders per picul when Taiwan's sugar was shipped to Japan, Persia and the Netherlands. Regarding the loss on the way, for Japan, we simply cite the loss recorded in the accounting book. For the Netherlands, we follow Gentlemen Seventeen's suggestion and assume it to be 15%. We also assume that the loss increased proportionally in distance, and calculate the loss on the way to Persia to be 7%. After considering all these factors, we could calculate the net profit margin. For instance, the formula for the Netherlands is:

⁶⁵ Kristof Glamann, *Dutch-Asiatic Trade, 1620-1740*, p. 48.

⁶⁶ The port to port distance is cited from <http://www.searates.com/reference/portdistance>, accessed 15 November, 2012. Because Taiwan Port (current Anping) is no more an international port, we cannot find its distance to other international ports from the website. We use Kaohsiung, the international port very close to Anping, as a proxy.

$$\text{sugar's net profit margin} = \frac{85\% * P_s}{PM + 1.56 + 4.86} - 1. \quad (3)$$

According to formula (3), from 1634 to 1636, the net profit margin in the Netherlands was between 262% and 423%. From 1625 to 1641, the margin in Persia was between 148% and 342%. From 1625 to 1659, the margin in Japan was between -3% and 204%. If Chinese merchants were responsible for the packing of their purchased sugar, the margin to sell to Chinese merchants was 29% as previously calculated.

The profit margins in the Netherlands and in Persia in the early period are quite impressive. Glamann once compiled value of cargoes received from Asia and their sale revenue in the Netherlands from decade to decade.⁶⁷ Between 1639/40 and 1649/50, according to his numbers, the average (gross) profit margin was 176%, and these cargoes mainly consisted of spices and pepper. Compared to these articles, the performance of sugar from Taiwan in the early period was not inferior at all.

Because of our limited data, only margins in the early period could be calculated for Persia and the Netherlands. Figures 5 and 8 hinted that the margins in these two places should become much lower in the 1650s. In the case of the Netherlands, we already know that Gentlemen Seventeen lost interest in Taiwan's sugar when the Brazilian revolt ended. And for Persia, Governor-General in Batavia, Joan Maetsuycker, reported that the gross margin (as calculated by formula (1)) dropped to 96.75% in 1657.⁶⁸ If we consider transportation cost and other costs, the net margin should be 77%. In Japan, from 1654 to 1659, the margin was low between 22% to 30%, almost the same as the margin earned from the sales to Chinese merchants. It explains why after losing the market in the Netherlands, Taiwan's sugar was sent by and large equally to Persia, Japan and China.⁶⁹

⁶⁷ Kristof Glamann, *Dutch-Asiatic Trade, 1620-1740*, pp. 13-16.

⁶⁸ W. Ph. Coolhaas, ed., *Generale Missiven van Gouverneurs-Generaal en Raden aan Heren XVII der Verenigde Oostindische Compagnie* (abbreviated hence *GM*), *Deel III: 1655-1674* (The Hague: Martinus Nijhoff, 1968), p. 173.

⁶⁹ From figure 4, Taiwan continued exporting sugar to the Netherlands after 1655, though the quantity was not comparable to the quantity before the Portuguese revolt. Wei-sheng Lin, "Taiwan's Sugar Trade in Dutch Colonial Era," p. 20, also points out that after 1655, Taiwan's sugar was sent to Persia, Japan and China, but he ignores that in some years the Netherlands remained an important market.

(3) A Cane Farmer's Income

Our data also allow us to estimate a Chinese cane farmer's income. For those years that we know both the sugar purchase price and the sugar output, multiplying them yields the product value of Taiwan's sugar which was to be divided between Chinese mill owners and their hired farmers. The returns to mill owners were to compensate their provision of various capital goods including cattle, sugar mills, pots to boil cane juice, etc. In the Qing dynasty Taiwan, on average, a mill owner received half of sugar's product value.⁷⁰ Since the sugar production technology hardly changed from the Dutch era to the Qing dynasty, we assume that mill owners in the Dutch era also received about half of sugar's product value. So long as we know the number of cane farmers in the Dutch era, dividing half of the product value by the number will give us a cane farmer's income. Assuming that the proportion of cane farmers to the Chinese population is the same as the proportion of the cane field area to the total farm area, with our population data and farm land area presented earlier, we obtain an estimate of the population of cane farmers.

In our data set, only in the period from 1650 to 1657, variables mentioned above are all available. In this period, the estimated per capita income of cane farmers ranged from 4.44 reales to 25.15 reales. Since the sugar purchase price only changed from 6.04 reales per picul to 6.90 reales per picul, the huge fluctuations in income mainly resulted from the unstable productivity of sugarcane thanks to natural hazards. The poll tax in this period increased from 3 reales to 3.5 reales per person per year. When compared to the income, the poll tax was like an income tax at the rate from 14% to 79%.

According to Jan De Vries and Ad van der Woude, in the 1650's, among construction workers in the east Netherlands, a hod carrier had the lowest daily wage. It was 13 stuivers in 1650 and 14.4 stuivers in 1655. Suppose a hod carrier worked 307 days in a year, his annual income would be 3,991 stuivers and 4,421 stuivers in these two years. If we use the official exchange rate to convert 1 real to 48 stuivers, a Chinese cane farmer's annual income estimated above ranged from 213 stuivers to 1,207 stuivers, way below the income of a Dutch hod carrier. The food expenses of an orphan in the Dutch orphanage was estimated to

⁷⁰ Provisional Investigation Committee of Taiwan's Old Customs, *About Old Customs in Taiwan Sugar Industry* (Kobe: Provisional Investigation Committee of Taiwan's Old Customs, 1909), pp. 70-71.

be 767 stuivers in this period. So in a year of a bad harvest, a cane farmer's income could not even support the living of a Dutch orphan.⁷¹

It is not our intention to blame the VOC to exploit Chinese farmers to create an outrageous return. After all, unlike African slaves producing sugar in the West Indies, Chinese farmers came to Taiwan out of their own free will. Their choice revealed that if they stayed in Fukien, even less could be made. This conjecture could be backed up by Angus Maddison. According to his estimate, Chinese GDP per capita, expressed by 1990 international dollars, was 600 in both 1600 and 1700. On the other hand, the Dutch GDP per capita was 1,381 in 1600 and 2,130 in 1700,⁷² i.e. 2.30 and 3.55 times the Chinese one, respectively. Recall that Chinese migrants came from the bottom 6% of Fukien Province. Their income in Taiwan when the harvest was good, though still less than a third of a Dutch hod carrier's income, was already very close to the average income in China. That must have meant a significant gain to them.

Note that in our calculation, only farmers' income from sugar is considered. In case they had some sideline work and a supplementary income, their economic conditions surpassed our estimation. If we consider a Chinese coolie's income in Taiwan, we shall have some rough idea about a cane farmer's total income, earnings from his sideline work included. The daily wage of a Chinese coolie was 6 stuivers,⁷³ if he worked for a maximum of 307 days in a year, his annual income would be 1,842 stuivers. However, the VOC only had demand for these coolies on special occasions, for instance, when castles were constructed. So we cannot expect a Chinese coolie to have a steady annual income of 1,842 stuivers. Considering that a cane farmer could switch to be a coolie when the latter's income was higher (and vice versa), a farmer's income should be about the same as a coolie's income. Thus, a cane farmer's income should be more than our estimate, but no more than 1,842 stuivers which were still below the income of a hod carrier in the Netherlands.

⁷¹ After Calvinism prevailed in the Netherlands, in 1574, all holidays except Sunday and five religious holidays were abolished. It established a work year of 307 days. Pay records show labor routinely worked over 300 days in a year. Jan de Vries and Ad van der Woude, *The First Modern Economy: Success, Failure, and Perseverance of the Dutch Economy, 1500-1815* (Cambridge; New York: Cambridge University Press, 1997), pp. 612-613, 616-617, 625.

⁷² Angus Maddison, *Contours of the World Economy, 1-2030 AD: Essays in Macro-Economic History* (Oxford: Oxford University Press, 2007), p. 382.

⁷³ Pol Heyns, *Economy, Land Rights and Taxation in Dutch Formosa*, p. 145.

Next, we shall consider incomes of other contemporary occupations in Taiwan. The VOC also hired Chinese skilled labor, like carpenters or bricklayers, whose wage doubled that of a coolie.⁷⁴ If they worked a maximum of 307 days, their annual income would be 3,684 stuivers per capita which was still lower than, but comparable to, the lowest income of a construction worker in the Netherlands. A soldier received monthly 9 guilders from the VOC when in Taiwan. This accounted for half of his salary, and he would receive the remaining half when returning to the Netherlands.⁷⁵ Without time discounting, a VOC soldier's annual income would be 4,320 stuivers ($= 9 \times 12 \times 2 \times 20$), higher than a Chinese skilled labor. In sum, a cane farmer probably earned the lowest income in Taiwan: half the income of a Chinese skilled labor and even less than a Dutch soldier.

6. Conclusion

The VOC came to Taiwan when sugar from the West Indies was in a short supply and the Company keenly sought for an alternative supply from Asia. Taiwan became a natural sugar colony since Fukienese farmers across the Strait were experienced sugar producers, and famine and China's civil wars pushed poor farmers to migrate to Taiwan. With encouragement from the VOC, from 1640 to 1661, the Chinese population in Taiwan increased from 3 thousands to 25 thousands, and from 1645 to 1661, the farm land increased from 3 thousand morgen to 12 thousand morgen. While the Chinese worked in the cane-field and sugar mills, the Dutch was responsible for the marketing and transportation of sugar. Our study suggests that Chinese migrants made a significantly better living in Taiwan than in China. However, the VOC was even a bigger winner since their net profit margins reached 300% or even 400%. As the Brazilian revolt ended and Brazilian sugar flooded the European market in the mid-1650s, the Company lost interest in sugar from the East Indies. Persia, Japan and China then became main markets for Taiwan's sugar.

The development of the sugar industry was not a win-win situation for everyone. Aggressive agriculture development by joint efforts of the Dutch and the Chinese encroached habitats of wildlife and in some places native hunters

⁷⁴ Pol Heyns, *Economy, Land Rights and Taxation in Dutch Formosa*, p. 145.

⁷⁵ Pol Heyns, *Economy, Land Rights and Taxation in Dutch Formosa*, pp. 69-70.

could no more find their prey. When the aborigines complained about their loss of hunting ground, the Company decided to use the tithes collected from Chinese farmers to compensate their loss.⁷⁶ How the welfare of aborigines was affected when the Dutch and the Chinese co-colonized Taiwan awaits future research.

⁷⁶ Leonard Blussé, Natalie Everts, and Evelien Frech, eds., *The Formosan Encounter -- Notes on Formosa's Aboriginal Society: A Selection of Documents from Dutch Archival Sources, Vol. 3: 1646-1654* (Taipei: Shung-Ye Museum of Formosan Aborigines, 2006), pp. 300-303, 307-309, 406, 422-423; Hui-wen Koo, "Deer Hunting and Preserving the Commons in Dutch Colonial Taiwan," *The Journal of Interdisciplinary History* 42: 2 (Autumn 2011), pp. 185-203.

Appendix

Table 1. Estimated Chinese Population: 1640-1661

	based on population flow	based on poll tax
1640	3,112	3,112
1641	3,112	
1642	3,151	
1643	5,026	7,000
1644	3,795	
1645	5,728	
1646	6,015	10,000
1647	9,354	10,000
1648	14,073	
1649	14,073	12,000
1650	13,515	10,811
1651	14,810	14,400
1652	12,310	
1653	12,310	10,629
1654	13,093	10,372
1655	15,780	11,315
1656	15,343	11,315
1657	18,544	14,229
.....		
1661	25,000	

Table 2. Farm Land (morgen): 1645-1661

	total	sugar-cane	rice
1645	3,000	612	1,713
1646	4,000		
1647	5,743	1,704	3,957
1648			4,177
1649			
1650	6,470	2,928	3,481
1651		1,380	1,924
1652	5,929	1,315	4,539
1653	5,065	1,334	3,731
1654	4,309	1,310	2,923
1655	7,174	1,516	5,578
1656	8,413	1,837	6,526
1657	8,070	1,668	6,026
...			
1660	13,020		
1661	12,252		

Table 3. Sugar Outputs and Exports (catties): 1632-1660

	output	exports					
		total	Netherlands	Persia	Japan	China	others
1632		364,067					
1633		21,306					
1634		213,840	116,250		97,590		
1635		922,745	750,616		172,129		
1636	122,503	3,102,535	2,705,404		397,131		
1637		3,022,340	2,787,798		234,542		
1638		562,220	407,191	65,625	83,800		5,604
1639		1,900,542	1,379,596	520,946			
1640	180,000	2,138,409	866,070	1,271,339	1,000		
1641		2,556,316	1,062,486	1,301,578	192,252		
1642		1,503,990	1,502,990	1,000			
1643	250,000	1,404,173	904,173	400,000			100,000
1644	301,400	974,174	286,906	687,268			
1645	1,500,000	1,780,094	1,289,210	425,200	65,684		
1646		1,846,202	1,101,120	231,830	510,752		2,500
1647		1,424,585	1,351,285	70,000		2300	1,000
1648	900,000	865,686	511,286	300,000		54400	
1649	530,000	531,572	131,500	300,000	100,072		
1650	1,200,000	1,427,978	825,632	507,450	94,897		
1651	2,500,000	2,506,350	1,953,817	463,557	88,976		
1652	800,000	1,061,818	451,324	469,969	140,525		
1653	938,416	958,127	454,953	446,975	47,475		8,724
1654	2,028,543	1,109,370	148,230	426,593	108,197		426,350
1655	450,000	1,043,485	330,714	446,843	174,548		91,380
1656	2,700,000	2,216,060	932,285	428,953	368,760	133,294	352,768
1657	2,730,000	2,639,140	779,223	828,958	432,989	597,970	
1658	990,000	1,428,134			628,134	800,000	
1659	1,730,000	1,354,775	16,000	800,000	538,775		
1660	1,500,000	1,135,762	245,293	884,759			5,710

Note: Others include exports to Siam, Manila, Tonkin, Coromandel and shipment losses.

Sources: Exports to Japan are from the archive of VOC, Japanese Factory stored in The National Archives, Hague; documents include *Negotie Journalen*, *Grote Boeken* and *Facturen*. Sources of other items are as the follows.

1632: VOC 1105, 239-241; VOC 1109, 198.

1633: VOC 1113, 770.

1634: Shaogang Cheng, *De VOC en Formosa, 1624-1662*, pp. 145, 154-155.

1635: VOC 1116, ff.378-385; VOC 1120, ff.239-245.

1636: VOC 1123, ff.726-727.

1637: VOC 1123, ff.932-933; VOC 1128, f.378.

1638: VOC 1130, ff.1172-1173, ff.1425-1426, ff.1430-1431, 1435, 1441.

1639: VOC 1132, ff.297-298, 323, 326, 329, 332-333; VOC 1133, ff.170-171, 173-174.

- 1640: VOC 1135, ff.709-710; VOC 1139, ff.664-665; *DZ*, I, pp. 500-507; *DB*, 1640-1641, p. 125.
- 1641: VOC 1140, ff.224-225, 228-229, 231, 243, 255, 260, 274-277; VOC 1160, ff.624-626; *DB*, 1640-1641, p.116.
- 1642: VOC 1140, ff.278-281; VOC 1146, ff.700-702, ff.767-768.
- 1643: VOC 1145, f.200, 264; VOC 1151, f.858; *DB*, 1643, p. 145; *DB*, 1644, p. 146.
- 1644: VOC 1148, f.279; VOC 1149, ff.664-665, 696, 699-701.
- 1645: VOC 1149, ff.867-869; Shaogang Cheng, *De VOC en Formosa, 1624-1662*, pp. 277, 279.
- 1646: VOC 1163, ff.290-291, 307; VOC 1164, f.363; Shaogang Cheng, *De VOC en Formosa, 1624-1662*, p.281.
- 1647: VOC f.1164, 391, 414; VOC 1169, f.389, 413, 423.
- 1648: VOC 1170, f.512; *DZ*, III, p. 92; *GM*, II, p. 188; Shaogang Cheng, *De VOC en Formosa, 1624-1662*, pp. 302-303.
- 1649: Shaogang Cheng, *De VOC en Formosa, 1624-1662*, p. 312.
- 1650: VOC 1183, ff.542-543; VOC 1176, f.955; VOC 1183, f.539.
- 1651: VOC 1183, ff. 448, 580-581, 899; VOC 1194, f.61; Shaogang Cheng, *De VOC en Formosa, 1624-1662*, p. 343.
- 1652: VOC 1194, f.141; VOC 1197, f.769.
- 1653: Shaogang Cheng, *De VOC en Formosa, 1624-1662*, p. 385; VOC 1197, f.786, 803, 808; VOC 1207, f.641, 649; VOC 1208, f.187.
- 1654: VOC 1206, f.207, 213; VOC 1208, f.526.
- 1655: VOC 1212, f.324, 331, 343; VOC 1216, f.429.
- 1656: VOC 1218, f.14, 69, 72, 313, 467, 470; *DZ*, IV, p. 137; Shaogang Cheng, *De VOC en Formosa, 1624-1662*, p. 454.
- 1657: VOC 1222, f.297, 300; VOC 1228, ff.660-661, 669-670; *DZ*, IV, p.316.
- 1658: Shaogang Cheng, *De VOC en Formosa, 1624-1662*, pp. 501-502, 507.
- 1659: Shaogang Cheng, *De VOC en Formosa, 1624-1662*, p. 514.
- 1660: VOC 1237, 167; *DB*, 1661, pp.61-62; *DZ*, IV, p. 323.

Table 4. Demand for Sugar from Taiwan and China (pounds)

	Netherlands	Persia	Japan
1629		150,000	
1630			
1631	0		
1632			
1633	400,000		
1634	0		
1635	600,000		175,000
1636	600,000	310,000	500,000
1637	600,000	330,000	
1638	1,000,000		
1639	3,000,000		
1640	2,750,000		
1641	2,750,000		
1642	2,750,000	600,000	
1643	3,000,000	660,000	
1644	1,000,000	520,000	-
1645	600,000		-
1646	500,000		-
1647	1,000,000	660,000	
1648	3,300,000	345,000	-
1649	3,000,000	390,000	
1650	3,000,000	500,000	
1651	2,750,000		
1652	2,600,000		
1653	2,600,000		
1654	2,850,000		
1655	2,550,000		125,000
1656		250,000	
1657	50,000		
1658	50,000	600,000	343,750
1659	0	800,000	
1660	1,200,000		
1661	700,000		
1662	900,000		
1663	900,000		

Note: (1) Demand from the Netherlands from 1664 to 1673 were all 0s.

Sources: (1) Demand from the Netherlands is mainly cited from the resolutions of Gentlemen Seventeen (VOC, *Resoluties van Heren XVII, 1654-1796* (inventory nos.: 99-210, the Amsterdam Chamber; 7343-7416, the Zeeland Chamber) Hague: The National Archives.) including VOC 101, f.32, 93, 117; VOC 102, f.44, 84, 100, 165, 245; VOC 103, f.25, 149, 357, 635; VOC 104, f.97-98, 231, 394, 577; VOC 105, f.23, 179, 297, 433, 540, 614; VOC 106, f.68 (and some without folio numbers); VOC 107 and VOC 7345-7347 (no folio numbers provided). Besides, data for 1631 is cited from Pieter Van Dam, *Beschryvinge van de Oostindische Compagnie, 1: 2*, p. 134. Data for 1637 and 1641 are cited from J. J. Reese, *De Suikerhandel van Amsterdam, van het Begin der 17de Eeuw tot 1813: een Bijdrage tot de Handelsgeschiedenis des Vaderlands, Hoofdzakelijk uit de Archieven Verzameld en Samengesteld*, pp.161, 163. (2) Demand from Persia is mainly cited from *eijzen* (in VOC, *Algemene Serie: Overgekomen Brieven en Papieren uit Indië aan de Heren XVII en de Kamer Amsterdam, 1607-1794* (inventory nos. 1053-3987) Hague: The National Archives.), including VOC 1098, ff.596-597; VOC 1135, f.726; VOC 1139, f.481-483, 718; VOC 1150, f.264; VOC 1162, ff.38-39; VOC 1165, ff.194-195; VOC 1168, ff.765-766; VOC 1170, f.884; VOC 1224, f.415; VOC 1226, f.854. We also consult Hendrik Dunlop, ed., *Bronnen tot de geschiedenis der Oostindische Compagnie in Perzie* (The Hague: Martinus Nijhoff, 1930), pp. 542, 589; Pieter Van Dam, *Beschryvinge van de Oostindische Compagnie, 2: 3*, pp. 360-361 and Om Prakash, *The Dutch East India Company and the Economy of Bengal, 1630-1720*, p. 174. (3) Demand from Japan is cited from VOC, *Algemene Serie: Overgekomen Brieven en Papieren uit Indië aan de Heren XVII en de Kamer Amsterdam, 1607-1794*, including VOC 1116, f.285; VOC 1123, f.968; VOC 1143, ff.718-723; VOC 1148, ff.401-404; VOC 1161, ff.687-691; VOC 1164, ff.635-644, 665-668; VOC 1223, f.588; VOC 1228, ff.816-818.

Table 5. Sugar brought to Japan by the VOC and the Chinese (catties)

	VOC	Chinese
1634	97,590	
1635	172,129	
1636	397,131	
1637	234,542	1,600,000
1638	83,800	
1639	-	1,144,150
1640	1,000	1,231,107
1641	192,252	5,750,500
1642	-	432,900
1643	-	10,600
1644	-	1,417,550
1645	65,684	3,377,800
1646	510,752	1,203,100
1647	-	
1648	-	103,083
1649	100,072	737,250
1650	94,897	797,110
1651	88,976	591,050
1652	140,525	
1653	47,475	774,220
1654	108,197	760,580
1655	174,548	1,737,480
1656	368,760	1,870,260
1657	494,579	767,110
1658	628,134	1,686,335
1659	538,775	3,389,700
1660	-	1,176,986

Sources: Sugar brought by the VOC is the same as that in figure 4. For sugar brought by the Chinese, see table 3 in Yoko Nagazumi, "Formosan Trade in the Seventeenth Century: with Dutch Sources," p. 46. The data presented here differ from hers in a few years for which our sources are:

1637: VOC 1124, f.29.

1644: *DD*, 1644.11.15.

1651: VOC 1183, ff.424-8.

1655: *DD*, 1655.10.19 & 1655.10.23.

1657: VOC 1223, f.582.

Table 6. Sugar Prices (guilders/picul)

	Brazil (Ams)	East Inida (Ams)	Persia	Japan	Taiwan (purchase)
1622		33.75			
1623		32.03			
1624	58.88		44.67		
1625	64.03		44.67	14.37	6.00
1626					
1627	71.25			15.62	5.10
1628			51.04		
1629	84.06				
1630	83.54				
1631	87.03	67.50	52.08		
1632	84.17	67.50			
1633	82.50	57.50			
1634	82.50	61.25	31.25	18.75	7.09
1635	74.69	61.25		28.12	7.38
1636	105.83	58.75		16.10	7.79
1637	84.38	87.50		10.86	6.05
1638				12.31	6.97
1639	68.75				
1640	63.13				
1641	57.50		23.85	7.98	5.55
1642	54.69				
1643					
1644	57.29				
1645	81.56			17.75	10.37
1646				10.60	9.10
1647	74.38				
1648	82.66				
1649	84.00			24.00	13.72
1650	91.25			18.10	14.82
1651	86.25				17.60
1652	82.50			21.43	17.36
1653	86.25			34.36	17.08
1654				29.57	16.32
1655				24.92	16.26
1656				21.62	15.40
1657			33.96	23.98	14.49
1658				19.83	12.75
1659				18.69	11.28
1660					
1661					
1662					
1663	48.75				
1664	50.00				

1665					
1666					
1667					
1668	43.75				
1669	-				
1670	36.25				
1671	39.69				
1672	-				
1673	36.43				
1674	35.00				
1675	35.00				

Note: The price unit in Amsterdam was guilders/pound. We change it to guilders/picul using the formula that 1 picul = 125 pound.

Sources: (1) Prices of Brazil sugar in Amsterdam are cited from N. W. Posthumus, *Nederlandsche Prijsgeschiedenis, Deel I: Goederenprijzen of de Beurs van Amsterdam, 1585-1914; Wisselkoersen te Amsterdam, 1609-1914*, pp. 122-123.

(2) Prices of East Indian sugar in Amsterdam are cited from Kristof Glamann, *Dutch-Asiatic Trade, 1620-1740*, pp. 153-154.

(3) The purchase prices of Taiwan's sugar and the sale prices in Japan are cited from VOC, *Negotie Journalen* (1633-1660) and VOC, *Facturen* (1633-1662).

(4) Prices of Taiwan's sugar in Persia were cited from *prijscouranten*: VOC 1094, f.69; VOC 1103, f.224; VOC 1109, f.99; VOC 1113, f.115; VOC 1135, ff.628-629, 733, 738-739; VOC 1137, ff.18-19; VOC 1139, f.528, 708; VOC 1144, f.516; VOC 1146, f.797, 968; VOC 1150, f.118; VOC 1151, f.598 and Pieter Van Dam, *Beschryvinge van de Oostindische Compagnie, 2: 3*, p. 344.

References

- VOC 103, f.635, resolution in Amsterdam, 2 November 1655.
- VOC 104, ff.97-98, resolution in Amsterdam, 7 October 1656.
- VOC 1113, f.693.
- VOC 1114, f.11, letter from Hans Putmans to Camer Amsterdam, Tayouan, 28 October 1634.
- VOC 1116, 373r, report from Taiwan Governor, Hans Putman, to Batavia, 19 September, 1635.
- VOC 1120, 264, report from Taiwan Governor, Hans Putman, to Batavia, 7 October, 1636.
- VOC 1131, f.744.
- VOC 1146, f.758, letter from Paulus Traudenius to Wollebrandt Geleijnszen, Tayouan, 12 November 1642.
- VOC 1149, ff.842-843, letter from Francois Caron to Cornelis van der Lijn, Tayouan, 25 October 1645.
- VOC 1160, f.162, letter from Francois Caron to Cornelis van der Lijn, Tayouan, 31 January 1646.
- VOC 1163, f.297, letter from Pieter Anthonisz. Overtwater to Wolbrandt, Tayouan, 29 November 1646.
- VOC 1164, 373v, letter from Overtwater to van der Lijn in Batavia, Tayouan, 24 September, 1647.
- VOC 1164, f.412, land survey report, Tayouan, September 1647.
- VOC 1176, f.791-792, land survey report.
- VOC 1182, f.99, report by Willem Verstegen, Batavia, 20 January 1652.
- VOC 1183, f.853, letter from Willem Verstegen to Carel Reniers, Tayouan, 24 October 1651.
- VOC 1194, ff.148-149, letter from Nicolaas Verbuch to Carel Reniersz., Tayouan, 15 November 1652.
- VOC 1197, f.783, letter from Cornelis Caesar to Joan Maetsuijcker, Tayouan, 24 October 1653.
- VOC 1197, f.788v, letter from Cornelis Caesar to Joan Maetsuijcker, Tayouan, 24 October 1653.
- VOC 1206, f.233r, accounts of Formosa by Nicolaas Verbuch, Batavia, 10 March 1654.
- VOC 1207, f.724, land survey report, 1654.
- VOC 1213, f.462, letter from Leonard Winninx to Cornelis Caesar, Nagasaki, 19 October 1655.
- VOC 1213, f.553, land survey report, 1655.
- VOC 1218, f.4, letter from Cornelis Caesar to Joan Maetsuijcker, Tayouan, 20 November 1656.
- VOC 1218, f.110, resolution, Tayouan, 26 June 1656.
- VOC 1218, f.112r, resolution in Tayouan, 26 June 1656.
- VOC 1218, ff.370, 380, 383, letters from Cornelis Ceasar to Joan Boucheljon, Tayouan, dated on 8 July, 24 August and 21 October 1656.
- VOC 1218, f.458, land survey report, 1656.
- VOC 1218, f.468v, letter from Frederick Coyett to Joan Maetsuijcker, Tayouan, 27 December 1656.
- VOC 7346 (no folio number), resolution in Amsterdam, 28 September 1632.
- Fu Chien Shêng Ch'ing Tzu Liao K'u 福建省情資料庫 [Database of Fukien Province's State of Affairs], accessed 15 November, 2012; available from <http://www.fjsq.gov.cn>.
- Searates, accessed 15 November, 2012; available from <http://www.searates.com/reference/portdistance>.

Abbott, Elizabeth

2008 *Sugar: A Bittersweet History*. London and New York: Duckworth Overlook.

Andrade, Tonio 歐陽泰

2008 *How Taiwan Became Chinese: Dutch, Spanish, and Han Colonization in the Seventeenth Century*. New York: Columbia University Press.

Bethell, Leslie (ed.)

1987 *Colonial Brazil*. Cambridge; New York: Cambridge University Press.

Blussé, Leonard 包樂史 and Cynthia Viallé (trans. and eds.)

2001 *The Deshima Dagregisters: Their Original Tables of Contents, Vol. XI: 1641-1650*. Leiden: Leiden Centre for the History of European Expansion.

2005 *The Deshima Dagregisters: Their Original Tables of Contents, Vol. XII: 1650-1660*. Leiden: Leiden Centre for the History of European Expansion.

Blussé, J. Leonard 包樂史, M. E. van Opstall, Ts'ao Yung-ho 曹永和, Chiang Shu-sheng 江樹生, and W. Milde (eds.)

1986 *De Dagregisters Van Het Kasteel Zeelandia, Taiwan 1629-1662, Deel I: 1629-1641*. The Hague: Martinus Nijhoff.

Blussé, Leonard 包樂史, Natalie Everts, and Evelien Frech (eds.)

1999 *The Formosan Encounter -- Notes on Formosa's Aboriginal Society: A Selection of Documents from Dutch Archival Sources, Vol. 1: 1623-1635*. Taipei: Shung-Ye Museum of Formosan Aborigines.

2006 *The Formosan Encounter -- Notes on Formosa's Aboriginal Society: A Selection of Documents from Dutch Archival Sources, Vol. 3: 1646-1654*. Taipei: Shung-Ye Museum of Formosan Aborigines.

Blussé, J. L. 包樂史, N. C. Everts, W. E. Milde, and Ts'ao Yung-ho 曹永和 (eds.)

2000 *De Dagregisters Van Het Kasteel Zeelandia, Taiwan 1629-1662, Deel IV: 1655-1662*. The Hague: Martinus Nijhoff.

Blussé, J. L. 包樂史, W. E. Milde, Ts'ao Yung-ho 曹永和, and N. C. Everts (eds.)

1995 *De Dagregisters Van Het Kasteel Zeelandia, Taiwan 1629-1662, Deel II: 1641-1648*. The Hague: Martinus Nijhoff.

1996 *De Dagregisters Van Het Kasteel Zeelandia, Taiwan 1629-1662, Deel III: 1648-1655*. The Hague: Martinus Nijhoff.

Bulbeck, David, Anthony Reid, Lay Cheng Tan, and Yiqi Wu (compiled)

1998 *Southeast Asian Exports since the 14th Century: Cloves, Pepper, Coffee, and Sugar*. Leiden, The Netherlands: KITLV Press; Australia: Research School of Pacific and Asian Studies, ANU; Singapore: Institute of Southeast Asian Studies.

Chaudhuri, K. N.

1985 *Trade and Civilization in the Indian Ocean: An Economic History from the Rise of Islam to 1750*. Cambridge: Cambridge University Press.

Cheng, Shaogang 程紹剛

1994 "Chinese Sugar Production and Its Trade in the First Half of the Seventeenth Century [十七世紀上半期的中國糖業及對外蔗糖貿易]." *Journal of Chinese Social and Economic History* [中國社會經濟史研究] (Xiamen) 1994(2): 29-46.

- 2000 *De VOC en Formosa, 1624-1662* 荷蘭人在福爾摩莎. Taipei: Linking Publishing Co..
- Chiang, Shu-shen 江樹生
- 1997 "Population Changes in Dutch Colonial Taiwan." Presented in *International Conference on Belief in Matsu* held by Beigan Chao-Tien Temple.
- Coolhaas, W. Ph. (ed.)
- 1960 *Generale Missiven van Gouverneurs-Generaal en Raden aan Heren XVII der Verenigde Oostindische Compagnie, Deel I: 1610-1638*. The Hague: Martinus Nijhoff.
- 1964 *Generale Missiven van Gouverneurs-Generaal en Raden aan Heren XVII der Verenigde Oostindische Compagnie, Deel II: 1639-1655*. The Hague: Martinus Nijhoff.
- 1968 *Generale Missiven van Gouverneurs-Generaal en Raden aan Heren XVII der Verenigde Oostindische Compagnie, Deel III: 1655-1674*. The Hague: Martinus Nijhoff.
- Coyet, Frederik 揆一
- 1975 *Neglected Formosa* (trans. from *t Verwaerloosde Formosa*), ed., Inez de Beauclair. San Francisco: Chinese Materials and Research Aids Service Center.
- Dam, Pieter van
- 1929 *Beschryvinge van de Oostindische Compagnie, Vol. 1: 2*. The Hague: Martinus Nijhoff.
- 1931 *Beschryvinge van de Oostindische Compagnie, Vol. 2: 1*. The Hague: Martinus Nijhoff.
- 1939 *Beschryvinge van de Oostindische Compagnie, Vol. 2: 3*. The Hague: Martinus Nijhoff.
- Dunlop, Hendrik (ed.)
- 1930 *Bronnen tot de geschiedenis der Oostindische Compagnie in Perzie*. The Hague: Martinus Nijhoff.
- Fagan, Brian
- 2000 *The Little Ice Age: How Climate Made History, 1300-1850*. New York: Basic Books.
- Glamann, Kristof
- 1958 *Dutch-Asiatic Trade, 1620-1740*. The Hague: Martinus Nijhoff.
- Heyns, Pol 韓家寶
- 2002 *Economy, Land Rights and Taxation in Dutch Formosa* 荷蘭時代臺灣的經濟・土地與稅務, trans., Wei-chung Cheng. Taipei: Appleseed Publishing Co..
- Hoetink, B.
- 1917 "So Bing Kong: Het Eerste Hoofd der Chineezzen te Batavia (1619-1636)." *Bijdragen tot de Taal-, Land- en Volkenkunde van Nederlandsch-Indië* (The Hague) 73(3/4): 344-415.
- Hsu, Kenneth J. 許靖華
- 2012 *Climate Made History* 氣候創造歷史, Chinese trans., His-an Kan. Taipei: Linking Publishing Co..
- Hullu, J. de (ed.)
- 1903 *Dagh-register Gehouden int Casteel Batavia vant Passerende daer ter Plaetse als over Geheel Nederlandts-India, 1644-1645*. The Hague: Martinus Nijhoff.
- Iwao, Seiichi 岩生成一
- 1933 "Exports of Sugar and Tea from Taiwan to Persia Three Hundred Years Ago [三百年前に於ける臺灣砂糖と茶の波斯進出]." *Nan Pou Do Zo Ku* (南方土俗 / *Local Customs in the South*) (Taipei) 2(2): 9-28.

Koo, Hui-wen 古慧雯

2011 “Deer Hunting and Preserving the Commons in Dutch Colonial Taiwan.” *The Journal of Interdisciplinary History* (Cambridge) 42(2): 185-203.

2015 “Weather, Harvests, and Taxes: A Chinese Revolt in Colonial Taiwan.” *The Journal of Interdisciplinary History* (Cambridge) 46(1): 39-59.

Kooijmans, Marc and Judith Schoonveld-Oosterling

2000 *VOC-Glossarium: Verklaringen van Termen, Verzameld uit de Rijks Geschiedkundige Publication die Betrekking Hebben op de Verenigde Oost-Indische Compagnie*. Den Haag: Instituut voor Nederlandse Geschiedenis.

Lin, Wei-sheng 林偉盛

2001 “Taiwan’s Sugar Trade in Dutch Colonial Era [荷據時期的臺灣砂糖貿易].” In Su-chuan Chan, Lung-chich Chang, and Shu-min Chung, eds., *Conference Proceedings: Celebration of Mr. Ts’ao Yung-ho’s Eightieth Birthday*, pp. 7-29. Taipei: Lexis Book.

Maddison, Angus

2007 *Contours of the World Economy, 1-2030 AD: Essays in Macro-Economic History*. Oxford: Oxford University Press.

Meij van Meijenstein, Philippus Daniel

2003 *The Diary of Philippus Daniel Meij van Meijenstein*, trans., Shu-shen Chiang. Taipei: Echo Publishing.

Nagazumi Yoko 永積洋子

1999 “Formosan Trade in the Seventeenth Century: With Dutch Sources [由荷蘭史料看十七世紀的臺灣貿易],” trans., Shiu-feng Liu, in Shi-yeou Tang, ed., *Essays in Chinese Maritime Development History, Vol. 7: 1*, pp. 37-57. Taipei: Sun Yat-Sen Institute for Social Sciences and Philosophy, Academia Sinica.

Nakamura, Takashi 中村孝志

1997 “Agriculture and Its Promotion in Dutch Colonial Taiwan.” In Kaim Ang and Wu Mi-cha, eds., and trans., *Research on Taiwanese History under the Dutch Rule, Vol. 1: Overview and Industry*, pp. 43-80. Taipei: Daw-Shiang Publishing.

Parker, Geoffrey

2008 “Crisis and Catastrophe: The Global Crisis of the Seventeenth Century Reconsidered.” *The American Historical Review* (Oxford) 113(4): 1053-1079.

Pomeranz, Kenneth 彭慕蘭 and Steven Topik

2006 *The World that Trade Created: Society, Culture, and the World Economy, 1400 to the Present*. Armonk and London: M. E. Sharpe, 2nd edition.

Posthumus, N. W.

1943 *Nederlandsche Prijsgeschiedenis, Deel I: Goederenprijzen of de Beurs van Amsterdam, 1585-1914; Wisselkoersen te Amsterdam, 1609-1914*. Leiden: E. J. Brill.

Prakash, Om

1985 *The Dutch East India Company and the Economy of Bengal, 1630-1720*. Princeton, N.J.: Princeton University Press.

Provisional Investigation Committee of Taiwan's Old Customs

- 1909 *About Old Customs in Taiwan Sugar Industry*. Kobe: Provisional Investigation Committee of Taiwan's Old Customs.

Reesse, J. J.

- 1908 *De Suikerhandel van Amsterdam, van het Begin der 17de Eeuw tot 1813: een Bijdrage tot de Handelsonderzoek des Vaderlands, Hoofdzakelijk uit de Archieven Verzameld en Samengesteld*. Haarlem: J.L.E.I. Kleynenberg.

Schwartz, Stuart B.

- 2004 "A Commonwealth within Itself: The Early Brazilian Sugar Industry, 1550-1670." In Stuart B. Schwartz, ed., *Tropical Babels: Sugar and the Making of the Atlantic World, 1450-1680*, pp. 158-200. Chapel Hill and London: University of North Carolina Press.

Shimada, Ryuto 島田竜登

- 2006 *The Intra-Asian Trade in Japanese Copper by the Dutch East India Company during the Eighteenth Century*. Leiden; Boston: Brill.

Song, Ying-hsing 宋應星

- 1966 *T'ien-Kung K'ai-Wu: Chinese Technology in the Seventeenth Century*, English trans., Sun Zen E-tu and Sun Shiou-chuan. University Park: Penn State University Press.

Stols, Eddy

- 2004 "The Expansion of the Sugar Market in Western Europe." In Stuart B. Schwartz, ed., *Tropical Babels: Sugar and the Making of the Atlantic World, 1450-1680*, pp. 237-288. Chapel Hill and London: The University of North Carolina Press.

van der Chijs, J. A. (ed.)

- 1887 *Dagh-register Gehouden int Casteel Batavia vant Passerende daer ter Plaetse als over Geheel Nederlands-India, 1640-1641*. The Hague: Martinus Nijhoff.

VOC

- 1607-1794 *Algemene Serie: Overgekomen Brieven en Papieren uit Indië aan de Heren XVII en de Kamer Amsterdam*, collected in the archive of VOC, (archive no. 1.04.02), inventory numbers. 1053-3987. Hague: The National Archives.
- 1633-1660 *Negotie Journalen*, collected in the archive of VOC, Japanese Factory (archive no: 1.04.21), inventory numbers: 833-856. The Hague: National Archives.
- 1633-1662 *Facturen*, collected in the archive of VOC, Japanese Factory, inventory numbers: 762-785. The Hague: National Archives.
- 1633-1662 *Grote Boeken*, collected in the archive of VOC, Japanese Factory (archive no: 1.04.21), inventory numbers: 977-1001. The Hague: National Archives.
- 1654-1796 *Resoluties van Heren XVII*, collected in the archive of VOC, inventory numbers. 99-210 (Amsterdam Chamber); 7343-7416 (Zeeland Chamber). Hague: The National Archives.

Vries, Jan de and Ad van der Woude

- 1997 *The First Modern Economy: Success, Failure, and Perseverance of the Dutch Economy, 1500-1815*. Cambridge; New York: Cambridge University Press.

Wilson, Arnold T.

1928 *The Persian Gulf: An Historical Sketch from the Earliest Times to the Beginning of the Twentieth Century*. Oxford: Clarendon Press.

Yao Keisuke 八百啓介

2003 “Two Rivals on an Island of Sugar. The Sugar Trade of the VOC and Overseas Chinese in Formosa in the Seventeenth Century.” In Leonard Blussé, ed., *Around and about Formosa: Essays in Honor of Professor Ts'ao Yung-ho*, pp. 129-149. Taipei: Ts'ao Yung-ho Foundation for Culture and Education; SMC publishing Co..

荷蘭時代臺灣砂糖的生產與貿易

古慧雯

摘 要

本文研究荷蘭時代臺灣的砂糖產業，我們利用了荷蘭東印度公司的原始檔案整理當時臺灣的漢人人口、耕地面積、砂糖產出以及其外銷世界各地的數量。資料顯示，起初是荷蘭的需求促動了臺灣的砂糖生產；然而，1654 年巴西叛亂落幕之後，阿姆斯特丹充斥著巴西糖，荷蘭因此對於東印度的糖失去了興趣。此後，波斯、日本與中國便成為臺灣糖的主要市場。早期銷往荷蘭的臺灣糖利潤率曾經超越 400%，勝過香料與胡椒的利潤率。至於臺灣農夫的所得，因受到天然災害之影響，變化頗大；即使在最好的年份裡，漢人農夫的所得尚不及荷蘭挑磚夫所得的三分之一，但這已遠超過他們在中國的所得了。

關鍵詞：荷蘭時代的臺灣、十七世紀中葉的砂糖、跨國所得比較