The Horns of a Dilemma in Colonial Policies:
Rice, Rubber and Living Standards in the Malay Peninsula

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Abstract

The effects of colonial policies on the living standards of smallholder farmers have been widely debated. The ‘dependency’ view of local farmers becoming increasingly vulnerable due to exposure to international market volatility has been contrasted with the neo-classical view that suggests that this exposure was counteracted by an increase in surplus revenues generated by export crop specialization. The controversy becomes even fiercer when the debate is centred around the impact of the Great Depression on the material conditions of rural households. This article addresses this controversy by studying the most important agricultural policy in the British Malay Peninsula around the years of the Great Depression (1924-1937), using new fine-grained data on harvest yields, mortality and hospitalization rates at the district level. On March 1, 1931, the colonial government enacted the New Rice Policy, encouraging local farmers to substitute rubber cultivation with rice fields. This new policy was not implemented at the same time throughout the Malay Peninsula, nor was it enacted in all districts. We build our empirical approach around this temporal and spatial variation of the new law, and compare the mortality and morbidity responses to harvest failures before and after the New Rice Policy was in effect. The adverse effects of harvest failures were reduced in districts where the new rice policy was enforced, and remained largely unaffected in districts where the new rice policy was never implemented. Our findings underscore the decisive impact of the New Rice Policy in achieving widespread food security for local farmers while securing the general health of the population. To address potential endogeneity concerns, we also use rainfall variability as an instrumental variable to proxy for harvest fluctuations and harvest failures.

JEL classification: N55, Q17, F18, N35, Q18, N15

Keywords: Agricultural History; Living Standards; Health Outcomes; Rice; Commodity Trade; Colonial History; Southeast Asia; Colonial policies; Food Security.

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1. Introduction

“If the Great Depression left an inedible mark on the fears, values, and habits of a whole generation of Americans, can we imagine the impact of periodic food crises on the fears, values, and habits of rice farmers in monsoon Asia?”

—James C. Scott, 1976

“The rhythm, quality and deficiency of harvests ordered all material life”

—Fernand Braudel, 1967

The effects of colonial policies on the living standards of smallholder farmers have long been a subject of academic and ideological dispute, generating two sharply opposing views. The ‘dependency’ view, inspired mainly by Scott’s seminal work in the Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia (1976), holds that the introduction and imposition of new export crops diverted attention away from the cultivation of subsistence crops and as a result, generated a more vulnerable, less food secure peasantry. The typical peasant is described as being subsistence-oriented, preferring to avoid economic disaster rather than to take risks to maximize his average incomes. In a well-known expression, Tawney (1964, p. 77) graphically describes the position of the peasant as he is ‘standing permanently up to the neck in water, so that even a ripple is sufficient to drown him’. Over the years, several ripples have been proposed by the ‘dependency’ view. Yet, one of the most prevailing ripples is the one that looks at colonial policies as repeatedly favouring the cultivation of (non-edible) export crops to the detriment of (edible) staple crops, effectively jeopardizing farmers’ food security (Scott, 1976; Brown, 1986; Watts, 1984; Fafchamps, 1992). As it is often argued, a sharp contraction in the demand for the regions’ primary commodity exports (e.g. the case of the 1930s depression), could breed acute subsistence crises, especially for farmers living close to the margin (Elson, 1997).

Proponents of this view maintain that the colonial policies were essentially coercive and that farmers were largely reluctant at first in adopting and cultivating inedible crops for the market. They argue that the process of export-crop adoption was made possible through the direct coercion of compulsory cultivation and forced labour, and/or through the indirect pressure of taxes that had to be paid in cash (Mosley, 1983; Isaacman, 1996). It is also often remarked that taxation on export crops was seen as the most efficient way for the colonial government to monetize the economy in order to generate revenues and extract surpluses (Shenton & Freund, 1978; Lim, 1977). Furthermore, it is argued that non-edible export crop
production led to exploitation of smallholders due to monopsonistic conditions of marketing boards, which were setting prices lower than the world market ones (Bates, 2005). For those reasons, the dependency view, in general, holds that the colonial governments and their policies were entirely responsible for the major deterioration of peasants’ economic welfare in the first half of the 20th century.

The neo-classical view, on the other hand, maintains that smallholders expanded their output in response to price incentives provided by overseas international trade, making fuller use of previously underutilized stocks of land and labour. This view, which was originally pioneered by Hla Myint’s seminal work in the “classical theory” of international trade and the underdeveloped countries (1958), has given birth to the “vent-for-surplus” theory and models. From that standpoint, it is widely argued that the adoption and expansion of export crops to smallholder farmers provided the means to increase their incomes by reaping the benefits of inter-regional and international trade. Farmers could embark on export crop production without any (production) opportunity cost, since the production of edible crops for domestic consumption remained entirely unaffected (Myint, 1958; Goetz, 1993).

It is often also argued that specialization in export cropping increased farmers resilience to various exogenous shocks. For example, farmers could diversify their crop mix and production, by having two different crops in the same year. Thus, if the harvest of one crop failed, farmers could always rely on the yields of the other (von Braun & Kennedy, 1986; von Braun, 1995; de Haas & Papaioannou, 2017). Another argument that is frequently put forward by this view is that selling export crops to the market in return for cash, provides farmers with some kind of storable wealth. Such wealth can smoothen farmers’ consumption over the course of a year while also allowing them to afford other vital expenditures, including health care and education (Govereh & Jayne, 2003). Taken together, these studies support the idea that colonial policies favouring export crop production had a positive impact on farmers’ standard of living.

Unsurprisingly, the impact of the Great Depression on the material conditions of rural populations in Southeast Asia appeared as another attractive opportunity for dependency and neo-classical scholars to contest their worldviews. While few economic and social historians of Southeast Asia would deny that the Great Depression had been an important event with significant economic consequences, what remains largely debatable is the extent to which ordinary smallholders experienced a major deterioration in their material wellbeing. On the one hand, the dependency theorists stress how disastrous the period of the depression really was for those farmers, emphasizing the vital commitment of local farmers to a single non-edible commercial crop, which at the close of the 1920s, when the commodity prices collapsed, left
farmers with no outlets to sell their produce. Therefore, so the argument goes, a farmer who devoted virtually all his land, labour and capital to the cultivation of a single inedible crop and relied on the derived income from those sales to cover expenditure on food, clothing, shelter and agricultural tools, along with his obligation to pay taxes and service his debts, could not have avoided a collapse of his economic welfare (Brown, 1986). Furthermore, it is strongly argued that the colonial administrations, anticipating that the state’s tax revenues would sharply decline, enforced their tax demands against the rural populations despite the fact that they were experiencing major drops in their available income (Adas, 1974; O’Malley, 1977). Cases of considerable rural unrest and outright rebellion have been used as indicators of deteriorating material conditions. Rebellion was seen as the last resort for those farmers, mainly due to the high risks involved of being crashed (Kerkvliet, 1977). Consequently, farmers would resort to such behaviour only when they had nothing else to loose. Frequently cited cases in this literature are the recurrent farmers’ uprisings in Burma and Vietnam at the beginning of the 1930s, where farmers -while struggling with a subsistence crisis- attempted to get their households exempted from head and land taxes that the colonial state had levied upon them (Scott, 1976).

Proponents standing on the other side of the debate do not necessarily argue that there was nothing wrong during the depression years, rather they suggest that the aforementioned factors were not as harsh as it is usually argued (van Laanen, 1982; Boomgaard & Brown, 2000). They argue that not only the taxation was not as heavy as it has been previously assumed, but in many instances taxes were not levied in full and/or several socio-economic groups were exempted from certain taxes –notably head and land taxes (Boomgaard, 2000). This strand of literature claims that there were sufficient differences in the economic structures of the rural populations in the various export-oriented districts of Southeast Asia and appears reluctant to suggest a monotonic and abrupt reduction in overall material wellbeing (Lim, 1977; Kratoska, 2000; Boomgaard, 2000). Thus, instead of looking at the rural populations as passive victims of the depression crisis, they reveal a number of actions the cultivators undertook in order to mitigate the economic consequences. These actions not only involved the diversification of production into other economic activities, including mining, hunting, fishing and the exploitation of forest products, but also the adoption of other crops such as roots and tubers that secured a decent amount of calories as before at a lower cost (Drabble, 1973; Lim, 1977; Elson, 1997). Proponents of this view also question the line of reasoning that sees rural unrest as a reliable guide to proxy material conditions (the ‘rebellion thesis’). Instead, they point out cases in the region that went through the depression years without significant civil unrest (e.g.
Indonesia), which does not necessarily mean that farmers there did not suffer significant hardship (O’Malley 1977; Brown, 2005).

Yet, while both school of thoughts have published a considerable amount of studies on colonial policies, our understanding of their impact on the living standards of ordinary farmers is still ambiguous. Two are the reasons behind such ambiguity; one is the lack of reliable empirical data (e.g. disaggregated output series) and the other is the absence of sound empirical validation of either view. This study aims to fill this gap of knowledge in the literature by addressing a number of questions. Were the colonial policies solely encouraging the production of inedible export crops, while neglecting the food security of the peasant? Were farmers better off in areas where export crops were cultivated? What happened in times when food production was favoured by the colonial government (e.g. during the depression years)? Could such a policy change have led to less food shortages? And if yes, was that reflected in the general health of the population?

One way to investigate these questions is by measuring the morbidity and mortality response of smallholder farmers to short-term harvest fluctuations, before and after a major agricultural policy change. Comparing the response before and after the new policy, we will be in a better position to assess the material conditions of the rural population, shedding light on whether these conditions improved or deteriorated with the new policy. In recent years, there has been a growing body of literature across multiple disciplines, including demography (Bengtsson et al., 2004; Lohmann & Lechtenfeld, 2015), economic history (Edvinsson, 2017; Dribe et al., 2017; Papaioannou, 2017) and epidemiology (Deschênes, 2014; Burgess et al., 2017) that recognizes the importance of using short-term harvest fluctuations as a methodological tool to assess the living and nutritional conditions of rural populations over time.

The adoption of such a methodology allows for the use of more fine-grained, spatially disaggregated data to enter the empirical investigation, effectively moving beyond aggregate statistics at the country level; something that had previously dominated the literature (Booth, 1989; Brown, 2005). Regardless of their temporal and spatial selections, those studies point to the same direction; i.e. that, especially in pre-industrial societies, the mortality and morbidity response to short-term fluctuations in harvest yields and in food prices adversely affected the overall food security and health of the population (Bengtsson et al., 2004). According to the literature, serious declines in food consumption and lower income from agricultural sources meant a substantial deterioration of nutritional intake among children and adults along with an
impaired immune system and widespread malnutrition (Brown, 2005; O’Grada, 2009). Spikes of local food prices in the market can further precipitate this effect.

Our use of the term ‘living conditions’ resonates with Sen’s (1992, p. 39) functionings concept. A concept defined as the capacity of an individual to be “adequately nourished, in good health, avoiding escapable morbidity, and premature mortality”. It is a widely accepted that malnutrition, the spread of and exposure to diseases, as well as the likelihood of survival are largely influenced by economic stress and harvest fluctuations (Bengtsson et al., 2004, pp. 41-42). Several lines of evidence suggest that malnutrition, the immune system, and infectious diseases operate in a cyclical manner; infectious diseases have deleterious effects on nutritional status, and nutritional deficiencies can lower the strength of the immune system, which, in turn, affects the body’s ability to resist infections. Therefore, it is not surprising that high sensitivity to short-term harvest fluctuations reveals a lower standard of living (Bengtsson et al., 2004). Equally unsurprising is the fact that this relationship was particularly pronounced in agrarian, pre-industrial economies, where a considerable part of the population lived so close to the margins (Dribe et al., 2017).

The aim of this study is to assess the living standards of the smallholder farmers before and after the major policy change that took place in the Malay Peninsula during the British rule. On March 1, 1931, the colonial government enacted the New Rice Policy—mainly as a response to the economic recession of 1929, encouraging local farmers to substitute rubber cultivation with rice fields. The main objective of the policy was to reduce the country’s dependence on imported foodstuffs and to divert farmers’ attention and labour from rubber cultivation (Rice Committee Report, 1930, p.1), by encouraging the extension of domestic rice cultivation. The ultimate goal was to safeguard Malay smallholders against possible future subsistence crises (Rice Committee Report, 1930, p.2). The colonial government argued that the objectives could be accomplished by diverting financial resources away from rubber fields and towards padi-rice cultivation (Rice Committee Report, p.2). Against this background, the government took a number of steps to increase rice land and rice productivity, including the funding of several large-scale water control schemes and the establishment of an Irrigation and Drainage

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1 In the 1910s and 1920s, the Federated Malay States imported an average of approximately 82 per cent of their annual rice consumption. This is in sharp contrast to what is now the case for those States, where from the 1970s onwards less than 12 per cent of Malaysia’s domestic requirements came from foreign sources (Goldman, 1975). As far as domestic production is concerned, the reversal of fortune is truly remarkable.

2 In Malay’s neighbouring colonies of Burma, Thailand and Southern Vietnam, rice was not only the main food crop, but also, an important export crop. Instead, in the Malay Peninsula, rice output was intended solely for domestic consumption (Booth, 1998, p.55).
Department, which worked specifically on the implementation of the new policy (Rice Committee Report, 1930, p.16).

It is important to note here that the New Rice Policy was not enforced at the same time throughout the Malay Peninsula, nor was it enacted in all districts. For example, the NRP was only effective in the districts of the four adjoining Federated Malay States (F.M.S.) of Perak, Pahang, Selangor and Negri Sembilan, but not in the districts of the Unfederated Malay States (U.M.S.) of Johore, Kedah, Kelantan, Perlis and Terengganu (see Map 1). Unlike the U.M.S., which lacked common institutions, the F.M.S. were well-ordered states with an extensive public administration and services. The reasons for such diverse political structures go back to the early years of colonization (c. 1870s-1880s), and the Treaty of Federation (1896) that was signed by the Malay Rulers, effectively giving up their political power to the British (for a thorough discussion see Lim 1977, pp. 2-13 & 27-33).

Map 1. Malay States in 1930

Source: CO 576-1/38. Created by the authors in ArcGIS. In various colours, we denote the Federated Malay States where the new policy was in effect and in grey colour, we denote the Unfederated Malay States.

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3 The crown colony of Strait Settlements was not included in the analysis, as it functioned almost exclusively as a trading entrepot. Since the year that came under direct British control, this colony was a trading centre where goods were brought for import and export and where agricultural production was virtually zero.

4 It bears mentioning that the four Federated Malay States as well as the five Unfederated ones were all protectorates, where the crown had ultimate power and jurisdiction (see Kratoska, 2000 for more)
Our empirical strategy is built around this spatial and temporal variation of the new policy. We measure the morbidity and mortality response to harvest fluctuations before and after the new rice policy (henceforth NRP) was in effect. We, then, compare the two outcomes to see whether the NRP enabled farmers to cope more effectively with harvest failures, while getting a better understanding about their material conditions. Our selected approach resolves four major limitations of previous historical studies. First, instead of focusing only on extreme situations of famines and excessive mortality, we emphasize the consequences of smaller-scale harvest fluctuations. We argue that it is not only severe famines that have an impact on demographic outcomes (such as mortality, morbidity, fertility, etc.), but also smaller changes in food supply. Thus, looking at the whole gradient of harvest fluctuations enables us to gain better insights into the various mechanisms at play.

Second, we use data on actual harvest yields instead of data on wages and grain prices, moving beyond what most studies have used as indicators of living or nutritional standards. For many years, the relationship between harvest fluctuations and grain prices has been thought to be strongly negative and extremely inelastic, mainly due to constant demand for grains (Hoskins, 1964; Fogel, 1997). However, most recent historians have been more cautious about suggesting a linear relationship, demonstrating that domestic grain prices can be substantially influenced by economic conditions in wider grain markets outside the domestic economy (Campbell, 2009; Edvinsson, 2012; Edvinsson, 2017). Thus, the volatility in grain prices may reflect not only local harvest conditions, but also trade patterns and market integration (Dribe et al., 2017). The endogenous nature of grain prices has a considerable limitation from an econometric point of view too, as it can yield inconsistent estimates in the empirical analysis.

Third, the use of rainfall variation as an instrumental variable of harvest yields enables us to draw conclusions of a causal nature (Papaioannou, 2017). Isolating the effect of harvest fluctuations on vital demographic outcomes from the several other factors that could potentially influence those outcomes, holds significant academic merit (deVries, 1980). Fourth, a substantial benefit of our selected design is that we are able to observe the response annually for six years before the new policy as well as six years after it. Unlike earlier work that relies on relatively infrequent censuses or surveys, the design of this study enables us to confirm that the weakening effects of morbidity and mortality to harvest fluctuations appear precisely in the first year after the new policy was implemented for each district.

We hypothesize that increased acres of rice fields and, by extension, rice production, would reduce levels of malnutrition to rural peasants and, as a result, morbidity and mortality rates would decline. The data for this study come solely from primary archival sources (see data
section). Our dataset includes district-level information on rice yields as well as mortality and hospitalization rates for all administrative units (n=24) in the Malay Peninsula in the period 1924-1937. The selection of this period enables the construction of an equally balanced panel before (6 years) and after (6 years) the new policy. Besides balance, we selected those years in order to keep our estimates unaffected by long-term advances in preventive or curative medicine, and/or improvements in the registration capacity of the colonial administration to record vital statistics such as death rates. Keeping a relatively short period allows us to avoid any measurement bias in the results.

Overall, we find a substantial morbidity and mortality response to fluctuations in rice harvests, which is in line with the demographic, epidemiological and economic historical literature. In particular, we find that a one standard deviation decrease in rice output meant a 23 per cent increase in morbidity and a 10.1 per cent increase in mortality rates. The response to harvest fluctuations was markedly reduced in districts where the new rice policy was enforced. This reduction is of sizeable magnitude, since it dropped morbidity response down to 11 per cent and mortality response to 4.3 per cent. It bears mentioning that in districts where the NRP was never implemented, the response was 33.4 per cent for morbidity and 16.5 per cent for mortality.

It is worth putting these findings in perspective. From a historical comparative perspective, the mortality response is of slightly higher magnitude than what, for instance, Drive et al., (2017) find for pre-industrial southern Sweden. They suggest an overall mortality response to harvest fluctuations of about 4 per cent on average that varies dramatically with centuries (10 percent in the eighteenth century, down to 1 percent in the nineteenth century) and with the various agro-ecological farming regions (e.g. stronger response on plains region rather than on forest or brushwood regions). Similarly, Bengtsson et al. (2004), in an edited volume, suggest a 2.8 per cent mortality response for late imperial China (1749-1909, chapter 10), a 2 percent response for eastern Belgium (1812-1900, see chapter 7) and a 5.4 for four Scanian parishes in Sweden (1766-1865, see chapter 6). What is striking here is that these examples are dealing with cases at least a century apart from our case, which is situated in the early 20th century. This could be seen as a reflection of the diverging development between these world regions. Yet, the slightly higher effect is evident even when looking at the response from a contemporary comparative perspective, Lohmann and Lechtenfeld (2015), for example, suggest a 10 percent morbidity response in 2,000 households in rural Vietnam, and Deschenes (2014), in a meta-analysis article, suggests an average of 12.5 percent morbidity response to harvest fluctuations.
There is an explanation why the response is somewhat stronger than that which the literature predicts (considering the large chronological difference). We argue that this has to do with the economic and institutional framework in which this study is embedded, which to some extent, reflects the limited attention the colonial government paid to local food production. And although the Malaya Peninsula is often portrayed as a “success” case – mainly due to the relatively high growth in GDP in the first decades of the 20th century, it remains questionable the extent to which the colonial government managed to convert this growing national output into improved living standards for the rural population (Booth, 1998). Economic historians of Southeast Asia have recorded that the nutritional intake for the mass of the population in that region did not improve during those decades and that high mortality rates were prevalent (Booth, 1998; Brown, 1986; Elson, 1997; Boomgaard & Brown, 2000).

With our results, we certainly do not argue that the rural populations in the Malaya Peninsula were economically secure in the post-1931 era, nor that their living standards exhibited a marked increase beyond subsistence. Rather, our argument is that during the years of depression the rural peasant farmers avoided a further major deterioration in their material conditions, mainly due to the government’s strong emphasis on and encouragement of padi rice cultivation. Additionally, with our empirical design and results we aim to unveil the common held belief that colonial policies have always been monotonic and static without episodes of alteration (see Austin’s (2008) discussion on compression of history).

Turning now to our empirical strategy, in addition to the basic use of hospitalization rates as a measure of general illness and morbidity, we further sub-divide diseases into three distinct categories: (i) infectious diseases, (ii) non-communicable deficiency-related diseases and (iii) diseases that are not nutritional-related (e.g. venereal diseases). The results suggest that rice harvest failures only have an effect on nutritional-related diseases (the first two categories), leaving the non-nutritional ones unaffected. Such testing serves as an important validation to our empirical strategy and adds a degree of reliability to the selected data of morbidity and mortality, which appear to be highly suitable for capturing health conditions. In additional specifications, we refute that the effect of the new policy is driven by any of several confounders. We show that our results remain robust to the inclusion of several confounders (e.g. market access, rice prices), alternative threshold years of the NRP (e.g. rate of compliance

5 A demonstration of this point can be found in the administration reports in which many officials remarked that “in the course of our travels through the country, we have seen clearly demonstrated that, wherever rice equal to or in excess of the local needs of the population is being produced, the distress incident on the trade depression is minimal” (CO 437, pp. 68-69).
with the new policy), and alternative econometric specifications (e.g. using lagged independent variables).

As a ‘falsification’ experiment, we altered the first year that the new policy was in effect for each district and re-run the analysis. The results showed that when we use 1929 or 1930 as a cut-off point for the new policy, the effect, expectedly, disappears. As an additional falsification test (a so-called placebo test), we show that when we run the analysis with a sample where the new policy was never implemented (i.e. Unfederated Malay States), the response remains strong throughout the period (i.e. 36.4 per cent for morbidity and 13.3 per cent for mortality), without signs of decline. In other words, if there was a general increase in material conditions in the post-1930s era, it should have appeared in the Unfederated Malay States sample as well.

Our results have important implications for the literature on colonial policies. While few would deny that colonial agricultural policies brought enormous profits for the metropoles, limited attention has been paid on the fact that the implementation and impact of such policies varied across time and space. Contrary to what it is often assumed, colonial policies have been found to switch from facilitating European interests (e.g., export-commodity production and revenues) towards encouraging smallholder production if or when changing economic and political circumstances gave reason to do so (Frankema et al., 2016). Our results provide strong evidence to the idea that the colonial policies were far from static. More specifically, we show that while in the first three decades of the twentieth century there was a strong emphasis by the colonial government on importing large quantities of rice and fostering export-commodity production, in the 1930s there was a major food policy change that encouraged domestic rice production and prioritized food security among smallholders. As it is expected, such a major policy change was fiercely debated among the high-ranking colonial officials (see section 3), and certain restrictions to land and labour that had been previously proposed, were now being reversed (Elson, 1997).

The weakening morbidity and mortality response to harvest fluctuations we estimated is a general district average. That means that there is a degree of heterogeneity of the effect across the districts, and the response might be different in different districts. For example, some districts might have been more efficient in implementing the recommendations of the new policy than others. Does that not mean that we expect them to have an even sharper reduction in mortality and morbidity in years of harvest failures? To gain a deeper understanding of the underlying heterogeneity the new policy brought about, we perform a number of additional investigations. We test whether the responsiveness of morbidity and mortality to harvest
fluctuations was different after the new policy conditional on district-specific (contextual) factors. To illustrate one factor with one example; we would expect the morbidity response to harvest fluctuations after the new policy to have been even weaker in districts that invested considerably more of their budget in irrigation and drainage schemes (as compared to districts that the new policy was implemented, but did not invest as much in irrigation and drainage). The hypothesis here is that districts that invested a larger share of their budget in public infrastructure targeting rice production, eventually managed to diminish the consequences of harvest failures more efficiently than the ones that invested relatively less.

In summary, we find that the mortality and morbidity response to harvest fluctuations was substantially weakened in districts where the new policy was in effect and (i) where public expenditures for agricultural purposes were relatively higher and (ii) where the increase in new rice fields under cultivation was relatively higher. Contextual factors that did not seem to add heterogeneity to the result of the new policy was whether the overall suitability of soil to cultivate rice was relatively higher in some districts than other, whether a district had large volume of rubber production and whether easier access to the market made a difference.

The remainder of the study proceeds as follows. Section 2 reviews the social and economic conditions of Malay smallholders and discusses the motives behind the New Rice Policy. Section 3 reviews the food crop/export crop debate among colonial officials and among scholars. Section 4 describes the data and data sources. Section 5 lays out the empirical strategy. Section 6 presents the empirical findings. Section 7 concludes.

2. The New Rice Policy as a reaction to the Great Depression.

The economic depression of 1929 was undeniably the longest, deepest and most widespread downturn in economic activity the developed world had ever seen. Yet it had far-reaching and devastating repercussions also in countries of the global south that specialized in primary commodity exports. As world trade slumped, demand (and prices) for tropical agricultural products fell dramatically, leaving large parts of rural areas without an outlet to sell their products. The Malay States were the second largest rubber exporter of the world at the time, and as a result, during the depression their state revenues plummeted (Kratoska, 2000). Malay farmers encountered unprecedented threats to their livelihoods, as they were left with tons of unsold inedible crops (Lim, 1977; Elson, 1997). All exports showed a dramatic drop, but the fall in rubber earnings was especially disastrous. The value of rubber dropped from $202 million in 1928-1929 to $37 million in 1932 –a decrease of about 81% (AR, 1933). A quick glance at Figures 1 and 2 below, illustrate the collapse of the world market price for rubber after
1929. The price dropped from 0.126 in 1927 to a historically record low of 0.027 in 1934 (Figure 1). The drop is approximately 80 percent. The world market price for rice continued its declining trend (although not as sharp).

**Figure 1. World Market Prices**

![Graph](image)

*Source: Provincial Reports, CO 576-24/63. Both lines indicate the unit value price of each crop. The blue line shows the rubber world market price, and the red line shows the rice world market price. The vertical red (dashed) line indicates the beginning of the Great Depression (1929).*

Looking at the rubber to rice price ratio in Figure 2, it is evident that the material position of the rubber farmer was reduced in half after 1929. World market price for coffee, sugar and other primary commodities followed a similar (declining) trajectory. It is not entirely surprising, then, that in areas exporting large volumes of commodities, such as the economies of South and Southeast Asia, the economic depression had devastating effects. It should be noted here that the effects were by no means even among those areas. During the 1930s depression some of the economies have suffered severely but others, much less so (see Brown (2005) and Boomgaard & Brown (2000) for an overview of the uneven consequences of the economic recession in South and Southeast Asia). Since the middle of the nineteenth century, these areas contributed to a substantial expansion in the cultivation of crops for the world market. Yet as their contribution steadily augmented, so did their dependency on cash income derived from the cultivation of a single commercial crop.
Figure 2. Rubber to Rice Price Ratio

Source: Provincial Reports, CO 576-24/63. The line shows the rubber market price divided by the rice market price, multiplied by 100. The vertical red (dashed) line indicates the beginning of the Great Depression (1929).

In the aftermath of the world recession, one would expect that the spectacular drop in primary commodity prices to have significantly deteriorated the material circumstances of South East Asia’s rural populations. Nevertheless, when one turns, for example, to the morbidity statistics of the Federated Malay States around those years, will notice that they were actually on a sharp decline (Figure 3). While in 1928 there were 1,800 patients treated in hospitals for nutritional related diseases in the Peninsula, the same figure in 1932 was only 812 patients—a decline of a bit more than 50%. Reasonably, questions arise. How could the protected Malay States have survived such a recession? How did the States manage not only to remain seemingly unaffected, but also exhibit signs of recovery? After all, they had committed vast tracts of cultivated land to export crops and were the main source of one of the most important raw materials (rubber) used in the industrial production in the U.S.. Thus, one would expect to observe dramatic consequences to the general prosperity of the farmers. Instead, the historical record does not seem to corroborate this hypothesis. How can we reconcile those seemingly contradictory images? What would a plausible explanation be for such a paradox? In this study, we argue that the material conditions of the smallholders were not further deteriorated, as one would expect, mainly due to the implementation of the New Rice Policy the colonial government implemented.6

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6 Expectedly, there might be concerns that the observed decline of hospitalization rates could be driven by other unobserved factors (Figure 3). For example, one could hypothesise that there were fewer hospital beds available during the depression years, not necessarily because people were less sick, but because there was less money to bring people to the hospital. After all, travelling to the hospitals cost farmers and workers time and wages. For such and other confounding reasons, we have selected a methodology specifically to target and remedy those concerns (see Empirical Strategy section).
Although many colonial officials were initially unenthusiastic about rice cultivation, and keen to foster export-commodity production, the widespread depression strengthened the conviction among them that a new government policy was needed to boost peasant food-crop cultivation (Lim, 1977). Soon after the recession, the colonial government began devising a plan for fostering domestic padi-rice cultivation as a remedy to the economic crisis. The first step was to appoint a Malayan committee under the leadership of the director of Agriculture. The committee visited most of the padi-cultivating areas in Malaya and interviewed the local farmers as well as the district, land and agricultural officers. The results of the investigations, the minutes and additional evidence were brought together into a two-volume report, published as the Rice Committee Report (RCR). The report was highly effective, since it accomplished to bring together information that was hitherto scattered or inaccessible. It contained detailed information on land and crop suitability, rice cultivation methods and costs as well as the problems of water control (irrigation and drainage) and funding.

Following the recommendations of the Rice Cultivation Committee, the colonial government took several actions. One of the most significant and effective actions was the construction of several small and large-scale drainage and irrigation systems targeting specifically rice fields. For that purpose, a separate Irrigation and Drainage Department was established, borrowing existing agricultural techniques from the Hydraulic Branch of the Public Works Department. Re-organizations in several other administration branches were carried out as well. The Department of Agriculture, for instance, was split into two divisions, one to carry out inspections into the rice farms and the other to offer instruction and advice to Malay farmers.
The ultimate goal was to provide assistance in maintaining old drainage and irrigation schemes and to restore fields that had been abandoned or were threatened by silting.

The Rice Committee had a clear recommendation about lands that were not cultivated with rice or were not cultivated at all, stating that:

"…areas of land which still remain uncultivated constitute a source of wealth and above all security which should not lightly be diverted from the purpose to which it is best suited, viz., the production of rice. Large areas of potential rice land have already been planted under other crops to which in some cases they are ill-suited and we regard it as essential that further tendency in this direction should be checked so far as may be possible.” (Rice Committee Report, 1931, p.20, §35).

Against this background, the committee advised for harsh restricting measures against rubber cultivation and consulted the government to repeal and amend the Land Enactment of 1926, in order to contain the provision that

"…no land which is in the opinion of the Resident more suitable for cultivation with wet rice or for being rendered by irrigation shall be alienated except under a special condition requiring the same, or a proportion thereof, to be cultivated annual with wet rice and prohibiting the planting of any other product thereon.” (Rice Committee Report, 1931, p.20, §36).

To quell any remaining scepticism in the government and to make sure that the policy would be enforced and supported over time, the Committee worked in three directions. First, it bolstered its claims by providing detailed maps, in which it marked all areas that were (or could be made) suitable for rice cultivation. Those maps did not allow for much doubt as to which land would be considered as rice land and which not. Second, it is telling from the Committee’s requests on legislation enforcement that they were worried that their suggested provisions could be overlooked in the near future. Therefore, it recommended the inclusion of its recommendations and amendments in the Land Code of 1926, as a way to legally enforce its new provisions (Rice Committee Report, p.20, §40). Third, with regard to land tenure, it
was further proposed that if a plot of land has not been continuously cultivated with rice in the proper manner for a period of two years, the land should be liable to forfeiture. Similarly, when a water control scheme had been established in a plot of land and the planting of other crops was found, harsh penalties should be imposed (Rice Committee Report, p.22, §43-46).

In various occasions, the Committee expressed its disappointment about the state of affairs in the Unfederated Malay States, where the new policy could not be enacted:

“…we desire to state that we consider that legislation in respect of this question is desirable so far as possible throughout Malaya, that the provision of the Federated Malay States legislation with the modifications suggested above constitute a desirable standard at which to aim and that such legislation should be enacted in the Unfederated Malay States as and when occasion may present itself. These provisions are in the interests of the cultivators themselves.”

Reading the agricultural reports of the U.F.S., one can easily observe that the controversy between rice and rubber was equally acute. In Kelantan, 1930, (CO 827-2, p. 234) the district officer summarized that “before the advent of rubber, rice formed the exclusive occupation of the peasant, and was the chief source of general prosperity. The coming of rubber, however, with its high prices and comparatively easy work, naturally captured the imagination of many, and interest in padi planting declined. Ancient padi lands were planted with rubber, whose stunted growth and sickly appearance make a depressing spectacle”.

In line with the Committee’s recommendations, the government of the F.M.S. launched a series of programmes to promote the use of selected strains of rice that had been proven more resilient. Other programmes included the control of rats and various pests that damaged rice crops. In addition, large parts of previously uncultivated land were transformed into rice fields and generous investments in houses, roads, markets, schools and rice mills soon followed in those areas. It is, thus, not surprising that not only the area under rice cultivation increased shortly after the depression, but also the rice yields grew increasingly productive. What stands out, however, as key to this new policy, is the government’s willingness to abandon coercive measures and, instead, to favour an approach that emphasized education and willing cooperation of the rural population (Kratoska, 2000, p. 282).
The effect of NRP on acres of land devoted for padi cultivation and annual production was immense. In the six years following the new policy (1931-1937), the *acres under padi cultivation* in the Federated Malay States reached 196,181 as against 169,230 in the six years before the new policy (1924-1929). For comparative purposes, it is worth noting that the acres of padi cultivation in the Unfederated Malay States, where the new policy was never implemented, decreased during those years from 259,335 acres in 1924-1929 to 232,253 acres in 1931-1937 (see figure A-1). The increase in *rice production* was even more impressive. In the years following the new policy (1931-1937), the average annual production of padi in the F.M.S. was estimated at 49.7 million gantangs compared to 30.3 million gantangs in the years prior to the this policy; an increase of approximately 63.4 per cent or 3.2 million gantangs per annum (see Figure 4). The corresponding annual production in the U.M.S. was 80.1 and remained at 85.6 million gantangs, revealing the significance of the new policy.

**Figure 4. Total Rice Production in F.M.S. and U.M.S**

![Graph showing rice production in F.M.S. and U.M.S.](image)

*Source:* Annual Reports, CO 576-24/63. Provincial Reports, CO435, CO437, CO438, CO439. The line shows the rice production in million gantangs in FMS and UMS respectively. The vertical red (dashed) line indicates the beginning of the New Rice Policy (1931).

We argue that the reason for these sharp increases in rice acres and rice production in the Federated Malay States is primarily due to the attention paid to smallholder rice cultivation by the colonial government, and due to the provision of drainage and irrigation schemes that increased the overall productivity of the land. Unsurprisingly, the acres of rubber cultivation exhibit the exact opposite trend during those years, resembling more of a substitution than a complementarity effect between rice and rubber.

While the aggregate statistical returns leave no doubt about the NRP’s effectiveness, what remains debatable is the extent to which smallholder farmers actually benefitted from this policy and whether the increased degree of self-sufficiency actually increased their resilience.
to food crises, improving their general wellbeing. The empirical analysis that follows aims to fill this gap by studying the response of morbidity and mortality to harvest fluctuations before and after the new policy at the district level.

3. The Horns of a Dilemma: colonial and academic debates

The first four decades of the 20th century witnessed a continual debate among colonial officials concerning agricultural policies in the Peninsula. The disagreement stemmed from rather opposing theoretical and ideological viewpoints, and from a need to find the most efficient way to address the issue of self-sufficiency and public expenditure allocation (Goldman, 1975). Disagreements on those issues led to ongoing debates visible in the archival material. Reading through the sources can be very revealing about the nature of the conflict out of which the new rice policy was born.

In 1931, the director of the Rice Committee summarized the two dominant views quite eloquently: “there were few subjects which have attracted more attention in Malaya and concerning which there has been more discussion and correspondence at various times than the cultivation of rice...there has been a sharp conflict of ideas on the subject of the economic position of rice cultivation in Malaya.” According to him, there were two distinct schools of opinion. One school of thought held the conviction that the road to prosperity depended on the cultivation and production of commercial crops, and that rice was of comparatively small importance to the country. This was a strong conviction, largely strengthened by the country’s long tradition of importing food supplies along with its geographical location Malaya’s close proximity to three of the major rice exporting countries in the world –Siam, Burma and Indochina– acted as re-assuring condition. As a result, many officials was of the opinion that since “it had been always possible to purchase supplies of rice from foreign countries on more favourable terms than they can be produced in Malaya...”, there was no need for concerns about food supplies (RCR, 1930 p. 14).

That this view was dominating the policy agenda in the early days of colonization in the Peninsula is evident when one looks at the import volumes of rice. In the early 1910s, the Federated Malay States imported an average of 190.000 tons of rice annually or approximately 82 per cent of its annual rice consumption. Unsurprisingly, domestic production during the same period was significantly low and was estimated at 43,000 tons of rice annually. Other officials, in support of this view, were pointing out the “smallness of profits derived from padi planting as compared with other kinds of agriculture”. They were arguing that the “derived

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7 More specifically, import volume for the 1911-1916 was 170.357, 191.131, 208.155, 207.202, 188.571 and 181.607 tons.
earnings brought about by exporting rubber could offset any domestic food requirements, since the world market price for rice was low and that of rubber significantly high” (CO 576-32, p. 88).

The opposing view maintained that the domestic food supply is of vital importance and that “high dependency on imported supplies of rice is a source of danger” (CO 435-4). In the unfortunate event of an acute fall in the price of export crops or a shortage of rice in the foreign countries from which Malaya was importing, a grave food crisis might quickly arise (RCR, 1930 pp.14-15). Such was the case in 1919-1921, when a breakdown in imported food supplies from Burma and Siam left large masses widely distressed in the Peninsula. The strongest proponents of the domestic food supply view pointed out that “the market may slump as it will, where rice itself is the export crop, without serious consequent suffering. But where other crops must furnish the money to buy foreign rice, hunger may enter promptly when rubber, tobacco, coffee and tea cannot be sold. (RCR 1930 p. 15)”. Therefore, they were encouraging the government to take decisive steps “to enhance notably the production of rice in Malaya, which may be regarded as an insurance against the possibilities of future crises owing to food shortage” (RCR 1930, p. 15).

In many of the Agricultural reports, officials often praised the governments of Burma, Java, and the Philippines, who “gave their keenest attention to stimulating the production of rice”, thus securing a better nutritional status for the rural populations. Several officials were also highly concerned with the viability of this option of importing food supplies in the long run, indicating that “the available quantity of rice to export in these countries does not show a marked tendency to increase, and data do not warrant the expectation that any increase will occur. In the presence of such condition of affairs a failure of rice crop in these exporting countries may well create a condition of serious crisis throughout rice importing countries which has not hitherto been paralleled.” (RCR 1930, p. 15). Other were commenting (CO 438-5, p. 113) that “the return to normal economic conditions as contrasted with the abnormal conditions produced by the rubber boom has led to more stable and satisfactory conditions of life”. The conflict of ideas was evident and ongoing.

Unsurprisingly, this debate did not only preoccupy colonial officials, but academics and social scientists too. The role of colonial agricultural policies in food security has been widely debated across several disciplines, including history, economics, sociology and demography (Scott, 1976; Watts, 1984; Fafchamps, 1992; Berry, 1993; Goetz, 1993; Braun & Kennedy 1994; Govereh & Jayne, 2003; Papaioannou & de Haas, 2017). While a consensus has emerged in the literature on colonial legacies that tropical economies have expanded, to varying degrees,
in response to access to international trade, there is widespread disagreement regarding the extent to which smallholder farmers have actually benefitted from such developments (Myint, 1958; Fieldhouse, 1999; Bates, 2005; Austin, 2014). To date there has been little agreement on what was the net effect of the late nineteenth, early twentieth century commercialization process of smallholder agriculture.

The literature is highly divisive on the subject, generating two rather opposing views. In the dependency view, on the one hand, it is widely argued that the colonial policies that favoured the cultivation of inedible export crops had mainly negative effects on the welfare of the farmers. The imposition of (new) export cropping forced the smallholder to shift his labour from food crops to inedible export crops, jeopardizing his food security. The process of export-crop adoption was made possible through the direct coercion of compulsory cultivation and forced labour, and through the indirect pressure of taxes (fixed head and land taxes) that had to be paid in cash. To the eyes of the colonial government, taxation on export crops (custom duties) was also an efficient way to monetize the economy in order to generate revenues and extract surpluses. Another argument usually put forward from dependency theorists is that export crop production led to exploitation mainly due to monopsonistic conditions of marketing boards, as those boards were setting prices lower than the world market price, preventing smallholders from realizing maximum potential benefit from trading.

Besides the economic impact of those policies, arguments of a more social nature have been suggested. For example, it has been argued that export crop production eroded precapitalist, “moral economy”, insurance institutions across the communities, by advancing capitalist production and capitalistic market relationships (Scott, 1976; Watts, 1984; Fafchamps, 1992). Notions like fair market price, solidarity and safety net were substituted with others like profit, interest and individualism. In the dependency literature, smallholders are usually portrayed as being risk-averse and guided by the ‘safety-first’ principle. As Scott (1976, p.24) puts it “the safety-first principle does not imply that peasants are creatures of custom who never take risks they can avoid. When innovations such as dry season crops, new seeds, planting techniques, or production for market offer clear and substantial gains at little or no risk to subsistence security, one is likely to find peasants plunging ahead. What safety-first does imply, however, is that there is a defensive perimeter around subsistence routines within which risks are avoided as potentially catastrophic and outside of which a more bourgeois calculus of profit prevails.”

The neo-classical view, on the other hand, holds that the cultivation of export crops besides raising rural incomes, improves welfare, food security and nutritional statues that could
otherwise have been worse (Maxwell & Fernando, 1989; Braun & Kennedy, 1994; von Braun 1995). According to this strand of literature, cash cropping allows improved factor utilization in both the short and long terms. In the short term, it utilizes factors that otherwise would have been idle, the so-called “vent-for-surplus” theory (Myint, 1958), while in the long term, it leads to specialization, labour productivity and gives rise to economies of scale. Furthermore, it is argued that the diversification of production (i.e. cultivating both food and cash crops) enables smallholders to spread risk and smooth their consumption patterns. Having storable wealth from export crops, smallholders were less dependent on extreme weather conditions and harvest fluctuations (Govere & Jayne, 2003; Papaioannou & de Haas, 2017). In bad years, farmers were able to obtain food at the market and to utilize such income for other essential expenditures (e.g. medical, house improvements, investment in improved seeds).

Similarly, it is argued that there is a complimentary spillover effect between food crops and cash crops. Cash crop schemes induce state investments in a particular area that provide benefits to all farmers in that region, regardless of whether they engage in that commercialization scheme (Govere & Jayne, 2003). Lastly, the revenues generated from export crops provided the state with the means to invest in new agricultural technologies (e.g. fertilizers, improved seeds), infrastructure (e.g. railway, roads) and food security (e.g. food relief programs). The debate is far from settled and the findings are contradictory.

In recent years, the debate about colonial agricultural policies has gained fresh prominence in economic history with many studies engaging in empirical testing in support of one or the other view (Papaioannou & de Haas, 2017; Fenske & Kala, 2015; Papaioannou, 2016; Tadei, 2016; Burgess & Donaldson, 2010; de Haas & Papaioannou, 2017). This surge can be partially explained due to the recent data revolution in the economic history of developing regions (Fourie, 2016), and partially due to methodological advances that enable scholars to isolate the net effect of a certain policy while taking into account the inherent complexities of the socio-economic environment.

While there is a considerable amount of studies indicating that in pre-industrial European societies, short-term fluctuations in food prices and/or real wages led to demographic responses (e.g. lowered fertility and marriage rates, and to extreme cases, increased mortality), there has been little discussion about such responses in colonial societies. In addition, there have been very few studies that use harvest fluctuations as the key measure of material conditions (Dribe et al., 2017). Instead, the vast majority uses either food price or real wage fluctuations. One of the main reasons for this is the absence of reliable output series (e.g. crop yields) for pre-industrial societies. The main problem with grain prices is that they entail
information that not only reflect local harvest conditions, but also levels of trade openness and market integration, and to some extent harvest conditions of surrounding areas (Edvinsson, 2012; Dribe et., 2017). Thus, when available, the food yields should be preferred.

4. Data

The data for this study were obtained from original archival sources located at the National Archives in Kew Gardens, London. Several colonial administrative accounts were used. These were published by the Colonial Office and include the Annual Reports, the Provincial Reports and the Blue Books of Statistics (see Appendix for more details). We were able to retrieve spatially disaggregated and chronologically consistent information on climate, agricultural output, health and demographical rates, assembling several strongly balanced panel datasets for the period 1924-1937. The summary statistics are presented in Table 1 below. Panel (a) includes the main dependent variables. Panel (b) includes information on padi-rice acres and production as well as other agricultural indicators. Panel (c) includes the weather measures and their adjusted forms. Lastly, Panel (d) lists the remaining control variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalization rate</td>
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<td>61.16</td>
<td>29.90</td>
<td>3.74</td>
<td>166.11</td>
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<tr>
<td>Ln(Infectious diseases)</td>
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<td>0.71</td>
<td>1.44</td>
<td>4.65</td>
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<tr>
<td>Ln(Non-communicable deficiency diseases)</td>
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<td>3.73</td>
<td>0.57</td>
<td>1.05</td>
<td>4.23</td>
</tr>
<tr>
<td>Ln(Non-nutritional related diseases)</td>
<td>336</td>
<td>2.89</td>
<td>0.44</td>
<td>1.01</td>
<td>3.67</td>
</tr>
<tr>
<td>Total Mortality rate</td>
<td>336</td>
<td>21.50</td>
<td>5.24</td>
<td>10.50</td>
<td>40.96</td>
</tr>
<tr>
<td>Ln(Mortality rate)</td>
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<td>15.05</td>
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<td>Deaths in Hospital</td>
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<tr>
<td>Ln(Death rate)</td>
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<td>0.35</td>
<td>-0.72</td>
<td>1.17</td>
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<table>
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<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
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<tbody>
<tr>
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<td>2.61</td>
<td>1.46</td>
<td>-0.85</td>
<td>5.46</td>
</tr>
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<td>Padi rice production (z-score)</td>
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<td>0.00</td>
<td>-2.31</td>
<td>2.80</td>
</tr>
<tr>
<td>Ln(Acres of padi rice)</td>
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<td>4.18</td>
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<td>6.59</td>
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<td>Acres of padi rice (z-score)</td>
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<td>0.00</td>
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<td>-2.21</td>
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<tr>
<td>Ln(Rubber Acres)</td>
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<td>Rice suitability (FAO)</td>
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<tr>
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<table>
<thead>
<tr>
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<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
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<th>Max</th>
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<tr>
<td>Rainfall deviation (z-score)</td>
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<td>0.00</td>
<td>1.00</td>
<td>-2.56</td>
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<td>Rainfall absolute deviation (linear)</td>
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<td>1.00</td>
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<td>0.31</td>
<td>0.00</td>
<td>1.00</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
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<td>122.49</td>
<td>129.80</td>
<td>6.44</td>
<td>694.63</td>
</tr>
</tbody>
</table>
Road density (miles)  |  336  |  298.57  |  133.44  |  146.20  |  601.68  
Ln(Public Expenditures)  |  336  |  12.29  |  0.79  |  9.96  |  13.31  

*Notes:* Author’s calculations. See main text. *^1* denotes that this category was included in the total hospitalization rate. *^2* denotes diseases that are not nutritional-related and were not included in the total hospitalization rate.

### 4.1 Dependent Variables: Morbidity & Mortality

#### 4.1.1 Morbidity

One of the two principal measures of health conditions is constructed with data obtained from the annual *Medical Reports*. These reports provide detailed information on the number of patients that sought for treatment in the local hospitals as well as the type of disease related to the visit. Our preferred measure to capture morbidity is the natural logarithm of hospitalization rates per 1,000 of the population. Under hospitalization rates, we only included patients that suffered from nutritional-related diseases. Following the epidemiological literature, the nutritional-related diseases are (a) infectious diseases such as gastroenteritis, tuberculosis, pneumonia, dysentery, malaria etc. and (b) non-communicable deficiency-related diseases that can be acquired in the short or in the long-term such as cardiovascular, ischaemic heart disease, beriberi, hypertension, diabetes, dental decay etc. Our hypothesis is that food shortages and lower income from agricultural sources can give rise to those two categories of hospitalization. We hypothesise that food scarcity may lead to a substantial deterioration of nutritional intake, instigating malnutrition and an impaired immune system, and as a result, more individuals will end up in hospital. Nevertheless, to validate our results, we perform a ‘falsification test’ (a so-called ‘placebo test’) using non-nutritional-related diseases (such as accidents, venereal disease etc.) as the dependent variable. We expect the response of harvest fluctuations to non-nutritional related diseases to be virtually zero.

Overall, we acknowledge that there may be differences in hospital capacity and/or in overall welfare across the 24 districts in the sample. For example, it is well known that some districts had sufficiently funded Mosquito Destruction Boards while other did not (see Parmer 1989 for a thorough discussion on Malay regional differences in health outcomes). Such factors of course can explain sharp level differences in annual deaths. However, our intention is not to compare if and how one district performed better or worse than a neighbouring one, but rather to investigate how each district reacts to harvests fluctuations year after year, and whether the new rice policy made smallholder farmers more resilient to those fluctuations. Moreover, we argue that the normalization adjustment we performed along with our econometric setting (fixed effects panel data approach), effectively deals with any remaining cross-district differences.
It is fair to say that many sick persons could not get to a hospital when they needed one and hundreds avoided them. In addition, many deaths went unrecorded. Therefore, we should acknowledge that the official data frequently understated the actual incidence of both disease and death. Nevertheless, that means that our estimated results would only demonstrate a lower bound estimate, as we expect this particular under-reporting bias to understate the effect.

4.1.2 Mortality

We were able to obtain death rates from two different sources. The first source was the annual Demographic Reports, which include the total amount of deaths in each district during a calendar year. The total crude death rate in the Federated Malay States during the interwar era was 23.11 deaths per 1,000 of the population. The second source was the annual Medical Reports, which include information on the total amount of patients dying in hospital during a year. Both measures were adjusted to serve econometric purposes. After aggregating them at the district level, we normalized them by dividing by the population and multiplying them by 1,000. To facilitate the reading of tables we took the natural logarithm. The summary statistics of these variables are presented in Panel (a) of Table 1. It is important to stress here that the mortality rates are almost surely underestimates of the extent of total mortality in British Malaya due to insufficient recording capacity. The correlation between crude mortality rate and deaths in hospital is reasonably strong with an $R^2 = 0.31$. Since we believe that the deaths in hospital measure is more reliable than the overall death rates, we show results only for the latter and keep the former set of results for the online Appendix. Lastly, we would expect the impact of food shortages to be less strong on mortality than on morbidity.

4.2 Rainfall

Data on rainfall were based on local meteorological stations and were obtained from the annual Meteorological Reports. All districts included in this study had at least one meteorological station within their border. If there were more than one, we took their average. Our main measure of rainfall is the standardized deviation of rainfall from the long-term mean for each district (equivalent of a z-score). While sufficient and well-distributed rainfall is crucial for subsistence and income generation in agrarian, rain-fed societies, extreme and unexpected rainfall patterns can reduce agricultural output through lower yields and jeopardy household food security. Thus, rainfall should be taken as the key climate variable in terms of its impact on agricultural productivity and, as a consequence, on rural livelihoods (Papaioannou, 2016).

Instead of estimating the impact of too little rainfall on the outcomes of interest, we allow our specifications to account for the impact of too much rainfall on the related outcomes.
This is a standard procedure in the literature, since many studies have found a non-linear (U-shaped) relationship between rainfall variation and agricultural output (Papaioannou, 2016; Papaioannou & de Haas, 2017; Blakeslee & Fishman, 2017). Since we expect the effect of rainfall extremes on rice production to be non-symmetrical, we refine our standardized rainfall measure and generate two additional variables of rainfall; one to account for excessive rainfall deviations, named floods, and one to account for negative rainfall deviations, named droughts. The flood variable takes the value of 1 when annual rainfall in a district is one standard deviation or more above the long-run mean rainfall level, and 0 otherwise. Similarly, the drought variable takes the value of 1 when annual rainfall is one standard deviation or more below the long-run mean.

4.3 Agricultural Data

District-level agricultural data were obtained from the annual Agricultural Reports as well as from the agricultural surveys devised by the Rice Committee. These sources include detailed information on rice yields (measured in gantangs), rice and rubber cultivation land (measured in acres), and volumes of imported and exported agricultural products for each district (measured in pounds). To allow for meaningful comparisons in the empirical analysis, our preferred measures are the natural logarithm of rice production per 1,000 of the population and the standardized z-scores of rice production.

4.4 New Rice Policy (NRP)

In 1931, the Rice Cultivation Committee introduced and passed the New Rice Policy Act to “provide the enhancement of livelihood security of the households in rural areas of the country by providing rice”. The Committee, after its comprehensive investigations of the Peninsula, published a series of findings and recommendations in a lengthy 120-page report, revealing the necessary steps in order to encourage the extension of rice cultivation in the Peninsula. Its ultimate goal was to provide “an insurance against possible future crises owing to food shortage”. The Committee revealed the dangers of relying on imported food supplies and pointed out the importance of water control in padi cultivation, calling for the establishment of the Department of Drainage and Irrigation with several branches across the Peninsula. It also proposed that the remaining underdeveloped areas of potential padi land should be preserved for padi cultivation, and not for rubber one. Assuming that all that land is used for padi cultivation, it concluded that the production of rice would then be sufficient for the needs of the Malay population (RCR, 1931, pp. 1-6).
The New Rice Policy was officially in effect from the 1st of March 1931. However, not all districts began acting on that at the same time. To get a precise estimate about the timing the new policy was in effect, we relied on three different sources. The first one was to read through the annual agricultural reports within the series of the *Provincial Reports*, the second one was to follow the annual reports from the *Drainage and Irrigation* department, and the third one was to observe the rice statistics published in the *Blue Books*. In this way, we were not only able to identify for each district (n = 24) the month during which the new policy was enacted (*de jure*), but also the month during which it was actually implemented (*de facto*). We then created a new variable by assigning a dummy of 1 in years when the new policy was actually implemented (*de facto*), and 0 otherwise.

For robustness, instead of taking the NRP dummy, as described above, we generated a new one based on the rate of compliance with the new Policy variable. For this variable, we estimated the degree of compliance with the new rice policy, by ranking the percentage increases of rice acres under cultivation after the new policy was in effect. To illustrate with one example, the mean rice land under cultivation in Lower Perak (Perak State) before the new rice policy (i.e. 1924-1930) was 3,670 acres. After a whole year that the new policy was in effect (i.e. January 1933) the mean rice land was 6,223 acres; an increase of about 69.5%. Conversely, in Ulu Langat district (Selangor State) the rate of compliance with the new policy was only 11% pre and after the new policy was in effect. We assigned the value of 1 in districts that exceeded a 50% rice compliance with the new policy and 0 otherwise.

4.5 Controls and Other Variables

We obtain data on a few time-varying indicators such as road mileage, population density and public expenditures. Their summary statistics are presented in panel (d) of Table 1.

5. Empirical Strategy & Econometric Framework

Our empirical strategy is divided into three distinct stages. In the first stage, we establish that annual harvest fluctuations influence morbidity and mortality rates in the full sample for all years (1924-1937), running a two-stage instrumental variable regression (IV-2SLS) with rainfall variation as the instrument. While previous studies in economics and economic history have established that rainfall variation is a suitable proxy for harvest fluctuations, particularly in pre-industrial settings (Mehlum et al., 2006; Dell et al., 2014; Papaioannou, 2017), we test its validity with several robustness checks. In the second stage, we proceed by assessing the impact of the New Rice Policy on morbidity and mortality rates before and after it was in effect.
To achieve that econometrically, we use the interaction term between the new rice policy dummy and harvest fluctuations (NRP dummy × Rice production). This approach resembles a difference-in-differences model, where we assign 1 in districts where the new policy was implemented and 0 otherwise. We then compare the estimated coefficients. In the third and last stage, we test between mechanisms that could explain our main result. The selection of the mechanisms is based on suggestions from the historical literature of the region. Overall, after each stage, we perform several robustness exercises to test the sensitivity of our findings.

To estimate the morbidity and mortality response to harvest fluctuations (first goal), we run the following IV-2SLS fixed effects specification:

\[
\text{Ln(Health)}_{it} = \beta_0 + \beta_1 \text{Rice Production}_{it} + \text{IV: Absolute Rainfall Deviation}_{it} + \delta'Z'_{it} + \nu_i + \mu_t + (\text{District dummy} \times \text{Time Trend})_{it} + \epsilon_{it}
\]

where Ln(Health)_{it} denotes the natural logarithm of the two dependent variables; hospitalization rates_{it} and mortality rates_{it} per 1,000 of the population in district \( i \) and year \( t \). Rice Production_{it} denotes the production of rice per 1,000 of the population in \( i,t \). Absolute Rainfall Deviation_{it} denotes the annual absolute rainfall deviation of each district \( i \) from the historical long-term mean of the same district (equivalent of a z-score). \( Z'_{it} \) denotes a vector of time-varying controls to avoid any potential omitted variable bias. These include road density, population density and public expenditures in district \( i \) and year \( t \). \( \nu_i \) and \( \mu_t \) are district and year fixed effects, respectively. These controls serve a two-fold purpose. First, they are crucial in controlling for unobservable time-invariant district characteristics, including income levels, production structures, ethnic fragmentation, property rights and geographical conditions and second, they account for factors that could affect the mortality and morbidity rates (either upwards or downwards) across all districts in the same year.

\( (\text{District dummy} \times \text{Time Trend})_{it} \) denotes a set of variables which is the result of interacting unobservable district characteristics (\( \nu_i \)) with a linear time trend. In practice, we control for any other unobservable characteristics that may change over time. A useful example of such a case is changes in district capacity to record and treat patients over time, since doctors in districts with high morbidity may become more efficient in curing patients and certain diseases. \( \epsilon_{it} \) is the error term. The coefficient of interest, \( \beta_1 \), is the estimated effect of a one standard deviation change (either positive or negative) in rainfall on health outcomes. A
negative sign, $\beta_1 < 0$, indicates that harvest failures and negative harvest fluctuations are associated with higher morbidity and mortality.

To address autocorrelation concerns of harvest fluctuations the standard errors are clustered at the district level (no. of clusters = 24). For robustness, we cluster standard errors at the state level (no. of clusters = 4) and at the year level (no. of clusters = 12) as well as both state-year level by two-way clustering. This way we avoid concerns about state-year characteristics that may vary across time, such as law enforcement, or state’s capacity to record and/or treat patients over time. In addition, we control for spatial correlation (cross-sectional dependence) by adjusting standard errors following Conley’s (2009) correction.

To achieve our second goal of assessing the impact of the New Rice Policy on morbidity and mortality rates, we run the following specification:

$$\ln(\text{Health})_{i,t} = \beta_0 + \beta_1 \text{Rice Production}_{i,t} [\text{IV: Absolute Rainfall Deviation}_{i,t}] +$$
$$+ \beta_2 (\text{NRP dummy} \times \text{Rice Production})_{i,t} + \delta Z'_{i,t} +$$
$$+ \nu + \mu + (\text{District dummy} \times \text{Time Trend})_{i,t} + \epsilon_{i,t}$$

(2)

where $(\text{NRP dummy} \times \text{Rice Production})_{i,t}$ denotes the interaction of annual rice production with districts where the new policy was in effect. A negative sign here, $\beta_2 < 0$, would indicate that districts where the new policy was enforced the morbidity and mortality response to harvest fluctuations was weakened. In other words, after the new policy local farmers avoided a further major deterioration in their material conditions and managed to grow increasingly more resilient to harvest fluctuations.

To achieve our third and last goal of revealing the mechanisms that explain our findings, we use an exercise previously used by Dell (2012) and Papaioannou (2017), which explores mechanisms by limiting and dividing samples. In practise, we first reduce our sample to districts that the new policy was in effect and we then assess how the response of each district changed (heterogeneous compliance), conditional on contextual factors (such as high/low public expenditures on irrigation, high/low market access, etc.).

6. Results

The first part of this section (6.1) presents the results of harvest fluctuations on mortality and hospitalization rates (both the first-stage and two-stage IV-2SLS) as well as the results on the different types of disease. Section 6.2 presents the results of the impact of the new rice policy.
Section 6.3 presents the results for various mechanisms and Section 6.4 presents the results from a set of robustness checks.

6.1 Morbidity and Mortality Results.

We show the results of the two-stage least square estimation in Tables 2 and 3. Table 2 shows the correlation between annual rainfall deviation and rice production (first-stage) and Table 3 shows the results of the IV-2SLS (second-stage). In all specification of Table 2, the first-stage relationship between rainfall deviation and rice production is strongly negative and current (not lead or lagged) rainfall deviation is significantly related to rice yields at 99 percent confidence. A one standard deviation increase (flood) or decrease (drought) in rainfall is associated with a more than 0.683 standard deviation drop in rice production. The rainfall instrument is considerably strong. The F-statistic is 28.1 (column 3), which is our preferred specification since all the controls are included. This relationship is robust to the inclusion of time dummies and fixed effects (column 1), district-specific time trends (column 2) and of additional time-varying controls (column 3). Lagged rainfall deviation from the previous two years (t – 1 and t – 2) had no effect on rice yields. As an identification check, we estimate a “false experiment” specification in which lead rainfall deviation (t + 1) is included as an additional explanatory variable. We find that the coefficient estimate is indeed near zero (column 5).

Table 2. Harvest Fluctuations & Rainfall Variation (First-stage)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Rainfall Deviation t</td>
<td>-0.780***</td>
<td>-0.690***</td>
<td>-0.683***</td>
<td>-0.653***</td>
<td>-0.669***</td>
</tr>
<tr>
<td></td>
<td>(0.101)</td>
<td>(0.131)</td>
<td>(0.129)</td>
<td>(0.093)</td>
<td>(0.110)</td>
</tr>
<tr>
<td>Absolute Rainfall Deviation t - 1</td>
<td>-0.058</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.093)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute Rainfall Deviation t - 2</td>
<td>-0.032</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.120)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute Rainfall Deviation t + 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.223</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.151)</td>
</tr>
<tr>
<td>District &amp; Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Controls</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>District-specific effects</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Table 3 shows the results of the two-stage least square estimation (IV-2SLS), as described in equation (1). The estimated coefficient of rice production on mortality is $-0.101$ (column 1) and on hospitalization rates is $0.234$ (column 4). Both estimated coefficients are statistically significant at the 99 percent confidence. In other words, a one standard deviation decrease in rice output increases mortality rates by 10.1% and morbidity rates by 23.4%. The results show that current (not lagged) rice fluctuations are associated with higher mortality and morbidity. The inclusion of district-by-year fixed effects along with district-specific time trends allows us to purge the estimates from a large number of confounding factors that might be correlated with both harvest yields and health outcomes.\(^8\)

**Table 3. Mortality and Morbidity Response to Harvest Fluctuations**

<table>
<thead>
<tr>
<th></th>
<th>Ln(Death rate)</th>
<th>Ln(Hospitalization rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Rice production $t$</td>
<td>$-0.101^{***}$</td>
<td>$-0.111^{***}$</td>
</tr>
<tr>
<td></td>
<td>$(0.016)$</td>
<td>$(0.015)$</td>
</tr>
<tr>
<td>Rice production $t-1$</td>
<td>$-0.001$</td>
<td>$-0.008$</td>
</tr>
<tr>
<td></td>
<td>$(0.004)$</td>
<td>$(0.014)$</td>
</tr>
<tr>
<td>Rice production $t-2$</td>
<td>$0.005$</td>
<td>$-0.016$</td>
</tr>
<tr>
<td></td>
<td>$(0.003)$</td>
<td>$(0.018)$</td>
</tr>
<tr>
<td>District &amp; Year FE</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Controls (time-varying)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>District-specific effects</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>(District dummy $\times$ Time trend)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>No. observations</td>
<td>336</td>
<td>312</td>
</tr>
</tbody>
</table>

Notes: *Significant at 10%, **5%, ***1%. Sample period: 1924–1937. IV-2SLS. The dependent variables are the logarithm of deaths in hospital and hospitalization rates expressed as per 1,000 of the population. The instrumental variable is rainfall deviation at year $t$. Reported in parentheses are standard errors clustered at the district level. Controls include population density and road density. District-specific effects indicate the interaction of each District dummy $\times$ Time trend.

\(^8\) Table 3 shows the results for the natural logarithm of deaths in hospital per 1,000 of the population. The results for total mortality rates are very similar. One standard deviation decrease in rice output increases total mortality by 9.3%.
Table 4 shows the results for the different types of diseases. As expected, low rice crop yields only affect the nutritional related diseases (columns 1-2). A one standard deviation decrease in rice yields increases infectious diseases by 21.1% (column 1) and short-term diseases by 19.7% (column 2), while it does not have an effect on other non-nutritional related diseases. This serves as an important validation to our argument that only diseases reflecting nutritional deficiencies –and by extension reduced living conditions, are affected by reduced food availability. The effect of rice production on non-nutritional-related diseases remains virtually zero and statistically insignificant.

<table>
<thead>
<tr>
<th></th>
<th>Non-communicable Diseases</th>
<th>Non-nutritional Related Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice production ( t )</td>
<td>(-0.211^{***})</td>
<td>(-0.197^{***})</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>District &amp; Year FE</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Controls</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>District-specific effects</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>(District dummy ( \times ) Time trend)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>No. observations</td>
<td>336</td>
<td>336</td>
</tr>
</tbody>
</table>

Notes: *Significant at 10%, **5%, ***1%. Sample period: 1924–1937. IV-2SLS. The dependent variables are the logarithm of each category of hospitalization expressed as 1,000 of the population. Reported in parentheses are standard errors clustered at the district level. Controls include population density and road density. District-specific effects indicate the interaction of each District dummy \( \times \) Time trend.

6.2 The New Rice Policy results

Table 5 presents the results of the new rice policy. These are our estimates of equation (2). Column 1 reports the baseline relationship from the full sample, reproducing column 1 of Table 3 for comparison purposes. Column 2 reports the mortality response to rice fluctuations after the new policy was in effect. The estimated coefficient of the interaction term shows that the mortality response to rice fluctuations was markedly reduced in districts where the new policy was in effect (column 2). This reduction is of sizeable economic magnitude, since it dropped mortality response down to 4.9 per cent; a decrease of a bit more than 50%. To put it differently, the material condition of the smallholder farmers was substantially improved with the new
policy and as a result, farmers became less vulnerable to the adverse effects of harvest fluctuations and harvest failures. In column 3, we show that our results remain robust when we use an alternative method of assigning a district as being under the new policy (i.e. the rate of compliance with the new policy). It is very re-assuring that the rate of compliance with the new policy variable exhibited a slightly lower coefficient than the NRP dummy.

Column 4 reproduces the results of column 4 of Table 3 for comparison purposes. Column 5 shows that the response of morbidity to harvest fluctuations was markedly reduced in districts where the new rice policy was enforced (column 5). The coefficient shows that in districts where the new policy was in effect the morbidity response declined from 23.7 (column 4) down to 12.9 percent (column 5) –a decline of approximately 45%. Column 6 reports the results using the rate of compliance with the new policy as the dummy for the interaction term. Results remain largely similar and statistically significant at the 99 percent confidence.

It is important to note here that our results show only average effects. This average is likely to mask important heterogeneity. For instance, smallholder farmers who did not switch to rice cultivation, and who were not immediately affected by the developments in irrigation and drainage schemes may have been equally vulnerable to harvest fluctuations before and after the new policy.

Table 5. Mortality and Morbidity Response to Harvest Fluctuations after the new Rice Policy

<table>
<thead>
<tr>
<th></th>
<th>Ln(Death rate)</th>
<th></th>
<th>Ln(Hospitalization rate)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td><strong>Rice Production t</strong></td>
<td>-0.101***</td>
<td>-0.147***</td>
<td>-0.165***</td>
<td>-0.237***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.018)</td>
<td>(0.024)</td>
<td>(0.028)</td>
</tr>
<tr>
<td><strong>New Rice Policy Interaction</strong></td>
<td>-0.064***</td>
<td></td>
<td></td>
<td>-0.129***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td></td>
<td></td>
<td>(0.035)</td>
</tr>
<tr>
<td><strong>Rate of Compliance with NRC</strong></td>
<td></td>
<td></td>
<td>-0.041***</td>
<td>-0.111***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.017)</td>
<td>(0.031)</td>
</tr>
<tr>
<td><strong>District &amp; Year FE</strong></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Controls (time-varying)</strong></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>No. observations</td>
<td>336</td>
<td>336</td>
<td>336</td>
<td>336</td>
</tr>
</tbody>
</table>

**Notes:** *Significant at 10%, **5%, ***1%. Sample period: 1924–1937. IV-2SLS. The dependent variables are the logarithm of deaths in hospital and hospitalization rates expressed as 1.000 of the population. Reported in parentheses are standard errors clustered at the district level. Controls include population density and road density. District-specific effects indicate the interaction of each District dummy × Time trend.
6.3 Mechanisms and Heterogeneous Response

In this section, we empirically elucidate the potential mechanisms driving our results. Table 6 presents the results for different sub-samples. Column 1 reports the baseline IV-2SLS result from the full sample, reproducing column 4 of Table 3 for comparison purposes. It should be noted here that with this method we aim to tease out heterogeneous compliance with the new policy. In other words, we investigate whether key observed district characteristics (e.g. high market access, high expenditure in irrigation, etc.) had a supporting effect on the effectiveness of the new policy.

Column 2 divides the sample to districts where the acres of rice increase in the years after the new policy were above the median district, and column 3 divides the sample to districts where the acres of rice was below the median. While the correlation between the NRP interaction term and morbidity is statistically significant in both samples, it is substantially larger in districts where the rice field increase was higher (coeff. = −0.097, s.e. = 0.045), than in districts where the rice field increase was lower (coeff. = −0.198, s.e. = 0.093). The two estimated coefficients are statistically different from each other (p-value = 0.003). In other words, moving from districts with higher rates of increase in rice fields to lower ones, the morbidity response to harvest failures becomes less pronounced and declines to at least a half.

Column 4 limits the sample to districts that invested a lower share of their budget in irrigation and drainage schemes than the median district, and column 5 limits the sample to districts that invested a higher share of their budget than the median. Both coefficients are statistically significant, but the morbidity response for the sample of districts that invested more of their budget in irrigation is about three times weaker. The coefficients of interest are statistically distinguishable from each other (p-value = 0.013). In other words, districts that heavily invested in irrigation managed to diminish the impact of harvest failures on nutritional intake much more. Column 6 limits the sample to districts that had a higher per capita rubber production than the median district, and column 7 limits the sample to districts that showed a lower per capita rubber production than the median. While both yield a statistically significant correlation with hospitalization rates, the difference between the two coefficients is not statistically significant (p-value= 0.441). This suggests that the reduced morbidity response after the NRP was not particularly influenced by the total amount of rubber produced in a district.

Columns 8 and 9 divide the sample by whether a district had less barriers to market access than the median district. It is often argued that well integrated markets reduce the probability of food crises and famines in years of harvest failures. Rail and road networks allow
surplus regions to sell food to deficit regions and thereby limit the consequences of reduced food supplies on farmers’ health. Thus, we proxy market access with infrastructural density. Nevertheless, we find no evidence for such a channel. Our results show that while both coefficients are statistically different from zero, they are not statistically distinguishable from each other (p-value = 0.219).

Lastly, with the results in columns 10 and 11, we investigate whether the observed differences in rice suitability across districts might be responsible for the heterogeneous response of the new rice policy. One could hypothesize that districts with more suitable land for rice production to become more productive with the new policy and thereby diminish the morbidity response to harvest fluctuations simply because the land yields better in those districts. The estimated coefficients suggest that there is not a statistically significant difference between the two groups (p-value = 0.431).
Table 6. Heterogeneous Effects: Compliers

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Low Rice Acres Increase</th>
<th>High Rice Acres Increase</th>
<th>Low Public Expenditure</th>
<th>High Public Expenditure</th>
<th>Low Rubber Acres</th>
<th>High Rubber Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
</tr>
<tr>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
</tr>
<tr>
<td>Rice Production t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.314***</td>
<td>-0.235***</td>
<td>-0.345***</td>
<td>-0.277***</td>
<td>-0.347***</td>
<td>-0.293***</td>
<td>-0.311***</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.041)</td>
<td>(0.047)</td>
<td>(0.052)</td>
<td>(0.035)</td>
<td>(0.051)</td>
<td>(0.038)</td>
</tr>
<tr>
<td>New Rice Policy enforced</td>
<td></td>
<td>-0.129***</td>
<td>-0.198*</td>
<td>-0.097***</td>
<td>-0.199*</td>
<td>-0.116***</td>
<td>-0.182***</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.093)</td>
<td>(0.045)</td>
<td>(0.101)</td>
<td>(0.015)</td>
<td>(0.040)</td>
<td>(0.043)</td>
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<tr>
<td>District &amp; Year FE</td>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<td>Controls</td>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>District-specific effects (District dummy × Time Trend)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>No. observations</td>
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<td>182</td>
<td>154</td>
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<td>182</td>
</tr>
</tbody>
</table>

Dependent variable: Ln(Hospitalization rate)

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Low Market Access</th>
<th>High Market Access</th>
<th>Low Rice Suitability</th>
<th>High Rice Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(8)</td>
<td>(9)</td>
<td>(10)</td>
<td>(11)</td>
</tr>
<tr>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
</tr>
<tr>
<td>Rice Production t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.341***</td>
<td>-0.359***</td>
<td>-0.286***</td>
<td>-0.429***</td>
<td>-0.265***</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.039)</td>
<td>(0.049)</td>
<td>(0.071)</td>
<td>(0.031)</td>
</tr>
<tr>
<td>New Rice Policy enforced</td>
<td></td>
<td>-0.129***</td>
<td>-0.152***</td>
<td>-0.133**</td>
<td>-0.145**</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.036)</td>
<td>(0.057)</td>
<td>(0.056)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>District &amp; Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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</tr>
<tr>
<td>Controls</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>District-specific effects (District dummy × Time Trend)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>No. observations</td>
<td>336</td>
<td>154</td>
<td>182</td>
<td>154</td>
<td>182</td>
</tr>
</tbody>
</table>
6.4 Robustness checks

In this section, we perform a range of robustness exercises, which we report in the Appendix. First, in Table A-1 we show that our results remain nearly identical when we include past values (lags) of the dependent variable in our analysis. Econometrically, this is achieved by running a dynamic panel data model (system-GMM) with lags of the dependent variable. One might expect that the current level of health outcomes (either morbidity or mortality rates) to be heavily determined (either positively or negatively) by their past levels. If that is the case, then the model will suffer from omitted variable bias, and the results might be unreliable. While this inclusion might have taken much of the variance of the main explanatory variable and yield less significant results, it appears not be the case here. The influence of rice production on morbidity and mortality remain largely unchanged, suggesting a strongly significant relationship.

Second, we show that our results remain stable even after we control for potential widening unobservable differences across states and over time. Table A-2, presents the IV-2SLS results of standard errors clustered at the state level, year level as well as two-way clustered at both state and year level. Moreover, to account for any cross-sectional spill-over effects (cross-sectional dependency bias), we adjust standard errors following Conley’s (1999) correction. The estimated coefficients remain statistically significant at 99 percent confidence interval.

Third, as a falsification experiment, we take the years of 1929 and 1930 as the hypothetical starting years of the new policy and re-estimate the model. As expected, the interaction terms of 1929 and 1930 did not exhibit any statistically significant relationship with mortality or morbidity, further validating our selected approach (Table A-3). Fourth, as an additional falsification test, we perform a ‘placebo test’ using a different sample which we expect to yield no statistically significant correlation with mortality or morbidity after the new policy (Table A-4). To achieve our goal, we use similar data from the four Unfederated Malay States and investigate whether they exhibit a similar response to morbidity and mortality after the New Policy was in effect (de jure). However, since the new policy was never implemented in the Unfederated States, we expect the response of harvest fluctuations to mortality and morbidity to be nearly zero. Indeed, in sharp contrast to what we find for the Federated Malay States, the interaction between rice production and the NRP dummy in the Unfederated States remained largely unaffected before and after the new policy was in effect, further underscoring
the importance of the new rice policy in reducing levels of malnutrition in the rural areas of the Federated States.

7. Conclusion

The present study was designed to deepen our understanding on the effects of colonial agricultural policies on the material conditions of smallholder farmers in the Malay Peninsula during the interwar era (1924-1937). This was achieved by using a unique dataset that enabled us to observe in more detail the impact of local harvest fluctuations on the mortality and morbidity of the population before and after the implementation of the 1931 New Rice Policy. This new policy was not implemented at the same time throughout Peninsula, nor was it enacted in all districts and states. Our empirical approach was built around this temporal and spatial variation of the new policy. Borrowing ideas from a burgeoning literature that recognizes the importance of using short-term harvest fluctuations as a methodological tool to assess the living and nutritional conditions of rural populations over time, we were able to cautiously assess the impact of the rice policy.

Our findings indicate a strong mortality and morbidity response to fluctuations in domestic rice production. In particular, we find that a one standard deviation decrease in rice output meant a 23 per cent increase in morbidity and a 10.1 per cent increase in mortality rates. The morbidity and mortality response was markedly diminished in districts where the new policy was in effect, suggesting that the material conditions of the farmers improved in those areas. The estimated reduction was of sizeable magnitude, since it dropped morbidity response to 11 per cent and mortality response to 4.3 per cent. It is important to mention here that in districts where the NRP was never implemented (i.e. the Unfederated Malay States), the response to harvest fluctuations remained high throughout the whole period (i.e. 26.4 per cent for morbidity and 13.3 per cent for mortality). Several falsification experiments were performed to refute alternative explanations that might drive our results. First, we show that altering the year when the NRP was implemented does not yield a similar outcome. Second, we show that when we run the analysis with a sample of districts where the new policy was never in effect (i.e. the Unfederated Malay States), the declining trend observed in the F.M.S. disappears.

It is worth putting these findings in perspective. First, the significantly higher mortality and morbidity response of the Unfederated Malay States to harvest fluctuations is in line with the historical literature of Southeast Asia, which suggests that the Federated Malay States were on average relatively more prosperous than the Unfederated ones. Second, the response is slightly higher than what the economic history literature suggests for pre-industrial European
societies (see Bengtsson et al., 2004; Dribe et al., 2017). The difference becomes much more meaningful and significant if we consider that the aforementioned studies were dealing with European cases at least a century apart from our case (which is situated in the early 20th century). Thus, our findings could be considered as a reflection of the diverging development between those two world regions. Despite the large chronological difference, there is a key explanation why the response is somewhat stronger than what the literature predicts. It has to do with the economic and institutional framework in which this study is embedded, which to some extent reflects the limited attention the colonial government paid to local food production. Booth (1998, p.143) was right in pointing out for colonial Southeast Asia that “while exports may have boomed and government revenues expanded, nutritional intake for the mass of the population did not improve…and as a result mortality rates were high”.

Our findings have important implications for both the literature on colonial (agricultural) policies and the economic history of the region. They suggest that, contrary to what it is often assumed, colonial policies have been found to switch from facilitating European interests (e.g., export-commodity production, custom duties) towards encouraging smallholder production if or when changing economic and/or political circumstances gave reason to do so. In our case, it is obvious that the 1930s depression was of pivotal importance, in forcing the colonial government to intervene. Furthermore, our findings are a case in point that colonial policies should not perceived as monotonic and static. As Austin’s (2008, p. 1009) puts it “cases of reversal of policy within the same colony, cannot be captured within a before/after cross-country regression, by its nature. They illustrate the value of ‘decompressing’ history; considering the interplay of the variables in more detail”. Evidently, this is the case for British Malaya as well.

With respect to the historical literature of the region, our findings are in line with Boomgaard and Brown’s (2000) main line of argument that some societies of Southeast Asia managed to cope with the economic recession much better than others did. While our findings challenge the commonly assumed impression that the 1930s depression had been a uniform and homogeneous ordeal for indigenous peoples of Southeast Asia, future research in more detail is required on this subject, taking into account differences in economic/occupational structures (within and) across colonies, differences in imperial connections and differences that might vary by socio-economic group.

As a concluding remark, we would like to note that the changes introduced during the early 1930s, not only achieved to move the country much closer to self-sufficiency, but they also marked a decisive shift away from the earlier practice of simply trusting wider markets and
imperial connections to provide the country’s food requirements. The Malay States managed to reduce their domestic food requirements from foreign sources from 82 percent in the beginning of the century to 10 percent by the early 1970s (Goldman, 1975). Against this background, it is not entirely surprising that “when the Colonial office reviewed its policies for setting the agenda in the post-world war II era, it concluded that the pre-war agricultural policies aiming at increasing local food production were sound, and should be continued” (Kratoska, 2000, pp. 283-284). The steps to the Malaysian “Green Revolution” required heavy investments in agriculture, most notably in irrigation and drainage projects, as well as an increasingly active role of the state in the economy –mainly towards the direction of self-sufficiency (Goldman, 1975, Frankema, 2014). Investments in agriculture provided the technological preconditions for the rapid spread of double cropping and the adoption of new varieties of higher resistance, which in combination with other critical junctures, heralded the Green Revolution in the region.

References


**Statistical yearbooks and government reports**

All documents were retrieved from The National Archives, London. Government Printing Office. Various issues, reported in alphabetical order:

Appendix

Figure A-1. Acres of Rice

Source: Annual Reports, CO 576-24/63. Provincial Reports, CO435, CO437, CO438, CO439. The line shows the acres of rice in FMS and UMS respectively. The vertical red (dashed) line indicates the beginning of the New Rice Policy (1931).

Table A-1. The impact of Lagged Dependent Variable

<table>
<thead>
<tr>
<th></th>
<th>Ln(Death rate)</th>
<th>Ln(Hospitalization rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>GMM</td>
<td>GMM</td>
<td></td>
</tr>
<tr>
<td>Dependent variable, lagged $t - 1$</td>
<td>0.532***</td>
<td>0.442***</td>
</tr>
<tr>
<td></td>
<td>(0.160)</td>
<td>(0.185)</td>
</tr>
<tr>
<td>Rice Production $t$</td>
<td>-0.113***</td>
<td>-0.211***</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>District &amp; Year FE</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>District-specific effects (unobservable x year)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Number of observations</td>
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<td>309</td>
</tr>
<tr>
<td>Number of districts</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Number of instruments</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>AR1 statistics (p-value)</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>AR2 statistics (p-value)</td>
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<td>0.585</td>
</tr>
<tr>
<td>Hansen test (p-value)</td>
<td>0.892</td>
<td>0.765</td>
</tr>
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</table>

Notes: System-GMM estimation for dynamic panel data-model. Sample period: 1924–1937. Corrected t-statistics are shown in brackets. Significance level at which the null hypothesis is rejected: ***, 1 percent; **, 5 percent; and *, 10 percent. Second (and latter) lags were used as instruments in the first-differenced equations, and their once-lagged first differences were used in the levels equation. Two-step results using robust standard errors corrected for finite samples using Windmeijer (2005) correction.
### Table A-2. Clustering Standard Errors at Different Levels

<table>
<thead>
<tr>
<th></th>
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<th>(2)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
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<tr>
<td>Rice Production *t</td>
<td>-0.101</td>
<td>-0.101</td>
</tr>
<tr>
<td></td>
<td>(0.0161)</td>
<td>(0.0161)</td>
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<tr>
<td></td>
<td>&lt;0.0204&gt;</td>
<td>&lt;0.0204&gt;</td>
</tr>
<tr>
<td></td>
<td>[0.0150]</td>
<td>[0.0150]</td>
</tr>
<tr>
<td></td>
<td>(0.0296)</td>
<td>(0.0296)</td>
</tr>
</tbody>
</table>

### Dependent variable: Ln(Death rate)

<table>
<thead>
<tr>
<th></th>
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<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV-2SLS</td>
<td>IV-2SLS</td>
</tr>
<tr>
<td>Rice Production *t</td>
<td>-0.237</td>
<td>-0.237</td>
</tr>
<tr>
<td></td>
<td>(0.0283)</td>
<td>(0.0283)</td>
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<td></td>
<td>&lt;0.0304&gt;</td>
<td>&lt;0.0304&gt;</td>
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<tr>
<td></td>
<td>[0.0231]</td>
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<tr>
<td></td>
<td>(0.0342)</td>
<td>(0.0342)</td>
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</tbody>
</table>

<table>
<thead>
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<th>(2)</th>
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<td>IV-2SLS</td>
<td>IV-2SLS</td>
</tr>
<tr>
<td>District &amp; Year FE</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>District-specific effects</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

**Notes.** The specifications and the estimated coefficients in this Table are the same as in Table 3. The standard errors in column 2 are clustered at the district level (in parentheses), the year level (in angle brackets) as well as two-way clustered both at the district and at the year level (in square brackets). In double parentheses, we show the adjusted Conley (1999) standard errors for cross-spatial dependence.
### Table A-3. Falsification Experiment, using alternative policy years.

<table>
<thead>
<tr>
<th></th>
<th>Ln(Death rate)</th>
<th>Ln(Hospitalization rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Rice Production $t$</td>
<td>-0.102***</td>
<td>-0.103***</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>New Rice Policy Interaction, 1929</td>
<td>-0.064</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.058)</td>
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<tr>
<td>New Rice Policy Interaction, 1930</td>
<td>-0.029</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td></td>
</tr>
<tr>
<td>District  &amp; Year FE</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Controls (time-varying)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>No. observations</td>
<td>336</td>
<td>336</td>
</tr>
</tbody>
</table>

**Notes:** *Significant at 10%, **5%, ***1%. Sample period: 1924–1937. IV-2SLS. The dependent variables are the logarithm of deaths in hospital and hospitalization rates expressed as 1.000 of the population. Reported in parentheses are standard errors clustered at the district level. Controls include population density and road density. District-specific effects indicate the interaction of each District dummy $\times$ Time trend.

### Table A-4. Placebo Test, using alternative sample.

<table>
<thead>
<tr>
<th></th>
<th>Ln(Death rate)</th>
<th>Ln(Hospitalization rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Rice production $t$</td>
<td>-0.133***</td>
<td>-0.264***</td>
</tr>
<tr>
<td></td>
<td>-0.062</td>
<td></td>
</tr>
<tr>
<td>New Rice Policy Interaction, 1931</td>
<td>-0.044</td>
<td>-0.138</td>
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<tr>
<td></td>
<td>(0.039)</td>
<td>(0.105)</td>
</tr>
<tr>
<td>District  &amp; Year FE</td>
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<td>Y</td>
</tr>
<tr>
<td>Controls (time-varying)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>No. observations</td>
<td>58</td>
<td>58</td>
</tr>
</tbody>
</table>

**Notes:** *Significant at 10%, **5%, ***1%. Sample period: 1924–1937. IV-2SLS. The sample is the four Unfederated Malay States. The dependent variables are the logarithm of deaths in hospital and hospitalization rates expressed as 1.000 of the population. Reported in parentheses are standard errors clustered at the district level. Controls include population density and road density. District-specific effects indicate the interaction of each District dummy $\times$ Time trend.
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