

Local Granaries and Central Government Disaster Relief: Moral Hazard and Intergovernmental Finance in Eighteenth- and Nineteenth-Century China

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During the eighteenth and nineteenth centuries, the Chinese state attempted to administer famine relief partly through a nationwide institution of local granaries. This article explores regional variations in the performance of this institution to understand the reasons for its ultimate breakdown. The evidence suggests granary storage levels were systematically lower in provinces that received more frequent central government disaster relief; and an unintended consequence of disaster relief was that it modified local incentives for self-insurance and led to an incompletely resolved moral-hazard problem. China's experience provides an instructive example of the long-term dynamics present in intergovernmental policies.

A prominent institution in the Qing dynasty (1644–1911) was a national system of state granaries. Some granaries were used to hold reserves for military or bureaucratic personnel, but many were also created to help smooth price shocks and food-supply fluctuations for the civilian population. Based on a far-reaching vision of the potential scope and function of the state in helping to provide social security in the event of food crises, these civilian granaries in effect accumulated local-level investments to counter food crises. The operation of the granaries, however, was uneven, and interregional shortfalls in granary stocks at times stood in contrast to the rough uniformity of the guidelines for the civilian granaries under the original plan.

This article examines regional differences in the performance of this institution. I depart from conventional interpretations of the principle of the Qing administrative system by making the conflicts of intergovernmental incentives central to the analysis. The argument of the article is as follows. Local authorities at the provincial and subprovincial levels were required to maintain granaries primarily as a reserve in the event of famine. The granaries had to be supported in significant part with local investments, but the central government could not adequately monitor the actions of local offi-

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cial, who generally possessed discretionary power over a broad range of activities. At the same time, alternatives to storage existed in private markets, and the central government was also willing to provide other forms of relief, notably through tax relief. This led to a moral-hazard problem as these actions modified local incentives for self-insurance. In areas where central relief was more forthcoming, the budget constraint was more forgiving, and local officials may have had greater incentives to reduce their expenditures on granaries.

I consider the hypothesis that the evolution of the civilian granaries depended on incentives provided by market signals, state-sponsored procedures that were specifically designed to alleviate the impact of food shortages due to weather shocks and natural disasters, and a combination of the two. I use historical data on market integration and intergovernmental funding from the 1740s to the 1820s to evaluate this hypothesis. The data show that the geographical pattern of disaster-relief funding from the center was skewed and not likely to have been determined by the random occurrence of disasters. The results also show that there is a negative relationship between regional market integration and storage. After conditioning on this fact, I further find that provincial storage levels are systematically lower with a higher frequency of central government relief—empirical evidence that supports the contention that moral hazard existed on the part of local administrators and that they consciously chose to lower storage levels in the expectation of relief.

There are a number of economic and political variables that have long been regarded as being regionally important in China. First, transportation costs and market access differed across regions.¹ These differences typically affect the calculation of optimal granary stocks because stocking is a basic economic decision. Regions that are better connected to grain markets with a broad geographic spread do not have to rely as much on regionally self-sufficient means of consumption smoothing in times of dearth, such as storage, as in more autarkic regions.² Thus, granary stocks should be dependent on the degree of market access.

There is virtually no data on private storage, but the analysis of grain price data alone reveals that some kind of consumption smoothing in the form of storage did take place, particularly in the inland areas of China.³ This does not necessarily mean that the government acted with the same incentives as private agents. Nevertheless, both high-level decision makers

¹ See Needham, *Science*, on shipping technology in China; Watson, *Transport*, for Japanese estimates of Chinese transport costs; and Skinner, *City*, pp. 214–15, on the approximation of physical and urban boundaries via “macroregions.” On the history of commercialization during the Qing, see Wu, “Lun Qingdai” [Discourse on national markets]; and Nishijima et al., *Zhongguo jingji shi* [Research on the economic history of China].

² See Williams and Wright, *Storage*, for example, for models of storage decisions.

³ See Shiue, “Transport Costs.”

as well as lower ranking officials likely took into account the economic trade-offs between interregional and intertemporal arbitration. We know for instance, that while the activities of merchants and brokers drew at times misgivings from some governing quarters, official proposals with respect to granary stocks were framed in relation to whether or not the region had access to grain trade flows.⁴

Second, there were differences in regional influence. Although the Qing state was a unified government with a similar hierarchy of administrative structures within each province, certain regions were historically more significant for reasons of geography, distance to the capital or to military garrisons, agricultural productivity, and other factors.⁵ This in turn affected the provincial tax burden and the allocation of tax relief. In particular, the allocation of resources from Beijing to the provinces was utilitarian, often serving to reinforce existing strongholds of power, rather than to compensate provinces for their relative indigence or unimportance. This article does not attempt to rationalize these choices; rather, the aim is to assess whether or not there was a systematic relationship between central resource allocation and local granary stocks.

Another fundamental aspect of the political equation was that the central government, in Beijing, relied on local officials at the provincial and subprovincial level to implement its policies. The government was formally organized into a hierarchy of four administrative layers: the emperor, the governors and governor-generals (provincial level), the prefects (prefectural level), and the magistrates (county level). If the bureaucratic chain of command were intact, then “Qing officials” might be regarded as a single entity cooperating under a unified agenda. Numerous examples of departures from regulation in the lower ranks, however, suggest that this was not the case. In the existing literature, these cases are often cast in terms of the “corruption” or the “commitment” of various individuals.⁶ Although this is an interpretation that might have accorded with the opinion of eighteenth century commentators, it is also one that discounts the possibility that these actions might have had predictable origins.

⁴ See Perkins, “Government,” for a summary of how officials viewed industry and commerce; on merchants and the Chinese bureaucracy see Mann, *Local Merchants*, especially pp. 52–69; and Rowe, “State.” See specific examples of official proposals from Will, *Bureaucracy*, p. 305f. Source of original memorial from Jiangnan governor-general Yinjishan who sought permission to reduce storage because of adequate access to markets: Qianlong 29/4/11, Gongzhongdang archive, no. QL 17505.

⁵ Perkins, *Agricultural Development*, pp. 174–82, discusses the basis of economic regionalism; Chi, *Key Economic Areas*, outlines traditional key areas. Reischauer and Fairbank, *East Asia*, focus rather on the question of how significant regional powers came to be unified under imperial rulers.

⁶ From Will, Wong et al., *Nourish the People*, p. 110: “The performance of the men on the spot was thus entirely a matter of tight control and personal authority, which, of course, fluctuated from one magistrate to another as a function of professional commitment and the quality of their private staffs.” For numerous examples of official corruption in the eighteenth century, see Park, “Corruption,” pp. 969–85.

Principal-agent theory is a useful framework for analyzing these incentives: specifically, the principal (in this case, the central government) cannot monitor the agent (the local government) at all times and lacks sufficient information about the action(s) that the agent has undertaken or will undertake. The differentiated incentives experienced at the regional level and at the hierarchical level (local or central administration) gives rise to further implications: local governments may attempt to allocate resources over which they have discretion towards public goods that have higher priority in their own jurisdictions.

The Qing system of tax remissions and central disaster aid policies was prone to the problems of moral hazard. Even though the government's policies were formally governed by a set of rigid rules, with each ranking official reporting to the authority directly above his own, in practice there was a fair amount of flexibility in day-to-day management decisions. On the one hand, reprisals awaited those officials who were caught mismanaging, but on the other hand, because deviations from regulations and deficits in the local treasury were not always discovered, public funds controlled at the local level were more fungible in practice than was formally acknowledged. In addition, although local magistrates, prefects, and provincial authorities operated under routine guidelines and regulations, they were also delegated with very general responsibilities of governance for nearly all local affairs in their jurisdiction. Under such circumstances local administrators could and did find ways to collude and to channel funds for one operation to other aspects of governance.

The degree to which government practice deviated from ideal is a topic that has generated continuing interest and research.⁷ The existing literature highlights a variety of factors that contributed to differences in granary performance across regions and over time. Some of the variations may have been merely idiosyncratic or otherwise dependent on the ebb and flow of personalities throughout the dynasty. Case studies provide compelling stories that look at granaries from the perspective of local elites and their relationships to officials.⁸ In addition, there may have been a shift in the system linked to the rise and fall of the Qing state.⁹

Previous studies have also considered civilian granaries in light of economic and political factors. Pierre-Etienne Will, R. Bin Wong, James Lee,

⁷ The success of state projects is often used as an indicator of the effectiveness of the state in related literature. Hsiao, *Rural China*, pp. 153–59, for example, was concerned with the effectiveness of rural control, and his conclusion that the condition of community and charity granaries was unsatisfactory, fits with the notion that the problems could be attributed to difficulties in rural supervision. Ch'ü, *Local Government*, p. 157, additionally argued that the ever-normal granaries were not advantageous to the poor. Subsequent research giving larger estimates of grain stock data from Liu, "Reappraisal," p. 318; and Will, Wong et al., *Nourish the People*, pp. 507–25, has led to a reappraisal of the functions of the granary system and of the eighteenth century "state's capacities" as a whole.

⁸ See, for example, Esherick and Rankin, *Chinese Local Elites*, pp. 44–45; and Rankin, "Managed by the People," on the role of local elites in civilian granaries and famine relief.

⁹ See Will, Wong et al., *Nourish the People*, p. 93.

Jean Oi, and Peter Perdue, in what is perhaps the most comprehensive study to date on the civilian granaries, primarily view the institution as an expression of the paternalistic welfare ideology of the Qing state.¹⁰ For instance, higher storage per capita in the “border” regions (areas South, Southwest, West, Northwest, Northeast, and Southeast) compared to the “interior” regions (areas in the Middle Yangzi, Gan Yangzi, Lower Yangzi, and North China) suggests to the authors that “Qing leaders made clear commitments to inhabitants of less accessible areas to develop the governmental means of influencing food supply conditions.”¹¹ To define the interior and border regions, Will, Wong et al. draw on G. William Skinner’s concept of macroregions (each of which includes several provinces).¹² They do not, however, attempt to separate the economic from the political influences that would have jointly determined the negative correlation between grain storage and grain access.

Price analysis can offer a systematic way to assess differences in the degree of market integration across subprovincial units. However, existing price studies tend to focus on a limited number of provinces or cities at a time, and there are no studies I am aware of that use empire-wide evidence on central and local patterns of disaster relief together with the price data.¹³ The employment of storage data, prefectural price data, weather patterns, and disaster relief patterns may allow for a more detailed and comprehensive assessment than available so far.

A NATIONWIDE SYSTEM OF CIVILIAN GRANARIES

The Qing granaries were initiated by the Kangxi emperor (reign 1662–1722), based on precedents from previous dynasties. The three types of civilian granaries, the ever-normal granary (*changping chang*), the charity granary (*yichang*), and the community (*shechang*) granary, attempted to reach residents of urban and rural areas across an empire spanning millions of square kilometers. The granaries dealt with the problem of delays in grain shipments by holding a local stock of grain, thus tying over the crises until additional grain could arrive. The ever-normal granaries were managed by the local magistrate and primarily served those residing near the county seat. The state also hoped the ever-normal granary system could function as a buffer stock, enabling it to regulate market prices through purchases and sales. The community and charity granaries were usually located in towns

¹⁰ Will, Wong et al., *Nourish the People*.

¹¹ *Ibid* pp. 297–98.

¹² Skinner, *City*, pp. 211–49, “Regional Urbanization in Nineteenth-Century China.”

¹³ See Wang, “Secular Trend.” Chuan and Kraus, *Mid-Ch’ing Rice Markets*, focus on grain stocks and rice price differentials in a number of different provinces. Other analyses of grain prices include: Wang, “Food Supply,” on Fujian; Marks, “Rice Prices,” on Guangdong; essays in a volume edited by Rawski and Li, *Chinese History*; Chen, Wang, and Hu, “Time-Series Analysis,” on Suzhou; and Li, “Integration,” on North China.

or villages and supervised by local elites; overall, these granaries were relatively minor in size compared to the ever-normal granaries.

In the 1750s annual civilian stocks averaged about 1.5 billion liters of husked rice, equivalent to about 7.5 liters of rice per person, or roughly 3 percent of the consumption of an adult per year.¹⁴ The value of the grain in civilian granaries was a relatively large percentage of total government (local and central) nonwage expenditures. At an average market price in the eighteenth century of about one silver *tael* for a quantity of rice just over 100 liters, the monetary value of the stocks would have been around one-fifth of annual government revenue.¹⁵ Most of the grain remained within the area where it was stored; less than 1 percent of annual grain stocks were transferred to granaries in another province or elsewhere in the same province.¹⁶

LOCAL INVESTMENT IN CIVILIAN GRANARIES

Consistent investments in the maintenance and upkeep of the granaries would have been critical to their long-run operation. To prevent spoilage over years of normal harvest, county officials had to sell or loan (with interest) old grain from the previous harvest and use this money to acquire fresh grain for restocking through market purchases, or, by soliciting contributions from local residents. In years when relief was needed, county officials were supposed to sell the ever-normal granary stocks at reduced prices or distribute grain to the poor. If ever-normal grain was distributed outright for famine relief, then the local administration would be reimbursed by the central government.¹⁷ In practice, however, because the amount reimbursed was calculated according to a fixed schedule rather than current market prices, the money reimbursed to the locality did not guarantee sufficient funds for the purchase of replacement grain. Furthermore, although initially civilian granary reserves were built up in large part with tribute grain and contributions (*juanna*), by the mid-eighteenth century, local granaries could no longer rely on these sources for replenishing their stocks.¹⁸

¹⁴ Assuming population is 200 million and annual consumption per person per year is 250 liters of husked rice. Original units are in *shi* (Chinese bushel) of unhusked grain; 1 *shi* equals 103.5 liters. Granaries held unhusked grain as it spoils less easily than husked grain. Conversion rates differ across grains; unhusked rice is about twice the volume of husked rice. Source: *Quanguo fensheng minshu gushu qingce* [National registers of population and granary holdings arranged by province]. Reproduced in Will, Wong et al., *Nourish the People*, data appendix.

¹⁵ For more details on the size of tax revenues, see Wang, *Land Taxation*, p. 71; and the Appendix.

¹⁶ This is likely a conservative figure. Between 1736 and 1779, total grain stocks ranged between 27 and 41 million *shi*. Will, Wong et al. (*Nourish the People*, pp. 492–93) assume that 100,000 *shi* of grain among granaries was transferred interprovincially and an additional 100,000 *shi* moved intra-provincially.

¹⁷ *Ibid.*, p. 148.

¹⁸ Contributions were revenues from the sale of imperial academy studentships and degrees; this was a central government rent collected at the county level. On the discontinuation of the use of contributions starting in the 1740s, see Will, Wong et al., *Nourish the People*, pp. 51–52, 439.

The central government, therefore, subsidized but did not fully back the financial requirements of the granaries. By implication, this imposed upon local leaders a portion of the overall costs of this institution, which included spoilage costs, labor costs, and capital costs for repair and maintenance of the granary, indirect costs of trying to operate the granary partly as a local lending institution during normal years, as well as some costs of emergency grain relief during famine years. This resource problem alone would have presented significant difficulties because funds were always scarce; but in addition, local governments did not face uniformly favorable incentives to invest in the civilian granaries. There are at least three reasons that account for this: the incentives of local governance, the discretionary nature of revenue sharing, and the potential for intergovernmental transfers.

First, consider the incentives of local governance. Overseeing granary operations was only one of many tasks facing the county magistrate. From the point of view of the local government, amassing a stock of civilian grain was important if it helped to prevent chaos and rebellion in the area due to food crises. In addition, there was the risk that the failure to satisfy granary guidelines would be discovered. Both problems could potentially lead to demotion and severe reprimands if not addressed adequately, but the point at which a specific local official could be judged to be in breach of his responsibilities was seldom clear cut.¹⁹ This was partly because even if the center could observe the outcome through audits (of storage volume, for example) the center could not adequately observe the circumstances that led to those decisions. The principal-agent problem arises precisely because of these difficulties of asymmetric information.²⁰

Guidelines on the volume of grain that local managers were supposed to stock existed. They were intended to be estimates of need, assessed according to local conditions and population estimates; these were typically given in units of thousands of *shi* of unhusked grain—for example, 4,000 *shi* for a smaller county and 20,000 *shi* for a larger county. In 1748 the central government produced a comprehensive list of storage targets (*e*), and the list was adjusted three times thereafter—in 1776, 1818, and 1831.²¹ The figures represented the minimum storage levels required, because only storage below targets was problematic from the center's point of view, whereas storage above target was acceptable. Yet the delegation of responsibility of an activity such as storage implied that these storage targets should not be strictly enforced at all times; and in fact, flexibility in the timing of restocking according to local prices was encouraged.

¹⁹ Out of more than 400 cases of corruption from all officials of all ranks between 1736 and 1799, most were never prosecuted; see Park, "Corruption," p. 996.

²⁰ Ross, "Economic Theory."

²¹ See the Appendix on *Actual Granary Storage and Storage Targets*.

The successful operation of the granaries, where success is defined as conformity to central guidelines in storage levels, was perceived by the central government to be a question of adequate regulation and control. The center's main solution for reducing the problems of moral hazard was better monitoring, and the resulting procedures reflect efforts that especially aimed to reduce the problem of asymmetric information. The practice of annual routine audits on civilian granaries, begun in 1698, was performed at every level of the hierarchy by the unit directly superior to the one being audited. Renewed efforts at special province-wide audits were instigated in 1799 after the discovery of persistent shortfalls in grain, attempts by local officials to store cash instead of grain, and intergovernmental collusion to hide non-existent stocks.²² Despite the additional controls, accusations of local-level corruption and incompetence did not abate.

Second, much of the difficulty that the central government had in ensuring that the counties would stock grain in accordance with guidelines stemmed from the fact that local officials exercised a significant amount of discretionary power over the resources that were available for funding these granaries. In the mid-eighteenth century, three-quarters of total taxes were statutory taxes and one-quarter were in nonstatutory categories.²³ Counties were entitled to only a small share (perhaps less than 5 percent) of the main statutory tax revenues, which was the property of the central government.²⁴ Nonstatutory tax funds and other informal sources of local revenue, therefore, were used for nearly all items of routine local expense, administrative expenditures, and projects within the province, including the costs of maintenance and repairs of the local granaries.²⁵ Part of what made the case for granary maintenance more difficult was the presence of many competing uses for funds that were largely under the control of local governments.

Nontransparency of public finances, however, was in fact a general aspect of the Qing fiscal system as a whole, and it meant that local administrators could find ways of manipulating even statutory or imperial funds to their own benefit. Thus, even when contributions were earmarked for civilian grain stocks, local officials could transfer these contributions immediately to any number of uses other than as storage for famine relief.²⁶ As mentioned

²² Will, Wong et al., *Nourish the People*, pp. 196, 218, 221.

²³ Wang, *Land Taxation*, p. 70.

²⁴ Zelin, *Magistrate's Tael*, pp. 27–29. In Shanxi, a province that retained 30 percent of the tax locally, 65 percent of retained taxes were allocated to military uses and only 15 percent (or less than 5 percent of total taxes collected) were available for local expenses. Jiangxi province had 7 percent of total taxes available for local expenses. Moreover, these were for specific projects that were often for projects that were also of national interest, such as military supplies and postal road maintenance.

²⁵ Additional details on customary fees and ritual gifts are in Hickey, "Fee-Taking," see especially p. 394.

²⁶ Zelin, *Magistrate's Tael*, provides numerous examples of official skimming, and of advancing funds from one category to another. In the practice of wage contributions by officials, provincial governors appropriated the salaries granted by the central government to lower officials in order to pay

already, the grain stock itself represented a significant monetary resource, and because it was difficult and costly for the center to determine the exact amount of grain stored in each county, grain stocks were especially vulnerable to liquidation for other local expenditures. Magistrates were also able to use imperial tax relief to their advantage. In addition to falsifying reports of natural disasters in the hopes of receiving remissions, they were also known to delay the news of a tax suspension and to continue collecting taxes as before.²⁷

Third, the civilian granaries were only one aspect of the Qing emperors' overall approach to famine relief.²⁸ The immediate provision of relief in the case of natural disasters was an expenditure that early Qing emperors regarded as the responsibility of the central government.²⁹ Tax relief (exemptions, postponements, cancellations, and reductions in the rate of taxation) was the traditional fiscal device used specifically as a response to harvest failures and natural disasters. The rate of tax relief from the central government depended on the average percentage of the harvest lost in the county and the length of the disaster.³⁰ Taxes could be postponed for one planting season or for up to three years, depending on the severity of the disaster.³¹ Outstanding payments after that time could also be forgiven.

In addition to the land and head tax, the grain tribute was another important source of central government funds that was frequently used for disaster relief. A portion of the grain tribute could be exempted from collection, or, grain already en route to the capital could be diverted to the stricken areas. Both land-tax remissions and diversions from the grain-tribute granary helped alleviate the effects of food shortages by expanding purchasing power, by keeping grain in the region, and by increasing grain supplies.

Thus, although the central government did not permit the local county government to retain a large amount of the statutory tax revenues for unspecified purposes *ex-ante*, statutory revenues were nevertheless an important source of revenue sharing between the central and the local government

for public projects; see pp. 43–45. Also see p. 83 on the practice of selling grain stocks for additional revenues.

²⁷ *Ibid.*, p. 52.

²⁸ For a survey of Qing food policy, see Feng, *Zhongguo lidai minshi zhengceshi* [Civilian Food Policy].

²⁹ In the 1720s and 1730s the central government discouraged local officials from soliciting revenues for disaster relief; Zelin, *Magistrate's Tael*, p. 170.

³⁰ An edict of 1728 stipulated that a 70 percent exemption of the land tax was permitted in the case of a complete harvest failure; in the case of a 90-percent harvest loss, the exemption rate was 60 percent, whereas for 80, 70, and 60 percent harvest loss, exemptions were 40, 20, and 10 percent. Source: *Da Qing huidian shili* [Precedents and regulations supplementing the collected statutes], *juan* 288, *hubu* [Board of Revenue], *juanxu* [Exemptions and relief], *zaishang zhi deng* [Categories of disaster].

³¹ Rates are found in an 1815 text in the *Da Qing huidian shili*, *juan* 288, *hubu*, *juanxu*, *zaishang zhi deng*: for harvest damages below 50 percent, payments were postponed till the next harvest. For damages 50–70 percent, payments were postponed for two years, and for 80–100 percent damages, three years. Before 1815 the terms of postponement may have been more adjustable than exemptions, see Will, *Bureaucracy*, p. 246.

ex-post to a disaster. The mechanism of tax and grain-tribute relief suggests the terms of an implicit insurance contract between the local and center, in which the local region that experiences a normal or better harvest will pay its taxes in full, whereas the local region that cannot pay its taxes or may require additional assistance because of ruined harvests will receive remissions from the center. The moral-hazard problem, however, underscores the principal-agent problem when such terms of insurance are involved, because moral hazard arises if actions undertaken by the local administrator affect the outcome of the insurance contract.³²

In summary, we should expect that the larger the deviation of storage targets from the levels implied by regional market conditions, the less likely was it that local officials would have had sufficient resources and incentives to satisfy targets. From the local administrator's point of view, granary storage was a project that had to be financed in part with resources that could also be used for other local needs, and the basic lack of transparency in local finance meant these decisions could not be adequately monitored by the center. Moreover, in some cases, additional funds for local disaster relief that took the form of exemptions on statutory (central) taxes could be obtained, thus reducing the need for local investments in stocks. The combination of incomplete top-down control and discretionary funding reinforced this moral-hazard problem.

ANALYSIS

Interprovincial Concentration of Disasters and Relief

Information about natural disasters (*ziran zaihai*), tax exemptions, and postponements for disaster relief (*juanmian huanzheng*) are among the many aspects of governance that are recorded in the *Da Qing lichao shilu* [Veritable Records of the Qing]. The material documents motions of the court rather than requests or denied proposals. Thus, the information can be interpreted as an indicator of the relative level of central relief extended to each province. Column 6 in Table 1 provides a summary by giving the total number of separately dated entries regarding disaster relief from 1644 to 1820. According to this source, out of a total of 2,337 disaster reports collected between the years 1644 to 1820, nearly 70 percent can be attributed to droughts and floods.³³ The number of records of the center approving some form of aid exceeds the number of records on disaster reports (2,830 vs. 2,337). This may be related to the fact that a single disaster episode could

³² See Arrow, *Aspects*; and Mirrlees, "Optimal Structure." See Dunstan, *Conflicting Counsel*, pp. 89–93 for an administrative expression of the theoretical problem, entitled "Instructions to local administrators to exhort the people and assign them tasks, to make the population's food supply sufficient," a statement issued by the Qianlong emperor in 1744.

³³ Summary of material collected in Chen et al., *Qing shilu jingjishi ziliao*.

TABLE I
PROVINCIAL POPULATION, LAND TAX, PER-CAPITA LAND TAX, AND RELIEF

Province	1776 Population		Land Tax			Relief	
	Number of Persons (1,000s)	Rank	Taels Collected (1,000s)	Per Capita	Rank	Total Number (1644–1820)	Rank
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Zhili	20,567	4	3,180	0.15	11	477	1
Jiangsu	28,808	1	8,583	0.30	2	344	2
Shandong	21,397	3	5,301	0.25	5	288	3
Gansu	16,068	9	1,024	0.06	18	258	4
Anhwei	27,567	2	3,812	0.14	13	232	5
Henan	19,858	5	4,885	0.25	6	205	6
Hubei	14,815	11	2,081	0.14	12	158	7
Shaanxi	12,503	12	4,135	0.33	1	153	8
Zhejiang	19,365	6	5,627	0.29	4	148	9
Shanxi	8,193	14	2,413	0.29	3	147	10
Fujian	11,220	13	1,925	0.17	9	94	11
Hunan	14,990	10	2,000	0.13	14	65	12
Guangdong	16,849	7	2,625	0.16	10	64	13
Sichuan	7,790	15	878	0.11	7	58	14
Yunnan	3,103	18	730	0.24	16	58	15
Jiangxi	16,849	8	3,849	0.23	8	49	16
Guizhou	5,003	17	361	0.07	17	22	17
Guangxi	5,382	16	664	0.12	15	10	18
Total	270,327		54,073			2,830	

Sources: Column 1, see the text; column 3, Wang, *Land Taxation*, p. 70; column 6, Chen et al., *Qing shilu jingjishi ziliao*, see the text for details.

generate several instances of relief action. The correlation between the disasters reported by local officials and regional distribution of tax relief from the center is high (equals 0.94). However, both the frequency of disaster reports and the distribution of relief are geographically skewed. Additional details on this source as well as other data used in the paper are in the Appendix.

In the following, I restrict my empirical analysis to the ten major rice producing provinces.³⁴ These provinces constituted around 60 percent of the eighteenth-century population and contributed around 58 percent of the total land tax revenues.³⁵ They include areas that received relatively much relief as well as those that received relatively little, and it also includes the six main grain-tribute provinces (Anhwei, Jiangsu, Zhejiang, Jiangxi, Hubei, and Hunan). The restriction thus retains a representative sample of the nation while avoiding problems of heterogeneity associated with differences

³⁴ I exclude the lesser tribute provinces Shandong and Henan, which sent not only rice, but other crops. Sichuan was excluded due to unresolved problems in its population data (see the Appendix).

³⁵ Wang, *Land Taxation*, p. 70.

in primary crops and storage technologies.³⁶ Table 2 gives the frequency of relief and the shares of relief across the ten provinces within 20-year sub-periods between 1721 and 1820. The rankings indicate that the share of relief each province received was quite stable over this period.

Although precise data on income per capita across provinces are unavailable, it does not appear that the central government extended relief based on objective assessments of regional poverty. Rather, the concentration of relief seems heavily represented by areas traditionally considered wealthier (Jiangsu, Anhwei, and Zhejiang). It might be argued that because the richer provinces had a higher tax burden, they therefore had a greater need for relief relative to poorer provinces.³⁷ The argument, however, is tenuous. Richer provinces did have a higher absolute tax burden, but on a per capita basis, the differences are slight. Column 3 of Table 1 shows the provincial breakdown of the land tax revenue, and column 4 displays the implied per capita tax burden. The rankings of the land tax per capita and the frequency of relief, columns 5 and 7 in Table 1, do not offer support for the argument.

Furthermore, although relief was ostensibly linked to natural disasters, weather data from a separate source that normalizes climatic patterns in China do not generally support this proposition either. Table 2, column 6, displays the frequency with which the provinces experienced extremely bad weather (drought or flood conditions). Although some provinces had relatively good weather and rarely received relief (Guizhou, Guangxi, Hunan), a high frequency of relief does not necessarily relate to very bad weather. Overall, the rankings of weather severity do not coincide well with relief distributions.

Thus, differences in the frequency of relief across the empire are not proportional to population size, per capita tax burden, weather patterns, and general notions of income distribution. It is possible that special interests, regional favors, and security aims may indeed have been partly behind the pattern of relief. A strong hint of this is provided by Zhili, the province in which Beijing was situated. In both absolute numbers as well as in per capita terms, relief to Zhili over the Qing dynasty dominates other provinces by a factor that is not well-justified by notions of helping the poor.³⁸

³⁶ Storage techniques and costs were likely to be significantly different in the drier climate of the North relative to the central and southern areas of China, and the costs of storing different grains might be different as well. The greater the differences in climate, the less comparable storage will generally be.

³⁷ See Wang, *Land Taxation*, p. 18. A very rough approximation of progressive taxation applied across provinces, with the more agriculturally productive provinces (i.e., Shandong, Henan, Anhwei, Jiangsu, Zhejiang, Jiangxi, Hubei, and Hunan) contributing more.

³⁸ Jiangsu province surpasses Zhili over the Yongzheng period (1723–1735). In the Qianlong period (1736–1795), Gansu province surpasses Zhili in the disaster report rankings. The military presence in Gansu, and the fact that it was on the supply route to military garrisons in Central Asia may have played a role. See Perdue, “Qing State,” on the economic impacts of this activity in Gansu.

TABLE 2
FREQUENCY OF RELIEF, BY PROVINCE 1721-1820, AND WEATHER ACROSS PROVINCES

Province	(1721-1740) (1)		(1741-1760) (2)		(1761-1780) (3)		(1781-1800) (4)		(1801-1820) (5)		(1742-1796) (6)	
	Number	Share of Total	Number	Share of Total	Number	Share of Total	Number	Share of Total	Number	Share of Total	Number	Share of Total
Jiangsu	87	0.41	101	0.31	42	0.25	40	0.21	39	0.21	39	0.21
Anhui	31	0.14	63	0.20	43	0.25	46	0.25	34	0.18	34	0.18
Zhejiang	22	0.10	50	0.16	28	0.16	12	0.06	13	0.07	13	0.07
Hubei	24	0.11	29	0.09	29	0.17	33	0.18	34	0.18	34	0.18
Fujian	16	0.07	39	0.12	3	0.02	18	0.10	12	0.06	12	0.06
Jiangxi	8	0.04	4	0.01	9	0.05	10	0.05	15	0.08	15	0.08
Guangdong	7	0.03	22	0.07	2	0.01	6	0.03	17	0.09	17	0.09
Hunan	8	0.04	10	0.03	12	0.07	10	0.05	16	0.09	16	0.09
Guizhou	11	0.05	0	0.00	0	0.00	9	0.05	2	0.01	2	0.01
Guangxi	0	0.00	3	0.01	3	0.02	3	0.02	1	0.01	1	0.01
Average												
Total	214	1.00	321	1.00	171	1.00	187	1.00	183	1.00	183	1.00

* These figures are the percentage of years with floods or droughts.

Sources: Columns 1-5: Chen et al., *Qing shilu jingjishi ziliao*; see the text. Column 6: State Meteorological Society, *Zhongguo jin wubai nien hanlao fenbu tuji*; see the text for details.

TABLE 3
THE DEGREE OF INTERPREFECTURAL MARKET INTEGRATION, 1742–1795

Province	Average Bilateral Distance (Km) (1)	Average Bilateral Correlation (2)	Average Bilateral Correlation at 100–300 Km (3)
Jiangsu	297.31	0.75	0.79
Jiangxi	229.54	0.74	0.75
Hubei	254.86	0.70	0.75
Anhwei	185.95	0.72	0.71
Guangxi	256.96	0.62	0.66
Guangdong	408.09	0.60	0.65
Zhejiang	169.83	0.65	0.64
Hunan	257.71	0.58	0.63
Fujian	228.47	0.56	0.57
Guizhou	187.27	0.49	0.49

Source: *Gongzhong liangjiadan* [Grain price reports in the palace archives], Number One Historical Archives, Beijing.

Market Integration and Civilian Grain Storage

In order to examine whether the need for public aid might have depended on the ease with which a province could obtain imports of grain from outside the province after a harvest failure, I employ two different assessments to rank the strength of market integration across the provinces: price correlations and distance to major waterways. First, the bilateral price correlation between two markets is an informative means by which to compare the extent to which different markets are linked. Higher correlations suggest the presence of trade relationships, whereas low price correlations indicate their relative absence. Table 3 shows summary statistics in the bilateral relationship of rice prices between the prefectural markets within each province over the second half of the eighteenth century. Column 1 gives the average distance in kilometers between prefectures in each province; column 2 gives the average price correlation for each province. Column 3 controls for the fact that average interprefectural distances vary across provinces by giving the average of the bilateral price correlation coefficient only for those markets within each province that are between 100–300 kilometers apart (which is in the median range of interprefectural distances). Results in columns 2 and 3 are similar, and suggest that differences in market integration across the provinces are relatively stable across subsets of market distances.

Second, waterway access was important in China for long distance and interprovincial trade. It is possible that although a province such as Fujian did not engage in very much intraprovincial trade, it nevertheless had good access to distant markets because of easy access to seafaring transport. An inspection of the number of prefectures within each province that were proximate to a major waterway is indicative of the degree to which that

TABLE 4
WATERWAY ACCESS ACROSS PROVINCES

Province	Total Number of Prefectures (1)	Percentage on Waterway (2)	Rank (3)	Rank in Table 3 (4)
Jiangsu	10	100	1	1
Anhui	13	65	2.5	4
Guangdong	13	65	2.5	6
Zhejiang	11	54	4	7
Jiangxi	14	50	5	2
Hubei	11	45	6	3
Fujian	12	41	7	9
Hunan	13	23	8	8
Guizhou	13	0	9.5	10
Guangxi	12	0	9.5	5

Source: See the text.

province had access to markets more generally. For each prefecture for which we have price data, Table 4 reports the percent of prefectures within each province that was located on the Pacific coast, the Yangzi River, or the Grand Canal.³⁹ The correlation between the log of the rankings in the price correlation and the waterway access measurements is high, about 0.7. A simple two-variable analysis of variance shows the relation is positive and significant.

The rankings in columns 3 and 4 of Table 4 suggest that the three provinces within the sample with the highest market access and integration are Jiangsu, Anhwei, and Jiangxi; the three provinces with the lowest market access and integration are Guizhou, Fujian, and Hunan; and the remaining provinces, Hubei, Guangdong, Zhejiang, Guangxi are somewhere in between. With the exception of Hunan, Hubei, and Zhejiang, the quantitative results using price data are roughly in line with perceptions of market development in the historical period.⁴⁰

Figure 1 plots the relationship between per capita public storage and this three-way division of market integration for several years in the eighteenth and early nineteenth centuries.⁴¹ The figure shows provinces with better market integration tend to store less, and the relationship is stable over time across the three divisions. The relationship is consistent with the notion that such calculations played a major role in determining storage levels. The

³⁹ One may also include main tributaries, the Yuan River, the Xiang River, the Huai River, the Gan River, and the Lingnan Drainage basin, which would result in only slight alterations to the rankings in Table 4.

⁴⁰ Hunan, Hubei, and Zhejiang would be in Will, Wong et al.'s definition of the "interior" area. But here, Hunan is among the three provinces with lowest integration, and the ranking of Hubei and Zhejiang is comparable to Guangdong and Guangxi, which Will, Wong et al. include in the "border" areas that did not have easy access to grain.

⁴¹ Storage per capita is computed over a five-year average around each of the four years for which population data are available. See the Appendix for sources on the population estimates.

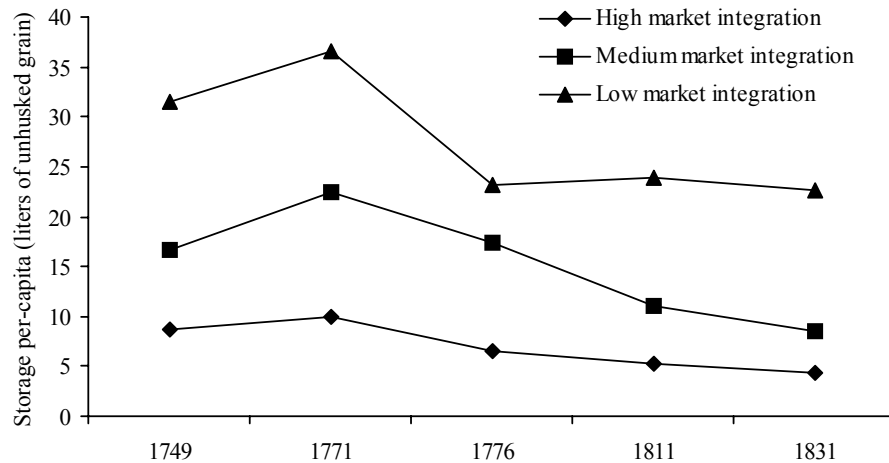


FIGURE 1
STORAGE PER CAPITA ACROSS TIME IN A THREE-WAY DIVISION OF MARKET INTEGRATION

Source: See the text.

following sections examine this further by considering the impact of central disaster relief.

Frequency of Central Relief and Local Grain Storage

I now consider whether the frequency of relief provided by the center is associated with the patterns of per capita storage at the provincial level. I use the frequency with which the central government extended relief to indicate the geographical concentration of central government expenditures in disaster relief. Figure 2 plot the number of separate instances in relief for four 20-year periods between the years 1740 and 1820 against the public grain stocks per capita for each of the ten provinces. There is a negative correlation between the frequency of relief and provincial storage levels. The pattern is similar over time within each 20-year subperiod. A negative correlation between central government relief and local storage across regions over the long-run together with the charges of “immorality,” “abuses,” and “mismanagement” from the center point to a conflict of incentives between central and local-level administrators. In other words, some provinces systematically under stored and received aid.

Central Relief and Local Storage Conditional on Differences in Market Integration

The negative correlation between the degree of market integration and storage levels suggests that the operation of the local granaries was closely

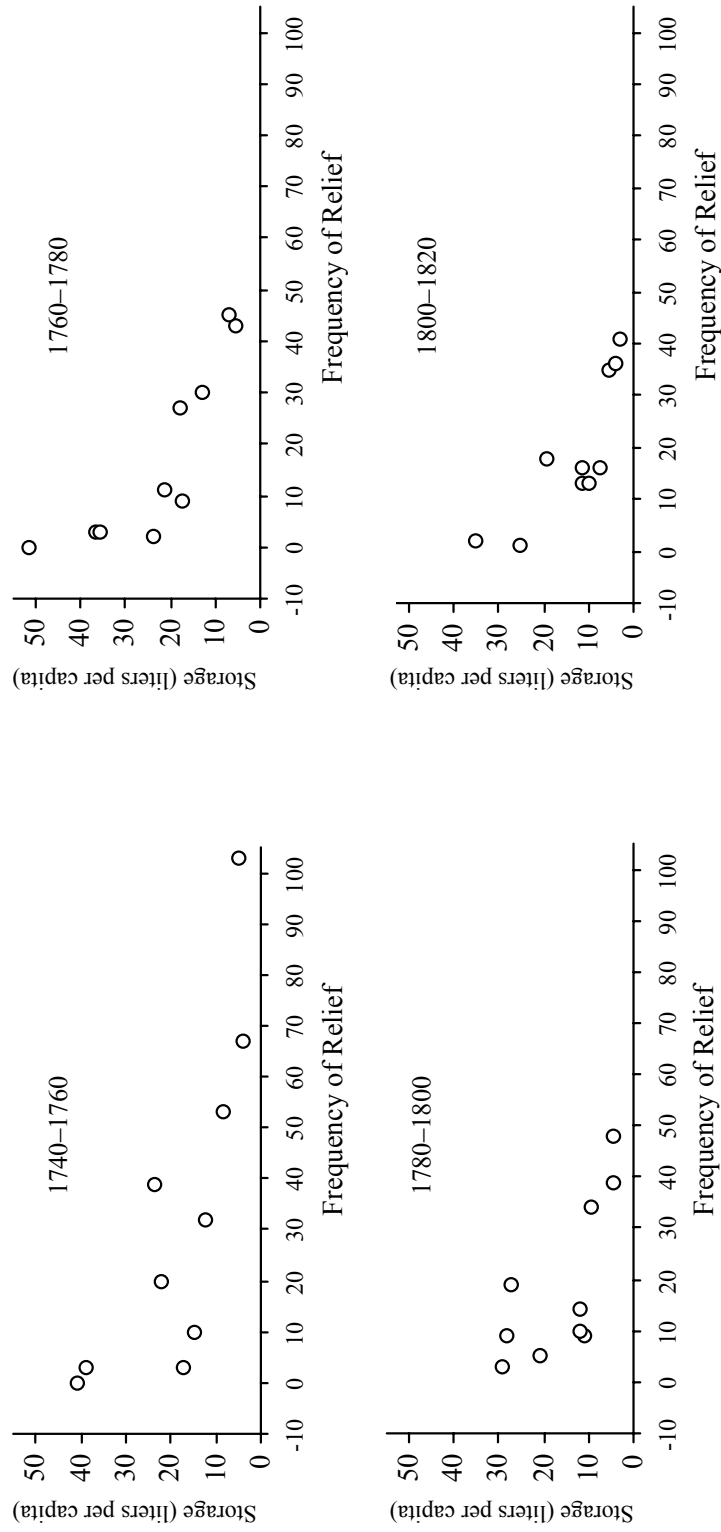


FIGURE 2
FREQUENCY OF CENTRAL DISASTER RELIEF AND LEVELS OF PROVINCIAL GRAIN STORAGE

tied to the local economy; therefore, the analysis of central relief and storage needs to condition on these regional differences. To do so, consider the pattern of storage among the provinces with relatively more market integration: these are Jiangsu, Jiangxi, Hubei, Anhwei, and Guangxi according to Table 3. Among these provinces, according to Table 2, Jiangxi and Guangxi received relief relatively infrequently (“low aid”), compared to Jiangsu, Hubei, and Anhwei (“high aid”). By contrast, Guangdong, Zhejiang, Hunan, Fujian, and Guizhou may be categorized as having had relatively less market integration; out of which Hunan, Guangdong, and Guizhou are in the “low aid” group.

In addition, local granary storage levels were influenced by directives from the center. To take that into account, I therefore examine provincial storage as a function of deviations from centrally issued target storage levels. If actual stocks were higher than the required levels, then stocking decisions were probably not dictated by a singular drive to adhere to central mandates, as that constraint had already been reached. However, if actual storage was at target or somewhat below, then we cannot rule out the possibility that the mandates were binding.

Figure 3 displays the average percentage deviations between actual and target storage across provincial groups, over the four dates when the center issued such targets.⁴² The figure illustrates three points: first, across all years, provinces that received less relief stored more than their targets, even after we condition on differences in market integration. Thus, for these provinces, central mandates were not binding. Second, in areas with relatively “bad” market access and which were in addition infrequent recipients of relief, the percentage deviation falls substantially over time. This fall, however, is primarily due to increases in the storage targets in those regions and not a decline in actual local storage levels. Third, across all years, provinces that received relatively more relief stored less than their targets, again, even after we condition on differences in markets. However, in these provinces, per capita targets were raised relatively little.⁴³ Thus, in contrast to the infrequent recipients of relief, the deviation from target in provinces that were frequent recipient of relief comes about primarily because of declines in actual storage levels.

The pattern of target adjustments also indicates that provinces that typically did not meet their storage target saw relatively small increases in their target whereas storage targets for those provinces that were already storing above target were raised. Over the mid-eighteenth and early nineteenth centuries, it was the adjustment of central storage targets that gradually

⁴² Deviations = [Actual storage (in the five years post target adjustment) – Target] / Target.

⁴³ The sum of per capita target adjustments, calculated by taking the sum of target adjustments over 1748 to 1831 and dividing by total population increases in the corresponding period, shows that on average, per capita target increases in low-aid provinces surpassed that in high-aid provinces by a ratio of 4:1.

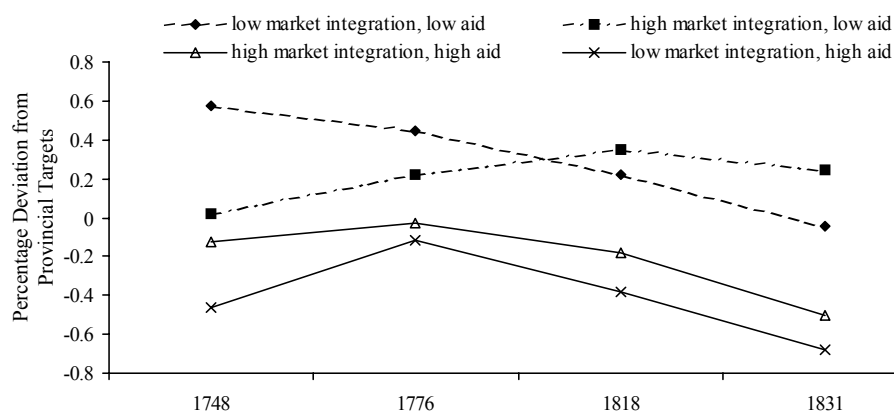


FIGURE 3
DEVIATIONS OF ACTUAL STORAGE FROM TARGET STORAGE, BY GROUP

Source: See the text.

closed the gap between actual and target storage, rather than the other way around.

The pattern of deviations from storage targets suggests that local governments acted independently, stretching the limits of authority that was delegated to them by the central government. Although the central government attempted to control these local activities through direct monitoring, it is still evident that the direction in which local governments pushed the boundaries of what they were permitted to do was in line with the incentives that we have seen. In part, the actions of the central government made the problem worse than it had to be. The provision of more frequent central relief in the aftermath of a disaster to the same regions that had too low storage simply worsened the basic monitoring problem arising out of the delegation of responsibility that the center was trying at the same time to control with audits.

SUMMARY AND DISCUSSION

The specific actions undertaken by the Qing government for disaster and famine relief were disparate and varied. Among the activities not explicitly considered in this article are the use of export blockades and import enticements, cash distribution, public works projects, and soup kitchens. In addition, we do not have a complete record of all episodes of relief, let alone a single interpretation on how Qing disaster policies should be viewed. Some types of historical records, however, such as those on intergovernmental revenue redistribution may be used to gain insights about the central and local sources of funds for disaster relief. The information also has the advantage of allowing us to analyze central and local relationships with respect to relief policy systematically.

This article suggests Qing disaster relief can be usefully understood as part of its intergovernmental public finance policy, in which the central government allocated funds to local governments, and at the same time expected local government to invest locally in famine insurance, specifically, in local civilian granaries. I find that civilian granary stocking patterns are affected by two factors: different degrees of access to interregional (private) markets for grain trade and the dynamic relationship between central policy setting and the local (provincial) response. Civilian stocks were consistently lower in provinces that had relatively good market access, compared to provinces where market access was relatively bad. The inverse relationship between local storage and interregional trading possibilities supports the idea that local officials' behavior was affected by straightforward economic calculation.

I also find, however, that provinces that received central government relief more frequently were more likely to understore relative to storage targets. Regions that could expect disaster relief from the central government may have rationally reduced storage below levels that would have otherwise been chosen in the absence of this implicit insurance relationship with the center. This would be consistent with the interpretation of moral hazard in a principal-agent setting. The negative correlation between central government relief and local storage holds for regions with relatively good as well as relatively bad interregional trade possibilities, and the pattern is quite stable over the period from 1740 to 1820.

The numerous charges of local corruption with respect to storage, the repeated efforts at monitoring on the part of the central government to raise storage, and the direction of deviation between actual storage and target storage all suggest that the extent to which intergovernmental relief allocation changed local calculations on storage was an unintended consequence of relief. In addition, the regional emphasis of tax relief is evident already early on in the Qing dynasty, even though the civilian granaries were not fully established until the Qianlong reign (1736–1795), further suggesting that the central-relief and local-storage patterns were not the calculated outcome of a unified administration that extended more relief to those areas where it helped less with local storage, but the result of uncoordinated and competing actions.

It would be interesting to extend these findings on different aspects of the Qing disaster relief system to the microeconomic level and to investigate the impact of the conflict in incentives on the welfare of different groups. The grain from the civilian granaries was intended for the farmers and the poor, whereas disaster relief probably amounted to a subsidy to landowners that offset lost rent. If central relief led to reductions in local civilian storage, as implied by the cross-regional results, then the overall outcome for potential beneficiaries of the granaries in those areas could be worse than what would

have occurred without the government's tax relief. The effects would be more pronounced if the poor had no means for private storage or for negotiating a share of the disaster relief through their landlords.

Like earlier writers on these topics, I find that the state's effectiveness in carrying out public projects should be considered jointly with an overall view towards the bureaucratic apparatus. The interpretation that emerges from this article, however, emphasizes a somewhat different set of factors, in particular, the role of intergovernmental fiscal relations (theory of fiscal federalism), substitution between trade and storage, and agency theory. China's experience in disaster aid provides an instructive example of the long-term dynamics present in the various elements of its institutions and intergovernmental policies. It also illustrates that it may be useful to view the evolution of some of these dynamics as being the outcome of repeated interaction among bureaucratic members with diverse preferences and resources.

Appendix 1: Data

Disaster Reports and Relief

The *Da Qing lichao shilu* [Veritable Records of the Qing] arranges in chronological order government communications (memorials), proclamations (edicts), and notices of the emperor's actions and events related to the court and its officials. Disaster relief was generally considered a benevolent act that testified to the generosity of the emperor. Thus, to the extent that one of the goals of official histories was to record the positive accomplishments during a certain reign, it is quite likely that items related to episodes of relief were included whenever possible.

The information compiled by Chen Zhenhan, Xiong Zhengwen, Li Chen, and Yin Hanzhang on the Veritable Records reveals a number of different characteristics of both reports of disaster, as well as the response to the disaster.⁴⁴ The information from the disaster report typically includes a short summary or quote from the memorial in which a provincial governor notifies the capital of a disaster, for example, and a few details about the nature of the disaster and the regions affected. Items on disaster relief will typically make clear if the aid takes the form of a tax postponement or an exemption, the rates of exemption or the length of remissions, the numbers of counties within each province that received exemptions, and whether the exemption was partial or complete. The data do not give the total amount of cash or grain relief in monetary terms, and although other kinds of relief actions are occasionally noted, the information is generally less explicit about relief actions apart from tax-related relief. However, tax relief was a low-cost method for transferring funds to a locality. If the central government mandated any relief action at all, tax relief was often an important component of the overall program.

Although a full account of relief expenditures is impossible to reconstruct, it is likely that the frequency of relief reports closely reflects the overall concentration of relief expenditures and the relative extent to which the center became involved in aid to a province. The number of separate decisions and edicts passed by the center for aiding each province provides one indicator of the strength of linkages between the center and each provincial government.

⁴⁴ Chen Zhenhan et al., *Qing shilu jingjishi ziliao*.

Rice Prices

In this article, the degree of market integration is measured by the correlation of rice prices across regions. Monthly price data are available in the *Gongzhong liangjiadan* [Grain price reports in the palace archives]. I use a biannual series—one observation around the time of the main harvest (eighth lunar month) and the other in the early spring (second lunar month)—over the years 1742 to 1795. These consist of 20,423 price observations on “middle-grade” rice, by prefecture. Approximately 24 percent of the observations on prices for the 121 prefectures over all these years are missing. The percentage of missing data, however, is similar across prefectures, and the missing data do not appear to be systematically related to prefectural characteristics.

Weather

This study uses weather data from a compilation published by the State Meteorological Administration, which tabulates weather conditions throughout China for 120 “stations” (a regional designation equal to one or two prefectures), using historical and contemporary information on weather fluctuations.⁴⁵ The data are not a measure of the number of inches of rainfall, but a discrete indicator of the degree of “wetness and aridity,” normalized to what is typical for that region. Specifically, a ranking of one to five summarizes the impact of weather conditions associated with floods, droughts, monsoons, or rainfall, as opposed to other weather phenomenon such as windstorms or temperature changes. Yao Shan-Yu (1942) and Zhang Peiyuan (1993) also provide useful discussions on the collection of historical Chinese weather data.⁴⁶

Population

Population data are available from secondary sources compiled by John D. Durand and Ho Ping-ti.⁴⁷ For the period under analysis, population data are available for the years 1749, 1771, 1776, 1812, and 1831. The Chinese population data for Sichuan and Guangdong do not fully account for the extent of migration to those areas that occurred before the mid-eighteenth century. Sichuan’s per capita stocks in 1748 are too high for this reason. Because of the special difficulties in population statistics from Sichuan Province, it was dropped entirely from the analysis. For Guangdong Province, I adopt the revised population estimates for the eighteenth century computed by Robert B. Marks.⁴⁸

Actual Granary Storage and Storage Targets

The original sources of the provincial-level storage data are palace memorials and Board of Revenue registers. The figures are supposed to be actual storage in the provinces as reported in the eleventh month of each year. Both these data and the official targets on granary storage are replicated by Will, Wong et al.⁴⁹

To reduce the effects of year-to-year fluctuations in the calculation of per capita storage, I average five years of storage data surrounding each of the dates of the population figures storage. Thus, for example, per capita storage in 1748 is the average annual storage from 1748–1752 divided by the population in 1748.

⁴⁵ State Meteorological Administration, *Zhongguo jin wubai nian hanlao fenbu tuji*

⁴⁶ Yao Shan-Yu, “Chronological and Seasonal Distribution”; and Zhang Peiyuan, “Extraction.”

⁴⁷ Durand, “Population Statistics”; and Ho Ping-ti, *Studies*.

⁴⁸ Marks, “Rice Prices.”

⁴⁹ Will, Wong et al., *Nourish the People*.

Tax Quota and Tribute Grain

The grain tribute and land taxation are discussed and recorded by Harold Hinton and Wang Yeh-chien, respectively.⁵⁰ Calculations of the statutory tax quota in this article are based on the latter source, which reports that in 1753, statutory taxes consisted of the land-based taxes (31 million “land and head” tax, and 13 million in grain tribute), the commercial taxes (11 million from the salt and customs taxes), and miscellaneous taxes (1 million, which included income from rents of public land and interest from government deposits, and sales of official degrees and public offices). China’s total tax revenue (quota plus estimated surcharges) in 1753 was approximately 73.8 million *taels*.

⁵⁰ Hinton, *Grain Tribute System*; and Wang Yeh-chien, *Land Taxation*.

REFERENCES

- Arrow, Kenneth J. *Aspects of the Theory of Risk-Bearing*. Helsinki: Yrjö Jahnssoonin Säätiö, 1965.
- Chen, Zen-Yi, Wang Yeh-Chien, and Hu T. H. “A Time Series Analysis of Rice Prices in Suzhou during the Eighteenth Century.” *Academia Economic Papers* 27, no. 3 (1999): 311–34.
- Chen, Zhenhan, Xiong Zhengwen, Li Chen, and Yin Hanzhang. *Qing shilu jingjishi ziliao* [Economic history materials from the Veritable Records], 4 volumes. Beijing: Beijing Daxue, 1989.
- Chi, Ch’ao-tin. *Key Economic Areas in Chinese History*. New York: Paragon Book Reprint Corp., 1963.
- Ch’ü, T’ung-Tsu. *Local Government in China under the Ch’ing*. Cambridge, MA: Harvard University Press, 1962.
- Chuan, Han-sheng and Richard A. Kraus. *Mid-Ch’ing Rice Markets and Trade: An Essay in Price History*. Cambridge, MA: Harvard University Press, 1975.
- Da Qing huidian shili* [Precedents and regulations supplementing the collected statutes of the great Qing dynasty]. 1899 edition.
- Da Qing lichao shilu* [Veritable Records of the Qing]. Zhonghua, 1986–1987.
- Dunstan, Helen. *Conflicting Counsels to Confuse the Age: a Documentary Study of Political Economy in Qing China, 1644–1840*. Ann Arbor: Center for Chinese Studies, University of Michigan, 1996.
- Durand, John D. “The Population Statistics of China, A.D. 2–1953.” *Population Studies* 3, no. 2 (1960): 209–56.
- Esherick, Joseph W., and Mary Backus Rankin, eds. *Chinese Local Elites and Patterns of Dominance*. Los Angeles: University of California Press, 1993.
- Feng, Liutang. *Zhongguo lidai minshi zhengceshi* [Civilian Food Policy in China’s Historical Period]. Beijing: Shangwu Yingshuguan, 1993.
- Gongzhong liangjiadan* [Grain price reports in the palace archives]. Beijing: Number One Historical Archives.
- Hickey, Paul C. “Fee-Taking, Salary Reform, and the Structure of State Power in Late Qing China, 1909–1911.” *Modern China* 17, no. 3 (1991): 389–417.
- Hinton, Harold. *The Grain Tribute System in China (1845–1911)*. Cambridge, MA: Harvard University Press, 1956.
- Ho, Ping-ti. *Studies on the Population of China, 1368–1953*, Cambridge, MA: Harvard University Press, 1967.
- Hsiao, Kung-chuan. *Rural China: Imperial Control in the Nineteenth Century*, Seattle:

- University of Washington Press, 1960.
- Li, Lillian M. "Integration and Disintegration in North China's Grain Markets, 1738–1911." *This JOURNAL* 60, no. 3 (2000): 665–99.
- Liu, Ts'ui-jung. "A Reappraisal of the Functions of the Granary System in Ch'ing China (1644–1911)." *Les techniques de conservation des grains à long term* 3 fasc.1, Éditions du CNRS, Paris, 1985.
- Mann, Susan. *Local Merchants and the Chinese Bureaucracy, 1750–1950*. Stanford, CA: Stanford University Press, 1987.
- Marks, Robert B. "Rice Prices, Food Supply, and Market Structure in Eighteenth-Century South China." *Late Imperial China* 12, no. 2 (1991): 64–116.
- Mirrlees, James A. "The Optimal Structure of Incentives and Authority within an Organization." *Bell Journal of Economics* 7, no. 1 (1976): 105–31.
- Needham, Joseph. *Science and Civilization in China*, Vol. 4, pt 3. Cambridge: Cambridge University Press, 1971.
- Nishijima, Sadao, Feng Zuozhe, Qiu Mao, and Li Chao. *Zhongguo jingji shi yanjiu* [Research on the economic history of China], Beijing: Nongye chubanshe, 1984.
- Park, Nancy. "Corruption in Eighteenth-Century China." *Journal of Asian Studies* 56, no. 4 (1997): 967–1005.
- Perdue, Peter C. "The Qing State and the Gansu Grain Market, 1739–1864." In *Chinese History in Economic Perspective*, edited by Thomas G. Rawski and Lillian M. Li, 100–125. Los Angeles: University of California Press, 1992.
- Perkins, Dwight H. "Government as an Obstacle to Industrialization: The Case of Nineteenth-Century China." *This JOURNAL* 27, no. 4 (1967): 478–92.
- _____. *Agricultural Development in China 1368–1968*. Chicago: Aldine Publishing Company, 1969.
- Quanguo fensheng minshu gushu qingce* [National registers of population and granary holdings arranged by province]. Beijing: Number One Historical Archives.
- Rankin, Mary Backus. "Managed by the People: Officials, Gentry, and the Foshan Charitable Granary, 1795–1845." *Late Imperial China* 15, no. 2 (1994): 1–52.
- Rawski, Thomas G. and Lillian M. Li, eds. *Chinese History in Economic Perspective*. Los Angeles: University of California Press, 1992.
- Reischauer, Edwin O., and John K. Fairbank. *East Asia: The Great Tradition*. Boston: Houghton Mifflin, 1958.
- Rowe, William. "State and Market in Mid-Qing Economic Thought: The Case of Chen Hongmou." *Études Chinoises* 7, no. 1 (1993): 7–39.
- Ross, Stephen. "The Economic Theory of Agency: The Principal's Problem." *American Economic Review* 63, no. 2 (1973): 134–39.
- Shiue, Carol H. "Transport Costs and the Geography of Arbitrage in Eighteenth Century China." *American Economic Review* 92, no. 5 (2002): 1406–19.
- Skinner, G. William, ed. *The City in Late Imperial China*. Stanford, CA: Stanford University Press, 1977.
- State Meteorological Society. *Zhongguo jin wubai nian hanlao fenbu tuji* [Collected maps of droughts and floods in China in the past five hundred years]. Beijing: Ditu chubanshe, 1981.
- Wang, Yeh-chien. "The Secular Trend of Prices during the Ch'ing Period (1644–1911)." *Journal of the Institute of Chinese Studies of the Chinese University of Hong Kong* 5, no. 2 (1972): 347–68.
- _____. *Land Taxation in Imperial China, 1750–1911*. Cambridge, MA: Harvard University Press, 1973.
- _____. "Food Supply in Eighteenth-Century Fukien." *Late Imperial China* 7, no. 2 (1986): 80–117.

- Watson, Andrew. *Transport in Transition: The Evolution of Traditional Shipping in China*. Ann Arbor: University of Michigan, 1972.
- Will, Pierre-Etienne. *Bureaucracy and Famine in Eighteenth Century China*, transl. by Elborg Forster. Stanford, CA: Stanford University Press, 1990.
- Will, Pierre-Etienne, R. Bin Wong, James Lee, Jean Oi, and Peter Perdue. *Nourish the People*. Ann Arbor: University of Michigan Press, 1991.
- Williams, Jeffrey C., and Brian D. Wright. *Storage and Commodity Markets*, New York: Cambridge University Press, 1991.
- Wu, Chengming. "Lun Qingdai qianqi woguo de guonei shichang [A discourse on the national markets of our country in the first half of the Qing Dynasty]." *Lishi yanjiu* 1 (1983): 96–106.
- Yao Shan-Yu. "The Chronological and Seasonal Distribution of Floods and Droughts in Chinese History." *Harvard Journal of Asiatic Studies* 6, (1942): 273–312.
- Zelin, Madeleine. *The Magistrate's Tael, Rationalizing Fiscal Reform in Eighteenth-Century China*. Berkeley: University of California Press, 1984.
- Zhang Peiyuan. "Extraction of Climate Information from Chinese Historical Writings." *Late Imperial China* 14, no. 2 (1993): 96–104.