Do institutions matter? The political economy of public health provision in the British Raj (1869 - 1904)[1]

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Abstract: British India was characterized by wide regional disparities in the provision of health-related services. This late-19th century regional inequality has been under-researched, despite health being a fundamental dimension of human and economic development. This paper relies on qualitative and quantitative research to show that land-related institutions, such as the land revenue system or the type of settlement, influenced health expenditure at the local level. The importance of geographical factors such as the rainfall should be considered, and relevant provincial differences in hospital and dispensaries expenditure have been found. Finally, the origins of each institution, as well as the mechanisms through which they influenced the supply of health services, are considered.

Key words: Land revenue system, caste system, British Raj, public health, geography.

I.   Introduction

The role of institutions in the economic development and the provision of public goods in different regions, countries and continents has been a mainstream topic for at least the last two decades. In this regard, the appearance of Neo Institutionalism, brought by Douglass North and its critiques, from which Chang, H. J. (2011) could be one of the most prominent examples, has cleared the path for the introduction of the institutional variables in the economic history debates. Overall, the use of institutions explaining the economic performance and the public goods provision of different regions has become extremely popular in the academia. In this regard, North, D.C. (1991: 109) assured that the mere economic evolution was not sufficient to explain economic growth since proper institutions appear to be necessary for such outcome.

The way institutional variables have been introduced varies among different authors: Acemoglu, D., *et al* (2001) and Nunn, N. (2008) study the effect of institutions with a very long run perspective and with an extensive use of econometric tools, while other authors have a more short run historical and dialectic approach (like Chaudhary, L. (2010a)). Overall, the long run approach has been extensively criticised. Among those critiques, Austin, G. (2008) presents a large set of issues that may appear in those studies (the quality of the evidences, the compression of history, the binary relation between economic development and rent seeking and the importance of the natives' agency[2]). There has been a third vision in all this literature which is developed by Sokoloff, K. L., & Engerman, S. L. (2000), who try to argue that the factor endowments of each geographical area explain the introduction of certain institutions and that explains the economic and public goods results in those regions.

Within this literature and line of research, one of the topics that has been debated is the development and public goods provision differences in India – particularly concerning the colonial period. Two main theories have emerged from this debate: One is presented

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[2] The quality of the evidences is criticised by Austin, G. (2008: 998) since long run estimations used in some studies appear to be almost arbitrary. The compression of history is a critique more to the core long run analysis on institutions since Austin considers that a lot of historical events between the institutional variable (say, for instance, the Atlantic slavery trade) and the economic results from which a correlation is searched. Finally, Austin denies the dichotomy established in some articles between rent seeking behaviour and economic development and reassesses the importance of the native agency in the institutional and economic results in areas colonized by the Europeans.

by Roy, T. (2014: 346), who outlines the influence of geographical factors in the fiscal capacity of each region as well as in the public goods provision for the late nineteenth century. Similarly, Roy, T. (2006: 171) considers that resource endowments played an important role in regional differentiation at least during the colonial rule and later. A different explicative framework is presented by Banerjee, A., & Iyer, L. (2005: 29) who argue that the land revenue system (institution) explains the differences in agricultural investment, especially after the Green Revolution, leading to modern differences in economic development and public goods provision between regions of India. Kapur, S., & Kim, S. (2006: 22) expand the argument defending that divergences in agricultural productivity already existed during the colonial rule. Finally, Chaudhary, L. (2010a) finds significant differences between provinces in the public spending on education for the early 20th Century, which apparently could have derived from the differences in the land revenue system and type of settlement of each area.

Even considering institutions as the main explanation to the regional differences on public goods provision, their origin has also drawn the attention of scholars. It is not clear to which extent certain institutions (like the caste system or the land revenue systems) were implemented by the British or already existed (Stokes, E. (1980: 40)). In that sense, the British dominion over India, and its development, has prompt a lot of research regarding its role in the legal and social fields. In other words, sociologists, historians and anthropologist have studied the role of the British in the creation of informal and formal institutions. Washbrook, D. (2004: 481) stands out for its general overview of the social effects of the British dominion over South India, defending that the British rule had some effects on the native institutions of India, but it did not explain the evolution of all of them. Nonetheless, as the previously mentioned author underlines, more radical positions have been established in this debate: On the one hand, some authors present the idea that the British were completely unable to introduce any significant change in the Indian society. Among those authors, Frykenberg, R. E. (1977) can be considered as the most prominent, as Washbrook, D. (2004: 479) and Stokes, E. (1980: 31) signal. On the other hand, Washbrook presents Parthasarathi, P. (2001) as the other side of the coin, arguing that the British rule dramatically transformed the Indian society.

Within this research framework, this work aims to identify the explicative power of institutions (the land revenue system, the type of settlement and the caste system) in India's regional differences regarding public goods provision during the colonial period (more precisely, regarding public health expenditure). This is expected to be done controlling for some other relevant aspects mentioned in the literature (see Section III). The analysis is not bounded into a Neo Institutional framework where property rights explain the levels of agricultural investment and future economic development (Kapur, S., & Kim, S. (2006)). Instead, it attempts to emphasise the role of public revenue and social organization in the provision of public health, which essentially consists of public rather than private investment. In this regard, the revenue collected by public administrations could be dependent on the land revenue system and the type of settlement, which somehow could explain the public health provision in the different regions. Also, the politic stability and limited differences in policy preferences generated by social fragmentation and stratification (which could be derived from caste fragmentation differences), as Chaudhary, L. (2006) and Easterly, W., & Levine, R. (1997) signal, could explain the differences in the public goods provision. Surprisingly, this institutional approach specifically focused on the provision of public health in colonial India has not been deeply explored yet. As for the influence of British colonialism and ancient Indian traditions in the caste and land revenue system institutions, it is aimed to define this influence[3] and to briefly present how the effect of those institutions on the provision of public goods (in this case, of public health) could potentially provide some clues regarding the origins and influences of each institution.

The methodology used is composed of two different approaches: The first one is a descriptive analysis which attempts to study the previous literature, describe the evolution of public health in India and the reasoning behind the potential importance of institutions in the public goods provision differences. The second one is an econometric study to complement and quantitatively back up the previous analysis. The descriptive analysis is focused mainly on the British Crown rule over India, although previous periods are also mentioned, especially regarding the study of the influence of ancient traditions in institutions. On the other hand, the econometric study uses data from the middle

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[3] From a revision of the already existing literature.

years of the British Crown rule (1901 – 1904). The reasons behind the choice of this period of study are various: Among them the availability of the data, the relevance of decentralization reforms (which were done during the second half of the 19th Century) and the famines suffered in the subcontinent (that generally ended at the turn of the century[4]).

The present study generally uses as its unit of analysis the districts of British India due to the importance of those in the public health expenditure after the decentralization reforms commented in Section II. Furthermore, the use of districts as the unit of study allows for a larger number of observations in the statistical analysis and the decentralization processes permit the study of a revenue source that supplied the district boards directly: The cesses.

The conclusions presented in this document are conditioned by the biases introduced by the data used (see Section IV). Having said that, the present work shows two formal institutions (the land revenue system and the type of settlement) as two important explanatory factors of the pattern of public health expenditure (provision) while geographical and other factors' explanatory power seem to be of less importance (but not null). As for the influence of British and ancient traditions in the different institutions, it can be said that apparently, neither the caste system nor the land revenue system appeared to be completely influenced by either. Moreover, the effect of each institution on the public goods provision (in this particular case, the public health expenditure) might be interpreted as an initial approximation to the influence of ancient traditions and the British colonial rule in each institution. Hence, the caste system, whose fragmentation apparently had no influence in the public health expenditure, might not have that influence due to the relatively recent[5] and potentially important influence exercised by the British in this institution.

The present work is organized as follows: In Section II it is discussed the administrative organization of the Raj, a general overview of the public health evolution during the British rule is made and the decentralization reforms of the late 19th Century are

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[4] According to Davis, M (2002: 299) the worst famines that the subcontinent ever suffered went from 1875 to 1900.

[5] As will be stated later in this work, this British influence might be dated from the Indian mutiny of 1857.

presented. Section III is devoted to the discussion on the historical origins and the potential mechanisms by which the land revenue system, the type of settlement, the caste system and other factors could have influenced the provision of public health in different districts. Section IV defines the data used and its potential biases and Section V describe and present the results of the econometric study. Finally, in sections VI and VII the results are discussed and some preliminary conclusions are highlighted.

II.   Public health, finance and local governance in British India

The administration of the Raj at the end of the 19th Century differed dramatically from the administration inherited from the British East India Company (from now on, the Company). There were mainly 3 administrative levels, as is presented in Figure 2.1: The central government, the provincial governments and the district boards or municipalities.

Figure 2.1. Administrative levels in the British Raj at the end of the 19th Century.
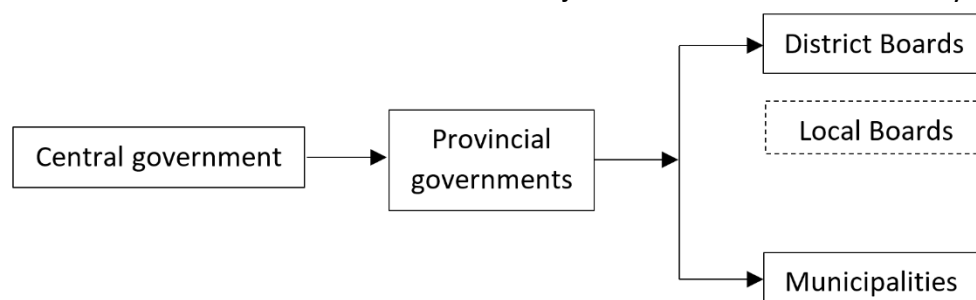
Source: Own elaboration and Meyer, W.S. *et al* (1909a).

The municipalities were formed by a group of municipal commissioners as is pointed out in Meyer, W.S. *et al* (1909a: 288-289). The provision of public services by the municipalities was classified as obligatory or discretional within the Government of Bombay (1901: 52), although this classification was applicable to the whole of India according to Meyer, W.S. *et al* (1909a: 290). Among the functions classified as obligatory, there were sanitary functions (watering, cleansing of public streets, the maintenance of hospitals and public vaccinations among others) as well as the establishment of police and the maintenance of primary education.

As is signalled in Chaudhary, L. & Garg, M. (2015: 940) the majority of the population at the turn of the century lived in rural areas (almost 90% of the population). Hence,

following Lord Ripon's reform of 1881-82[6], a new system of boards was extended through British India creating the local and district boards. Those institutions had similar functions to those assigned to the municipalities (including the maintenance of hospitals and dispensaries) and were created in rural areas (Meyer, W.S. *et al* (1909a: 301-302)). The district boards, were to the local boards, what the central government was to the provincial governments according to Meyer, W.S. *et al* (1909a: 302).

Having said that, local governance (hence, the establishment of municipalities, district boards and responsibilities as well as revenue sources for them) in British India was a matter that was not tackled until the crown assumed the direct control over the territory[7]. In this regard, it was not until the administration of Lord Mayo[8] that some effort was done in order to introduce an effective government at the provincial level. Previously to the reform by Mayo, the provincial governments had absolutely no control over their incomes, as is signalled in Meyer, W.S. *et al* (1909a: 164)[9] "*The local governments* [provincial governments] *had possessed, hitherto, practically no control over their own revenues, and the grants for the services in each Province were made annually by the Supreme* [central] *Government.*" However, in the year 1870-71, the administration of Lord Mayo introduced a new method for the financing of the provincial administrations that consisted on a fixed grant that the provincial government received from the central government, called provincial settlement. That change allowed the provincial governments to manage some services at their own expenses. Hence, the reform of Lord Mayo increased the sources of revenue for the provincial governments and stated the basis for further decentralization in the Raj. Later on, in 1877, the land revenue among other revenue sources were entrusted to the provincial governments (Patil, S. H. (1995: 40)) who had the responsibility to collect them.

Following Lord Mayo's reform, the appointment in 1880 of Lord Ripon as the Viceroy of India lead to another reform that dug more deeply into the finance and autonomy of local administrations. Firstly, the reform was presented with the objective to educate[10]

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[6] Reforms will be commented later in this section.
[7] After the Mutiny of 1857.
[8] Lord Mayo was the Viceroy of India from 1869 until its assassination in 1872.
[9] Meyer, W.S. *et al* (1909a).
[10] Hence, it might be considered that the British believed that the natives needed to somehow learn how to rule themselves and administrate public resources.

the Indian population on the government of public institutions and increase the assistance of Indian natives in the administration of the Raj (Vajpeyi, D. K., & Arnold, J. M. (2003: 35)). Secondly, the reform of 1882 (generally known as Ripon's Report) allowed for a greater finance of local administrations (including district boards) through the management of the rates of local taxes (cesses) of the municipal councils, district and local boards (Weinstein, B. (2018: 7)). Thirdly, provincial governments started receiving a share of their land revenue (Chaudhary, L. (2010a: 191)) and finally, according to Chaudhary, L. (2010b: 281), this reform decentralized, at the district/local boards level the management of public health, among other public services, in rural areas[11]. Nonetheless, health expenditure in rural areas was not exclusively done at the district board level: Provincial governments, the central government and certain private entities also financed the health system of the Raj. However, according to Chand, G. (1947: 230) from the 5,650 hospitals present in the country, 4,195 were financed by local bodies (district boards and municipalities) by 1939. This leads to the idea that the district boards and municipalities were the principal contributors to the public health system of the Raj. Overall, the main consequence of Lord Ripon's reform was an increase of the district boards and municipalities revenues and a certain decentralization of expenditures such as health and primary education to the district boards, increasing also the role of native people on administrative affairs, according to Meyer, W.S. *et al* (1909a: 287-288)

The finance of public goods was mainly provided by two revenue sources which are studied in this work. The land revenue represented the largest source of revenue at the year 1855-56 (Hendriks, F. (1858: 226)) for the administrations. The provincial governments were responsible for the land revenue collection (Chaudhary, L. (2010b: 281) from 1877, as has been already commented, but only received a share of their land revenues after the Ripon's reform (Chaudhary, L. (2010a: 191)), allowing the provincial governments to provide grants to district boards and municipalities. Despite an overall significant reduction by 1920 signalled by Roy, T. (2006: 318)[12], the historical relevance

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[11] Municipalities also were responsible for the management of Medical services in urban areas.
[12] The magnitude of the decrees is represented by a reduction of overall revenue from 55.5% in 1855-56 to about 20% in 1920. The same author points at the introduction of other taxes such as an income tax

of the land revenue is undeniable. Another main revenue source were the cesses which were a surcharge of the land revenue, obtained by the district boards. Data on the aggregate district board's revenue confirms the relevance of cesses at the district level of the administration: In the province of Madras, by 1903-04, cesses represented the 56.79% of the revenue of all local and district boards of the province[13]. During the 19th century, the cesses represented even a larger percentage of the whole Raj district boards' revenue: a 60%. However, district boards were still partly dependent on the grants provided by the provincial governments, which, according to Chaudhary, L. (2010b: 281), in 1929-30 represented a 43% of the district boards' income, compared to the 36 percent of the cesses.

Overall, as can be seen in Figure 2.2, cesses as well as the land revenue were affected by the reforms mentioned before. Those changes in cesses and land revenue emphasised the relevance of institutions such as the land revenue system and the type of settlement (which were institutions intrinsically related to those revenue sources, as will be analysed in Section III) explaining the revenue differences between districts and regions. Also, both reforms gave more responsibilities to provincial (Lord Mayo's Reform) and district (Lord Ripon's Reform) governments as well as more control over their revenue, decentralizing the finance of public goods generally at the district level.

Figure 2.2. The two main decentralization reforms of the second half of the 19th Century.

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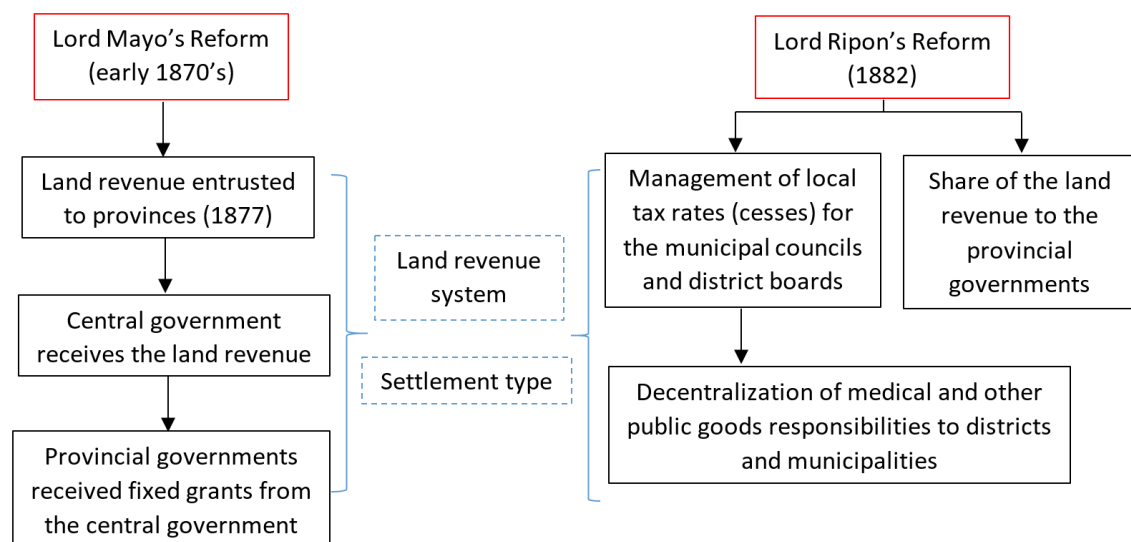
and the reduction of the importance of agriculture in the whole Raj economy as the reasons behind this decline.
[13] Francis, W. (1908: 139).

District and local revenues were used to finance locally-provided public goods. Among all of these, health was central, as fundamental for human and economic development. Historically, public health in India has drawn little attention from the academia. Nonetheless, this interest has revived in the last 30 years, when Ramanna, M. (2002) or Harrison, M. (1994) published their books on the public health in British India and other studies on Namibia, Senegal and other colonial regions also appeared[14]. Hence, the public health topic has not been much studied although its importance has clearly been reassessed relatively recently. For the specific case of India, the British medical presence is dated from the 17th Century under the Company rule and was followed by a steadily increasing number of surgeons. This tendency was proportionally related with the expansion of the commercial routes of the Company, although no permanent establishment was created until 1763, according to Harrison, M. (1994: 7). As is also signalled by the previously mentioned author, military expansionist policies of the middle 18th Century explain the creation and further expansion of medical boards in each of the three presidencies[15] by 1775. The role of those boards was to administer the different hospitals of their respective presidencies. According to Harrison, M. (1994: 88) from 1830's onwards, dispensaries began to be established (especially from charitable entities), representing the first attempt at introducing western medical care in India.

Once the western medical care was introduced in the subcontinent and the mentioned decentralization reforms became effective, the percentage of public health (medical) expenditure[16] over total district boards' expenditure went from a 4.30% in the province of Berar to a 20.62% in the province of Madras for the year 1903-04[17]. Although some of those percentages may appear to be small in some cases, there was an important variability among the different provinces. Table 2.1 shows the total health expenditure

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[14] Among those studies Gottschalk, K. (1988) or Echenberg, M. (2002) are some examples.

[15] A presidency was composed of several provinces. This word is generally used to refer to the original 3 presidencies in the Company's India: The Bengal presidency, the Bombay presidency and the Madras presidency.

[16] Public health expenditure refers to medical expenditure and vice versa all along the present work.

[17] Data obtained from Meyer, W.S. *et al* (1909) (Volumes 6, 7, 8, 10, 11, 16, 19, 20 and 24).

of the district and municipal administrations (local bodies), the percentage of the district boards with respect to the total medical expenditure in those administrations for the year 1903-04 and the per capita medical expenditure.

Table 2.1. Local bodies' total and per capita medical expenditure for the year 1903-04 (in rupees).

Province	Expenditure 1903-04					
	Total medical expenditure		District boards (%)	Per capita medical expenditure		
	District Boards	Municipal		District Boards	Municipal	DB+M
Assam	99578	8965	91,74%	0,019	0,002	0,021
Bengal	409277	569000	41,84%	0,005	0,008	0,013
Berar	22546	6499	77,62%	0,008	0,002	0,011
Bombay	294947	310099	48,75%	0,012	0,012	0,024
Central Provinces	109154	73486	59,76%	0,009	0,006	0,015
Coorg	4219	9021	31,87%	0,023	0,050	0,073
Madras	2064820	339160	85,89%	0,054	0,009	0,063
North-West Frontier	30967	50574	37,98%	0,015	0,024	0,038
Punjab	377654	587909	39,11%	0,015	0,024	0,039
United Provinces	693814	164518	80,83%	0,015	0,003	0,018

Source: Data obtained from the Imperial Gazetteer volumes (Meyer, W.S. *et al* (1909a)). The nominal expenditure has been obtained from the tables representing district boards and municipal revenues and expenditures for the year 1903-04. The percentages have been elaborated from the previous information, representing the percentage of the district medical expenditure with respect to the sum of the other administration's expenditure. The year of the rupees is not specified, but it's irrelevant for this analysis. The per capita medical expenditure has been calculated using the 1901 Census data available in Meyer, W.S. *et al* (1909) and DB+M represents the sum of municipalities and district boards' expenditure.

In the mentioned table, the district boards appear to have an important role financing the medical expenditure. The Madras and Assam cases are the most notable, since more than 85% of medical expenditure provided by local bodies (district boards and municipalities) was done at the district level. As has been signalled previously, district boards and municipalities seem to be the main financers of public health expenditure (Chand, G. (1947: 230)). Hence, Table 2.1 is expected to represent the majority of the public health expenditure in the Raj.

Focusing on the per capita expenditure, the table also shows an important variability among provinces: At the district board level, the province of Madras had an expenditure of 0.054 rupees per capita whilst Bengal only spent 0.005 rupees. This variability is also present if the expenditure from municipal administrations is considered and, still, remains to be explained.

Concluding, from an income perspective, the decentralization processes did not represent the total independence of district boards and municipalities since a substantial share of its revenue was obtained from grants from the provincial governments. From the expenditure side, linked to the decentralization processes, an important variability among regions in the public health expenditure (provision) could be observed (see Table 2.1). Trying to explain those differences, the analysis developed throughout the next sections of the paper focuses mainly on the district board level (as the majority of the population in the subcontinent lived in rural areas, its public health (medical) expenditure was relevant overall and allows for a larger number of observations than a provincial analysis for Section V). However, this approach has some limitations due to the nature of the sources and the data used (see Section IV).

III. The role of institutions and other factors

The differences in public health expenditure, presented in the previous section, may be explained by different mechanisms. To this study, institutions are expected to play an important role explaining those differences. However, other mechanisms present in the literature are taken into account in order to have a certain robustness on the results obtained. Thus, four main factors can be identified as potentially influential to the differences in this health expenditure levels: The land revenue systems, the settlement types, the caste system and other geographical and regional particularities.

III.I The land revenue systems and the settlement types

One possible factor explaining the differences in public health expenditure (provision) may be the land revenue system implemented in each district. The various land revenue systems can be summarized as in Table 3.1:

Table 3.1. Main land revenue systems under the British rule.

Type of revenue collection	Intermediary	Village/intermediary	No intermediary
Land revenue system	*Zamindari* System	*Mahalwari* System	Ryotwari System

In the *Zamindary* system there was an intermediary between the state and the peasants (*ryots*), the *zamindar*, who was responsible for the payment of the land revenue to the provincial government and who was not necessarily the owner of the land[18]. The *Ryotwari* system was a land revenue system where there was no intermediary between the *ryots* and the provincial government. Finally, the *Mahalwari* system was a land revenue system where a more or less representative board was responsible for the payment of the land revenue. This board could be responsible for the payment of a single village or a group of villages (*mahal*).

Historically, the British made their first attempt to collect revenue from the land cultivators in 1772 just after the acquisition of the *Diwani*[19] right for the Bengal province (Bengal and East Bengal, see Figure 3.1). As for the importance of the land in the subcontinent's economy, Bandyopādhyāẏa, Ś. (2004: 82) states that agriculture was the main sector of the Indian economy in 1765. Furthermore, it must be pointed out that in 1772, the Company owned the British territories in the subcontinent and neither district nor provincial decentralization reforms (either of revenue sources or expenditure responsibilities) were already made. According to Sarwar, F. H. (2012: 16), this first attempt to collect revenue from land consisted on an allotment of the collecting rights on a contract basis and its geographical applicability was constrained to the Bengal province[20]. According to Baden-Powell, B. H. (1892: 243) the idea was to determine what lump-sums the different intermediaries had previously been required to pay in order to then adjust and assure that everyone paid what, by law, should. Following this early initiative, the permanent settlement was established in Bengal (1793) during the Cornwallis[21] period. "Permanent" meant that those who held the settlement

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[18] For the case of *zamindars* in Bengal, according to Baden-Powell, B. H. (1892: 534) and Stokes, E. (1980: 2), it cannot be said that they possessed all the land in which they had the right to collect revenue. Ultimately, this leads to a differentiation in the rights over a certain plot of land, which is considered by certain authors like Roy, T. (2013: 51) but is neglected by others like Banerjee, A., & Iyer, L. (2005).

[19] The *Diwani* rights were the rights by which, in this case, the British East India Company, could collect revenues and decide the civil taxes.

[20] There were, until 1793, different types of revenue collection systems that were proved. This is well summarized in Ascoli, F. D. (1917). *Early Revenue History of Bengal: And the Fifth Report, 1812*. Clarendon Press. Chapter 3.

[21] Lord Cornwallis was the Governor-General and commander in chief in India from 1786 to 1794.

(intermediaries)[22] in the province would have a fixed payment, not subject to revision, for the land revenue.

Figure 3.1. Political divisions (provinces) of the Indian Empire (1909).

Source: Meyer, W.S. *et al* (1909c). Imperial gazetteer of India. Atlas. 1909 edition. Oxford: Clarendon Press.

The establishment of the permanent settlement in Bengal[23] also implied the formalization of the *Zaminadri* system under the British rule in the region. Those holding the settlements in Bengal were called *zamindars*, who during the early modern period were the civil servants responsible to collect taxes from the peasantry (Roy, T. (2013: 51-52)).

However, the story changes depending on the region of study. Madras, Central Provinces, Bombay and other provinces of British India enjoyed various land revenue systems. In this regard, Baden-Powell, B. H. (1892: 245) states that Bombay and Madras were generally under the *Ryotwari* system (no intermediary). In this system, the revenue collection was done individually (from peasant to peasant), while in the *Zamindari* system, the whole estate held by the *zamindar* (intermediary) was assessed for revenue. In parts of the Central Provinces and North-Western India the *Mahalwari* system was

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[22] The person holding the settlement is the person responsible for the land revenue (and cesses) payment. Hence, the intermediary according to the British government (Baden-Powell (1892: 339)).
[23] Bengal and East Bengal in Figure 3.1.

introduced, although compared with the other two systems, the *Mahalwari* system was the most marginal, according to Haque, T., & Sirohi, A. S. (1986: 29). This type of revenue system was characterized by the fact that the revenue was collected from a village or a *mahal*[24] as a whole, through the village committee (intermediary). It is important to state that generally speaking, those assigned for the revenue collection of the whole village or *mahal* (village committee) were usually the most important families of the villages (Stokes, E. (1959: 85)). Hence, it might be stated that this land revenue system had a *zamindar* flavour in its functioning. In this regard, Iversen, V. *et al* (2013: 10) and Stokes, E. (1980: 3) signal this representative intermediary character of the *Mahalwari* system, although it is recognised that in some cases, this system was more similar to the *Ryotwari* than the *Zamindari*.

The application of different land revenue systems was not a top-to-bottom decision. The British rulers did not, apparently, totally determine the type of land revenue system in the different regions. In the case of the *Zamindari* system in Bengal, as Baden-Powell, B. H. (1892: 389) points out: "[…] *the principles that underline the Bengal settlement have not been without their influence on the later systems, which in many respects depart widely from the old Bengal idea.*" In this regard, it appears to be clear that the *Zamindari* system was a modernization of the pre-colonial land revenue systems implemented in the province. However, Banerjee, A., & Iyer, L. (2005: 9) outline that by the end of the 18th century, there was considerable doubt about the original land revenue system of India. Those doubts may have appeared due to an erratic approach to the subject. The subcontinent had a wide variety of systems and governments, from the Moghul to the Maratha, thus it was impossible to determine one single system for all of India.

But, was it just history that mattered for the establishment of a certain land revenue system? Probably no, the variations on the establishment of different land revenue systems should not be exclusively attributed to the precolonial legacy. The British agency played also a relevant role in the introduction of the different land revenue systems. As Ludden, D. (1993: 257) highlights, the personal approach of some functionaries of the Company to the way in which revenue collection had to be made,

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[24] A *mahal* represents a territorial division, larger than a single village.

definitely influenced the creation and introduction of some land revenue systems. In this regard, Thomas Munro (Governor of Madras from 1820) aimed at destroying all intermediaries between the Company and the peasants in order to secure the revenue for the Company, ultimately leading to the creation of the *Ryotwari* system. Similarly, Stokes, E. (1959: 87) points at utilitarianism and its repudiation to landlords as the main explanatory factor for the introduction of the *Ryotwari* system and, to a certain extent, the *Mahalwari* system. Hence, the origins of the land revenue systems can by no means, be completely attributed to the influence of the British nor to the ancient traditions of the subcontinent. In that sense, the potential effect of this institution on the public health expenditure (provision) must not be understood as the exclusive effect of the influence of British nor Indian tradition.

As has been presented in the previous section, district boards were enabled to introduce surcharges on the land revenue, called cesses. This tax represents the core of the mechanism through which the land revenue could have influenced public health expenditure. The idea is that the land revenue could have influenced the cesses, and those the public health provision in each district, since the cesses were one of the main revenue sources for the district boards. According to Chand, G. (1947: 119) "*The cesses have to be paid by the landlords or the superior proprietors who are responsible for the payment of the land-revenue*". The tax base of the cesses varied across provinces (Chaudhary, L. (2010b: 282)) while its tax rate was established by the respective district boards (Chand, G. (1947: 125)) varying especially between district boards of different provinces according to Chaudhary, L., & Garg, M. (2015: 942)[25]. Overall, the land revenue systems could have affected the cesses through the surcharge's tax rate in two different ways.

One of this ways would be the following. Although it is true that the land revenue that was demanded had to be paid, the provincial government (land revenue) or the district boards (cesses) could demand more from *ryots* under the *Ryotwari* system, who did not owe a single rupee to any intermediary, than from a *zamindar* (*Zamindari* system), who had to make a living of the exploitation of the *ryots*. This idea of the *zamindar* profiting

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[25] This might lead to a certain provincial pattern of public health expenditure, since the main variances would potentially be found between provinces. This will be tackled in more depth in Section V and VI.

from the rents provided by the *ryots* is highlighted by Harris, M. S. (1989: 272) and, with this perspective, the *zamindar* might be seen as an economic "parasite". Hence, in the *Zamindari* system, the resources that could be obtained from the land had to be shared among three parties (administration, *ryots* and *zamindars*), whilst in the *Ryotwari* system, those resources were divided only between the administration and the *ryots*. This may have led to larger resources captured by the administrations (provincial and district boards), through larger tax rates in the *Ryotwari* system regions (where the administrations could secure a larger part of the resources obtained from the land) than in those with intermediaries (*Zamindari* and *Mahalwari* systems).

Another way the land revenue systems could have influenced the cesses' tax rate was through the bargaining power of the taxpayers. It is straightforward to assume that the *zamindars*, who were taxpayers negotiating generally, for a large land parcel, would have more bargaining power to obtain lower tax charges (especially for the cesses, since they had to negotiate with the district board and not with the central government (land revenue)) than *ryots* at the *Ryotwari system*, where each *ryot* had to pay for its land individually. For the specific case of the *zamindars*, they could negotiate with the district boards the cesses' tax rate but also with the *ryots* what share of the revenue obtained from the land the former should receive from the *ryots*[26]. This idea of the bargaining power is as old as economics itself as Adam Smith in his famous work of 1776, the Wealth of Nations, (Smith, A. (1987: 83-84)) stated, for the labour bargaining process, that the masters would unite much more easily than the workers and that would give the former a larger bargaining power than that of the latter. That would allow the masters (*zamindars*) to arrange favourable agreements on the bargaining process (lower tax rates leading to lower tax charges).

The different land revenue systems, therefore, could potentially influence the amount of revenue collected by the provincial government, through the land revenue (leading to larger or smaller grants for the district boards) as well as the amount collected by the district boards through the cesses (Chaudhary, L. (2010a: 194)). For this work, the land

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[26] This leads to the idea that the *zamindars* could transfer the effect of cesses' rates increases to the *ryots*. Even considering this provability, this transfer was limited and the *zamindars* had obvious incentives to negotiate also with the district board for a lower cesses' rate.

revenue system's effect that is most relevant is the one on cesses, since this kind of revenue depended directly on the different district boards. However, it might be the case that since certain land revenue systems might provide larger revenues to the provincial administrations, it may also provide larger grants to the district boards, leading to larger expenditures on public health[27]. This last mechanism would also work the other way around and although it is not directly studied in this work, it definitively presents an interesting starting point for future investigation - as well as a potential source of bias in the present analysis (see Section IV).

Apart from the different land revenue systems, there is another institutional factor related to the land revenue that could influence the provision of public health (and public goods in general), also through the cesses: The settlement type. The payment which each tax payer (intermediary or not) had to deliver to the provincial government for the land revenue could be either fixed permanently (permanent settlement) or revised after a certain number of years[28] (temporary settled). As has already been pointed out, under the *Zamindari* system in Bengal, the payments were fixed (permanently settled). However, not all provinces where the *Zamindari* system was established had a permanent settlement. For instance, in the majority of the United Provinces the *Zamindari* system was settled temporarily. In this regard, the *Ryotwari* system was temporarily settled, as well as the *Mahalwari* system generally.

Those types of settlements might have had an impact on the cesses' tax base. The tax base for the cesses could be represented either by the annual value[29] or by the land revenue (Chand, G. (1947: 118)). The former was used as the tax base of the cesses in permanently settled land while the later was used in temporary settled land (Chaudhary, L. (2010b: 282)). For temporary settled land (where the land revenue was the tax base for the cesses) both cesses' tax base and land revenue were actualized, allowing the administrations to take into account productivity increases and price increases in both

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[27] However, this last mechanism presents more problems than the first one since the grants provided by the provincial government to the district boards could be determined by other factors than just the revenue available to the provincial government. Among those potential factors, the composition of the district board, the relation between the provincial government and the district board or the decentralization aim of the provincial government could be signalled.

[28] According to Chaudhary, L. (2010b: 282), temporary settlements were revised every 30 years.

[29] The annual value was defined as the rent paid by the tenant to the intermediary (Chand, G. (1947: 118).

revenue sources. On the other hand, for permanently settled land, the tax base of the cesses was the annual value, which was fixed with "*outdated and inaccurate*" surveys generally based on the land revenue assessments of 1793 Chaudhary, L. (2010b: 282). Hence, the ability to change the cesses tax base as well as the land revenue depended on the type of settlement. More precisely, it could be expected that the cesses obtained from temporary settled areas might have been higher than the ones from permanently settled areas since the former could take into account the productivity and price increases. It must be said, however, that the rigidity of the cesses to changes in agriculture (Chaudhary, L. (2010b: 282)), due to the fact that the temporary settlement was actualized only after large periods (generally, after 30 years), might somehow have mitigated this effect.

Figure 3.1. Land revenue systems and settlement types influence over cesses and district board's public health provision.
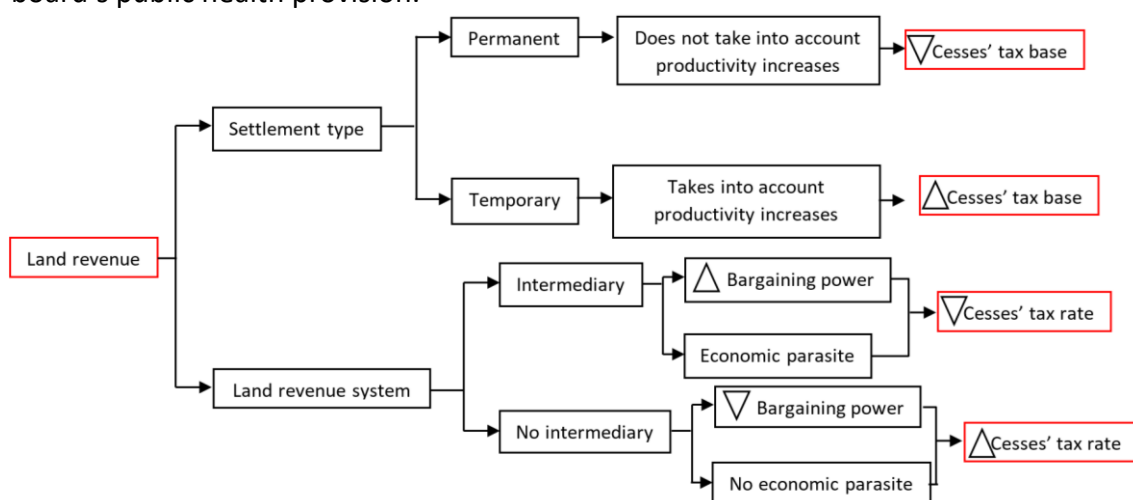
Notes: As has been commented in this subsection, it is assumed that larger cesses would allow the district board to have larger public health expenditure.

Thus, the type of land revenue system and the way in which it was settled (permanently or temporarily) might have influenced the level of public health provision in each district through both, land revenue and cesses. The present document is focused on the cesses effect, since it provided significant differences for the district boards' revenue (Chaudhary, L., & Garg, M. (2015: 942)) and its rates were managed by the district boards directly (Chand, G. (1947: 125)). It is expected that those systems with an intermediary (*Zamindari* and *Mahalwari*) would lead to lower revenue than the one without intermediary (*Ryotwari*) as well as land permanently settled with respect to temporary settled through the mechanisms summarized in Figure 3.1. All this explains the

introduction of the land revenue system and the way it was settled as explanatory variables in the regressions made in this work (see Section V).

III.II   The caste system as an explicative factor of public health provision

Another institutional factor that could explain the differences in the provision of public health at the district level was the caste fragmentation. According to Easterly, W., & Levine, R. (1997: 1206), ethnic diversity (or social polarization) is strongly correlated with factors such as investments in public goods with poor economic growth results. Another prominent study regarding the effect of ethnic diversity on economic performance is Alesina, A., & Ferrara, E. L. (2005), whose units of study are local communities in the USA and undeveloped countries. Those authors present a simple theoretical model which summarizes the literature on this topic, considering potential positive and negative effects of ethnic diversity. Among those effects of ethnic diversity influencing economic decisions, it can be found the potential enlargement of cooperative strategies among members of the same group, a preference for transactions between the members of the same group and a direct effect on the utility function of the individuals. In conclusion, there appears to be a trade-off regarding ethnic heterogeneity in which "*The potential benefits of heterogeneity come from variety in production* [referring to private goods production]*. The costs come from the inability to agree on common public goods and public policies*" (Alesina, A., & Ferrara, E. L. (2005: 7)).

This relationship between homogeneous ethnic groups and larger public goods provision is also find in Gennaioli, N., & Rainer, I. (2007). In this case, the authors focus on the African continent and use a measure on the politic organization of each ethnic group, previous to the European administrative rule, in order to state the relation between ethnic homogeneity and public goods provision. In fact, the conclusion at which those authors arrive goes beyond the previously mentioned literature as Gennaioli, N., & Rainer, I. (2007: 216-219) find historical evidence on a positive relation between precolonial centralization and local public goods in the colonial and postcolonial period, driven by more accountability on local chiefs. Finally, Nunn, N. (2008) and Banerjee, A., & Somanathan, R. (2007) also point at the ethnic (social) diversity as a factor explaining the actual provision of public goods.

Hence, similarly to the previously mentioned literature, this document looks for a potential effect of the caste diversity or concentration on the expenditure (provision) of public health. It is expected that those areas with more caste diversity would have lower levels of public goods provision (in this case, lower levels of public health expenditure) since larger social uniformity might lead to more political consensus on public policies, which might result in larger public goods provision. Nonetheless, two elements must be taken into account in this regard: First of all, a caste system is different from ethnic diversity. However, group differentiation within the society also occurs, so it might be stated that the mechanism by which differences in ethnic groups influence the provision of public goods and economic growth could be applied to the caste differentiation. Secondly, it may be that, as Alesina, A., & Ferrara, E. L. (2005) underlined for the ethnic differences, caste differentiation ends up having a positive impact on economic growth. For the present study, this result would definitely be an unexpected one, since this work is focused on the level of public health and not on production of private goods and/or services.

For the specific case of India, Banerjee, A., *et al* (2005: 644) appear to find a negative correlation between caste and religious fragmentation and primary public health provision with data from 1991 for the last and 1920's for caste and religious fragmentation in India. Baru, R. *et al* (2010: 50-51) underline the important differences existent nowadays in the accessibility to health services between regions and between caste groups. Similarly, Borooah, V. K., & Iyer, S. (2005: 43) identify an effect of caste on school enrolment for the years 1993-94, although the magnitude of this effect depends on non-community circumstances (like the literacy of the parents). Hence, literature appears to signal the caste system as a potential explanatory factor of divergences in the public goods provision and accessibility for the specific case of India.

The historical roots of the caste system in the Indian subcontinent are not as straightforward as most academics would predict at first sight. The initially dominant explanation was that the caste system was an almost intrinsic characteristic of the Indian society. Accordingly, the first formulation of a segregationist social system was done following the Aryan invasions of the Hindustan peninsula, approximately at the beginning of the *Rig-Vedic* period (1750 B.C), with the purpose of "*preserve*[ing] *and*

rationalize their superiority, the Aryans had to emphasize and maintain their racial distance from the indigenous community" ((Gupta, D. (1980: 253)). In this regard, the Aryans created a system of social segmentation according to the skin colour (*Varna* system) from which four main different social groups can be distinguished: the *Brahmans*, who were priests and teachers, shared the exploitative and dominant status with the warriors (*Kshatriyas*). The *Vaishyas*, who were peasants and artisans, and the *Shudras* (servants), were the social groups more adversely affected by the system[30]. In that sense, Dumont, L. (1980: 73) signals a clear "*homology* […] *between the two systems,* [caste and *Varna*]", which leads to the idea that the caste system already existed with the *Varna* system. However, according to this initial perspective, this system has not been completely stagnated into the *Rig-Vedic* period, and other social divisions have emerged with the introduction of the *Jati* system. This classification/system represents, according to De Zwart, F. (2000: 236), the different contexts at which the caste system may be represented (at the local, regional or national level). Summarizing this view of the roots of the caste system, it might be said that the characterization of the origins of the caste system appears as an ancient given.

Nonetheless, some academics have introduced a different perspective to the previously presented. This view introduces the importance of the state in the creation of the caste Dirks, N. B. (1989: 3), leading to a constructivist critique of the "ancient given" perspective. Hence, as Dirks, N. B. (1989: 4) outlines, the caste's structure, ritual and political form relied on the relations of power. This relations of power changed through history and were constructed also during the British colonial rule. Thus the British colonial rule itself played a role (as part of the subcontinent's history) in the modelling of the caste system according to this perspective.

Dirks, N. B. (2001: 20) clarifies that the caste system was present in India previously to the arrival of the British, however, its role on the society does not appear to be important. This seems to be the case not just because Europe itself was organized in hierarchical forms (making this organization form less surprising or worth mentioning for the first Europeans that arrived to India) but also because the relevance of the castes

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[30] Other social groups can be distinguished during the *Rig-Vedic* period: The *Dasas* who were enslaved enemies of the Aryans with no right to property of any kind.

appeared to be neither dominant nor clear. This approach was first introduced by Bernard S. Cohn, who understood the mutiny of 1957, ending with the coronation of Queen Victoria as empress of India and the trial to the Moghul emperor, as the turning point leading to the introduction of new "[…] *means by which Indians now could relate to this centre,* [this new authority] *and the development of the ritual expression of British authority in India.*" (Cohn, B. S. (1983: 179)). With this in mind, the caste system stood out among those means.

According to this view, the British colonisation presented an important turning point consolidating the caste system with cultural and religious characteristics of the past regimes but with a dominant role in society. In this regard, the concept of Orientalism is especially relevant. According to Ludden, D. (1993: 251) it is a body of knowledge that presents:

"*A venerable set of factualized statements about the Orient, which was established with authorized data and research techniques that has come so widely accepted as true* […] *that it determines the content of assumptions on which theory and inference can be built*".

Therefore, Orientalism, which started in India during the Company rule, planted the seeds for future investigation, that actually lead (according to this perspective) to the creation of a larger theoretical corpus that has dominated the historiography of India for years (even after the colonial rule[31]). Thus, from this view, company's officials as Thomas Munro were especially important in the creation of colonial knowledge[32] at their will and political interest, as Ludden, D. (1993: 257) exemplifies.

In conclusion, it appears to be the case that the caste system was modelled during the colonial rule with the structure of ancient cultural and religion relations, but isolated from the political and social processes at which it was previously attached. However, the caste system did somehow already existed in the subcontinent, although its systematization and effectiveness was rather doubtful. However, the "*desacralization*

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[31] For more on the mechanisms by which Orientalism, in the form of a developed theoretical corpus, has survived through the colonial period, see Ludden, D. (1993: 272).

[32] According to Ludden, D. (1993: 252), colonial knowledge is represented as "[…] *instrumental knowledge, produced to sustain technologies of colonial rule*".

of the person of the Mughal emperor […]" (Cohn, B. S. (1983: 178)) lead to the creation of a social organization system based on the antique culture and tradition and used by the British to peacefully hold the jewel in the crown. Therefore, it might be stated that the potential effect on public health expenditure lead by the caste system institution (similarly to the land revenue systems), cannot be attributed (at least solely) to ancient traditions assumed as given to the colonial overlords but (also) to the policies of the colonial government itself. Hence, there appears to be both, a certain *path dependence* effect and a colonial shock in this institution.

III.III   The potential effect of regional particularities in the provision of public health

Taking into account the institutional factors signalled previously in this section, the literature has also pointed at some other explanatory factors of the levels of public expenditure and/or economic development which do not explicitly refer to an institution. In that sense, the following potentially influential factors are generally of a geographical nature. Hence, Roy, T. (2014: 346) points at that type of factors as the main explanation to the regional divergence in British India. The methodology used by Roy is based on the comparison among the area of deltas, coasts and floodplains of the Himalayan Rivers and the arid uplands of the interior of the subcontinent. Although it is not done by Roy, provinces could somehow be used as proxies of those geographical areas, since they were more or less homogeneous in their geography (see Table 6.1).

Several studies (Banerjee, A., & Somanathan, R. (2007) or Banerjee, A., & Iyer, L. (2005)) use a different strategy (criticised by Roy, T. (2014: 332)): They take into account the geographical endowment. Essentially, they consider data on the type of soil and rainfall among others to represent the geographical factors that could influence the agricultural production and public goods provision. Furthermore, with this approach to the potential geographical influence, those studies find geographical factors of minor importance compared to the institutional factors.

Bearing the two previous approaches in mind, the geographical factor appears to be of special relevance in order to explain the regional differences in India. However, the way in which those geographical factors are taken into account is not uniform in the

literature. In this regard, as will be seen in the upcoming sections, it is tried to consider the two previously presented approaches in the present analysis.

Another factor that could be signalled as an important one is the level of agglomeration. In this regard, as Gallup, J. L. *et al* (1999: 184) point out, there might be a relation between population density and economic development. This relation, nonetheless, is not as simple as it might seem. According to the previously mentioned authors, population density in coastal regions seems favourable to economic development thanks to a good access to trade and increasing returns to scale of infrastructures. On the other hand, population density in interior regions appears not to induce economic development as is signalled by Gallup, J. L. *et al* (1999: 184). Following this framework, it is seek to control for a potential effect of population density on the expenditure on public health. The mechanism by which this effect might occur is similar to the previously presented relation between population density and economic development: It could be expected that those regions with high population density would have larger per capita expenditure on public health. This argument is extremely related with the New Economic Geography theory (NEG). Similarly to the economies of scale and forward linkages presented by large local markets in the NEG (Krugman, P. (1998: 8)), the public goods might also enjoy those characteristics depending on the population density.

Finally, another factor that could directly influence the expenditure on public health were the famines and scarcities which the subcontinent regions suffered, at different degrees through the Victorian era. In this regard, Davis, M. (2002: 287) classifies those events not just as natural disasters but also as the result of policies implemented by the Britons. Those famines could potentially affect the per capita public expenditure on health in three different ways: Firstly, famines could simply influence the per capita public health expenditure through a reduction of the total population. This reduction would positively affect the per capita public expenditure. Secondly, it could be stated that those districts that suffered more famines and scarcities in the past may have more expenditure in public health due to pressure from the population or simply due to a certain responsibility from the government to justify its existence. Finally, it might be stated that, following the systemic approach by Davis, M. (2002), famines and scarcities were, partially, the result of a low investment and unappropriated policies from the

state, which might include the public health expenditure. Whilst the other mechanisms for famines and scarcities presented a potentially positive relationship between this factor and the public health expenditure, this last mechanism presents a potentially negative relationship.

IV.   Data

Following the previously presented factors that can potentially explain the differences in the public health expenditure and the reasoning behind this potential influence, it is necessary to discuss the data used in Section V, how it is presented and its potential biases to shed more light on the issue. The econometric analysis presented in Section V has been done exclusively with primary sources, which vary from the census of 1901 to the Agricultural Statistics of India report of 1904. Geographically, the districts analysed are from the provinces of Bengal, Bombay, Central Provinces, Madras, Agra's division (United Provinces) and Punjab.

Taking into account everything said before, for some districts of the mentioned provinces there was no data, hence, the overall number of districts (observations) in the sample has been reduced to 152. Those districts represented the 79% of the total population of the Raj by 1901, hence, the set of districts used in this document appears to be representative of the whole Raj regarding quantity and geographical distribution, as is shown in Figure 4.1.

Data on the type of land revenue is presented as a percentage of land under a land revenue system with an intermediary (*Zamindari* system or *Mahalwari* system) over the total land surveyed per district in acres and has been obtained from the Agricultural Statistics of India report of 1904. The three types of land revenue are not represented in this work, since they have been gathered into two groups: One in which there is an intermediary between the cultivator and the state (*Zamindari* and *Mahalwari*) and a second one in which no intermediary existed (*Ryotwari*). The reasons behind this classification were that, in the Agricultural Statistics of India report of 1904, no distinction between the *Zamindari* and the *Mahalwari* systems could be appreciated since they were always aggregated and, the *Mahalwari* system may be considered as a

system with intermediaries. This classification presents the first potential bias of the present study, since the *Mahalwari* system is directly classified as a system with intermediaries. As has been mentioned in Section III, the *Mahalwari* system might not always be a system with a small number of privileged intermediaries but it could have a more representative set of intermediaries (leading to a more *Ryotwari* type of system). To correct this bias, a district by district analysis would have to be done, which could be considered as an impossible task given the time and resources constraints characterizing this work. Such bias is expected not to have a dramatic effect in the ongoing analysis since the *Mahalwari* system was the less spread system[33]. The data on the type of settlement also comes from the Agricultural Statistics of India report of 1904 and is presented as a dummy variable, where 0 represents a district with more land permanently settled than temporarily settled and 1 the other way around.

Figure 4.1. The British India map with the districts used in Section V highlighted (in green).
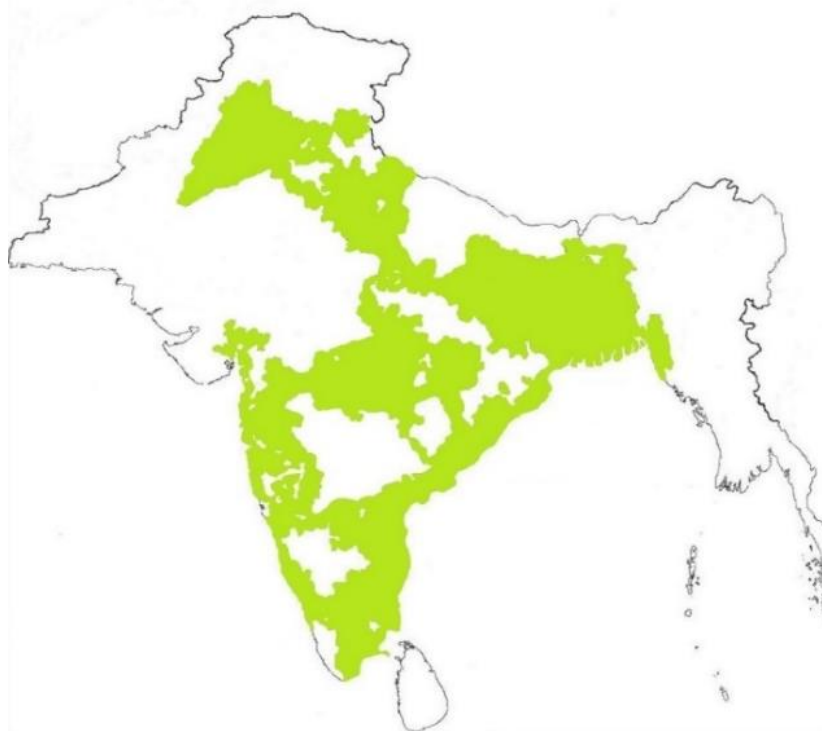
Source: Base map from Roy, T. (2014). Geography or politics? Regional inequality in colonial India. *European Review of Economic History*, *18*(3), 324-348. Own elaboration.

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[33] For more details on that see Haque, T., & Sirohi, A. S. (1986).

Table 4.1 Summary of the variables included in the models of Section V.

Name (label in models)	Description	Source
Intermediary (inter)	Percentage of land with a land revenue system with an intermediary over the total land surveyed in each district.	Agricultural Statistics of India report of 1904.
Type of settlement (settl)	Dummy variable indicating the type of settlement most common in a district.	Agricultural Statistics of India report of 1904.
Caste Fragment. Index (CFI)	Herfindhal Index using castes representing a 1% or more of the total population of each district.	1901 Census volumes
Brahman (brahman)	Percentage of the Brahman caste over the total population of each district.	1901 Census volumes
Rainfall (rain)	Average annual rainfall in each district[34].	Imperial Gazetteer of 1909 (Meyer, W.S. *et al* (1909))
Coast (coast)	Dummy variable indicating if the district has access to sea or not.	Imperial Gazetteer of 1909 (Meyer, W.S. *et al* (1909))
Famine (famine)	Number of years of famine or food scarcity from 1804 to 1904.	Imperial Gazetteer of 1909 (Meyer, W.S. *et al* (1909))

Source: Own elaboration.

Regarding the data on the caste fragmentation within each district, it has been obtained from the various Imperial tables in the 1901 Census volumes. In this regard, similarly to Chaudhary, L., & Garg, M. (2015) or Banerjee, A., & Somanathan, R. (2007), a fragmentation index (alike the Herfindahl Index) which in this work is called Caste Fragmentation Index (CFI) has been created for the 152 districts (observations). This Caste Fragmentation Index has been constructed following this formula: $CFI = 1 - \sum_{i=1}^{n} S_i^2$, where S represents the weight of each caste with respect to the total population of the district (observation). The value range of this index is (0,1) where numbers close to 0 represent high caste concentration and vice versa. Since the main objective of this fragmentation index is to consider the caste fragmentation effect, different religious population of the same caste (which is generally rare in the districts analysed) have been aggregated into a single caste. For this index, only those castes

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[34] The years of the mentioned average are not specified in Meyer, W.S. *et al* (1909). In this source, it is generally said that the average has been done "[…] over a long series of years […]" Meyer, W.S. *et al* (1909b: 307).

representing a 1% or more of the district population have been included. The reason behind this limitation on the castes taken into account is to avoid the potential introduction of mistakes regarding the caste identification and enumeration, as is argued in Banerjee, A., & Somanathan, R. (2007). The percentage of brahmans[35] with respect to the total population of each district has also been obtained from the Census of 1901, which is used to complement the caste concentration with the particular case of the brahmans (elite).

Data on the annual average rainfall (in inches), the years of famine or scarcity for the 1804-1904 period and whether each district has coast or not have been obtained from the Imperial Gazetteer of 1909 (Meyer, W.S. *et al* (1909)). The average rainfall has not been found for some districts, alternatively, the average rainfall on the capital city of the district or the mean average rainfall of certain regions of the district has been used. Regarding the years of famine or scarcity, the data from the Imperial Gazetteer presents some potential biases that are worth mentioning: It is probable that not all famines were registered in the gazetteer and the definition of scarcity is clearly subjective. Also, the magnitude of each scarcity and famine years is not considered, since no weight is applied to each year. Nonetheless, it is believed that the number of years in which there was a scarcity or famine in the district is the most likely to capture the effect of famines or scarcity in the public health provision.

Data on public health expenditure has been obtained from the Imperial Gazetteer of 1909 (Meyer, W.S. *et al* (1909)). In this source, the 1903-04 expenditure in hospitals and dispensaries for each district have been found. Although there is another source in which the whole district board medical expenditure is reported, containing tables concerning expenditures by district boards only, the availability of this source is relatively low[36]. Thus, the expenditure data used includes the whole expenditure made in the district (either from the provincial or central government, the district board or even private contributions). Inevitably, the use of this source brings about some potential biases: Firstly, using just the aggregate expenditure does not allow to

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[35] As has been mentioned in Section III, the brahmans were the traditional caste elite.
[36] This data source are the different district gazetteers, which are available in some libraries of the United Kingdom, USA and India basically.

differentiate the district boards' expenditure from the rest. Also, including all the expenditure in a district (not just the one of district boards) might allow some variables that are not taken into account in the present work[37] (like the capacity of the district to capture provincial or central investment) to play a role in the regressions made in Section V. Secondly, as previously mentioned in Section III: The impact of the land revenue systems on the land revenue collected by the provincial government might affect the resources available to the district boards (through grants). This alternative mechanism could be individually analysed through the use of district board's public health (medical) expenditure but not using the whole public health (medical) expenditure on each district. Last but not least, another potential bias to consider is the fact that only hospital and dispensaries expenditure is taken into account. After all, this could hide potential differences or tendencies that may appear adding other medical expenditures (such as vaccine expenditures) which would enrich the statistical modelling of Section V. Despite the potential noise in this preliminary analysis, the weight of local financing by the rural district boards, as well as the prominent role that they played in the funding of public health, point out the relevance of the institutional mechanisms presented above: although future research may refine the estimates, the qualitative historical information available to date suggests that a quantitative investigation of the issue is worth performing.

V. Model and results

The model developed in this work is a simple cross-section OLS regression model with the following formula:

$$pcexp\_tot_i = c + \alpha_i * Inter_i + \beta_i * Settl_i + \delta_i * CFI_i + \theta_i * brahman + \gamma_{i,z} * CONTROL_{i,z} + \varepsilon_i$$

The relationship that is analysed, therefore, is a linear one with the coefficients α, β, δ and θ representing the influence of institutional variables in the public health (medical) expenditure and uses districts as observations. More precisely, Pcexp_tot represents the total expenditure on hospitals and dispensaries in each district (i) for the year 1903-04.

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[37] Those variables used in this work have already been extensively commented in Section III.

Inter shows the proportion of the total area surveyed which had a land revenue system with intermediary (*Zamindari* or *Mahalwari*) in each district during 1903-04 and has a range between 0 and 1. Settle is a dummy variable, as has been previously mentioned, where 0 indicates that the district had a majority of permanently settled areas and 1 a majority of temporary settled areas in 1903-04. The CFI shows the values of the Caste Fragmentation Index, brahman shows the percentage of brahmans with respect to district's total population in 1901 and, CONTROL represents a matrix of all the controls which are presented in subsection III.III. Those controls include: Population agglomeration (popagg), which is the coefficient between the total population (1901) of each district and its total surveyed area (1903-04), the annual average rainfall in inches (rain), the number of famines and scarcities the district has suffered through the last century (from 1804 to 1904) (famine) and whether the district has a coast (1) or not (0) (coast).

With the arguments presented in Section III in mind, the variable inter is expected to have a negative impact on pcexp_tot and the CFI is also believed to have a negative impact on the dependant variable. On the contrary, settl is expected to have a positive impact on the public health expenditure on hospitals and dispensaries. Popagg, brahman, rain and coast are also expected to have a positive effect on public health expenditure, whilst famine could have both, a positive or a negative effect.

The model presented in Table 5.1 introduces the initial results taking into account all the data mentioned previously. As can be appreciated, almost no variable, except the CFI appears to be significant at a 10% of significance level. The coefficient for the CFI is positive, and represents that a unitary increase in the CFI (meaning to change, from total caste concentration to total caste heterogeneity) leads to a change in the total district hospitals and dispensaries expenditure of 0.10 rupees per capita. In order to check for the validity of this results, it is interesting to look at Graphic 5.1 and Graphic 5.2.

Graphic 5.1. Caste Fragmentation Index (CFI) against total district hospital and dispensaries expenditure.
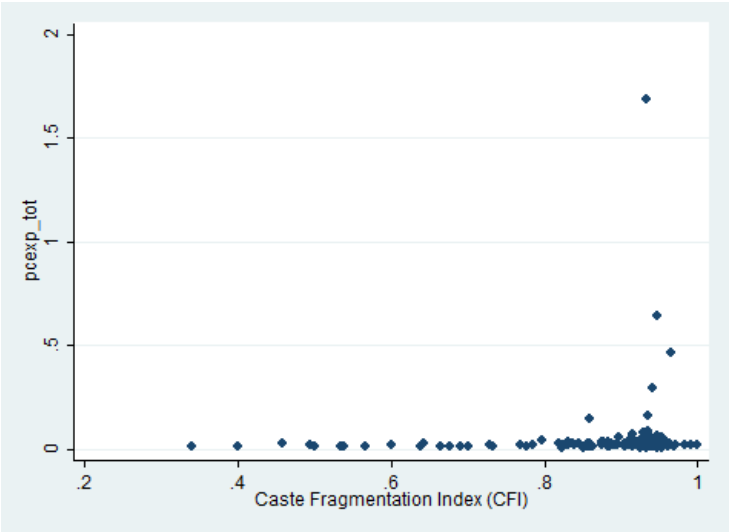
Source: Own elaboration.

Graphic 5.2. Intermediary variable against total district hospital and dispensaries expenditure.
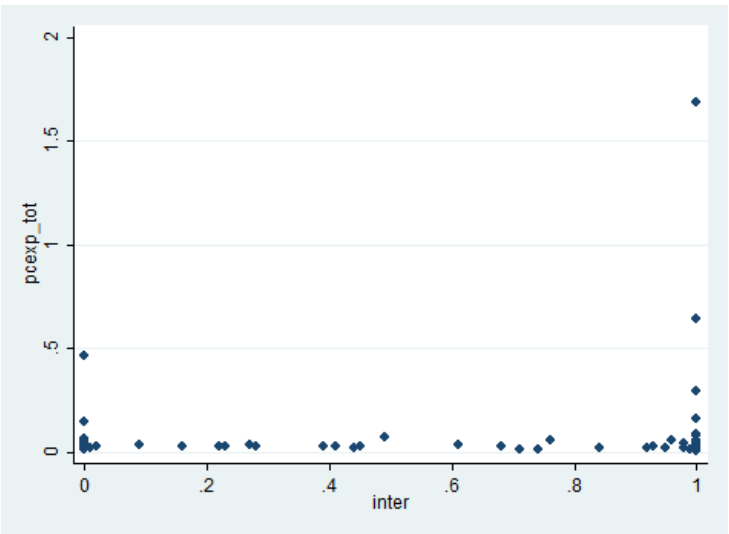
Source: Own elaboration.

Table 5.1. OLS regression model with all the observations.

```
Linear regression                                    Number of obs =       152
                                                     F(  8,    143) =      1.35
                                                     Prob > F       =    0.2244
                                                     R-squared      =    0.0780
                                                     Root MSE       =    .06672
```

pcexp_tot	Coef.	Robust Std. Err.	t	P>|t|	Beta
inter	-.0352566	.0286705	-1.23	0.221	-.2000722
rain	.0004368	.0003029	1.44	0.152	.1753118
coast	-.0274818	.0184469	-1.49	0.138	-.1558398
popagg	-.0021504	.0048072	-0.45	0.655	-.0198922
brahman	.0364421	.1130854	0.32	0.748	.0211008
cfi	.1083685	.0568382	1.91	0.059	.1915255
famine	-.0026754	.0030253	-0.88	0.378	-.1454148
settl	-.0041662	.0220579	-0.19	0.850	-.0269963
_cons	-.0338326	.0446812	-0.76	0.450	.

Notes: P>\|t\| represents the p-value for each variable in the regression.

In the previous two graphics, it appears clear that a small number of observations is driving all the regression due to an extraordinary high per capita hospital and dispensaries expenditure. There are two potential explanations to this exceptional per capita expenditure: First of all, since the expenditure taken into account is only on hospitals and dispensaries, there is a large proportion of that expenditure that might be fixed. It is straightforward to assume that an important proportion of hospital expenditures is fixed and cannot be avoided, leading to impressively large per capita expenditures in low populated areas (as seems to be the case in the present sample). Last but not least, military hospital expenditures and exceptionally large capital investments made in the 1903-04 year were considered in the total expenditure of some districts for the mentioned year.

Doing a simple exercise, relations between the hospital and dispensaries per capita expenditure and the CFI or the inter variables appear clearer. Omitting those districts with more than a 0.1 rupees per capita hospital and dispensary expenditure observations from the dataset eliminates those outliers and only 5 observations are eliminated. It should be said that the number 0.1 is more or less arbitrary, but it definitely does not affect the representation of the sample since it continues having a certainly large number of observations (147). Graphic 5.3 and Graphic 5.4 show the relations between inter, CFI and public health expenditure once only those observations (147) with a per capita hospital and dispensaries expenditure lower than 0.1 are considered.

In Graphic 5.3, it appears to be more or less clear that no relation between the CFI and the pcexp_tot existed. A quadratic relation has been tested and CFI continued not being significant at a 10%. Graphic 5.4 shows a certain negative relationship between pcexp_tot and inter, corroborating the hypothesis presented in Section III that those districts with land revenue systems with intermediaries (*Zamindari* or *Mahalwari*) presented a lower per capita medical expenditure. This relation is also observed in Table 5.2.

Having in mind this outliers' problem, the next step in the analysis is to take into account them through a more elegant and reliable method than simply omitting those

observations with a pcexp_tot>0.1. Hence, a data-dependent method for down weighting those outliers is used for the regression in Table 5.2[38].

Graphic 5.3. Caste Fragmentation Index (CFI) against total district hospital and dispensaries expenditure without pcexp_tot>0.1 observations.
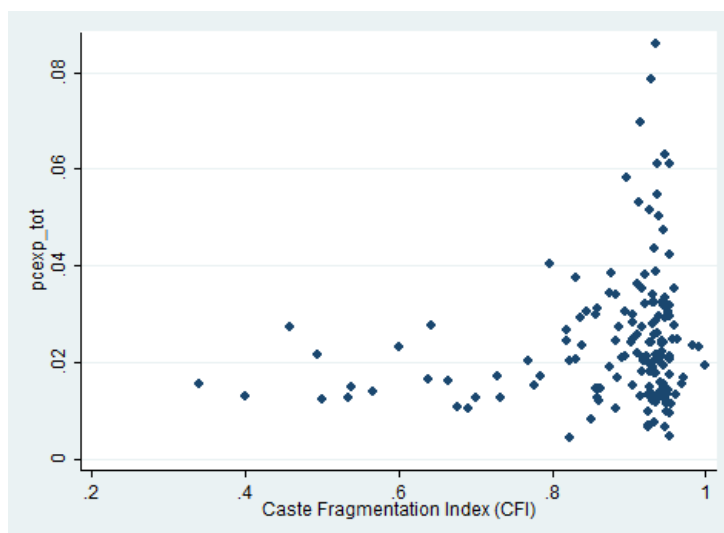
Source: Own elaboration.

Graphic 5.4. Intermediary variable against total district hospital and dispensaries expenditure without pcexp_tot>0.1 observations.
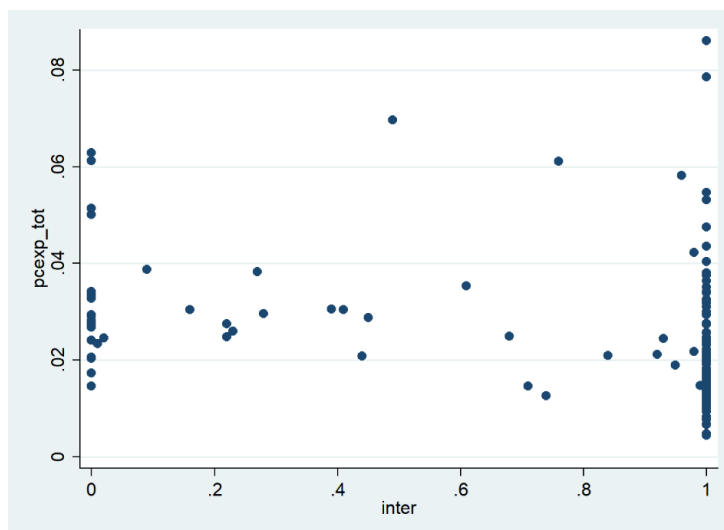
Source: Own elaboration.

The new regression (Table 5.2) differs dramatically from the first one (Table 5.1). In this case, there are 4 variables which appear to be significant at a significance level of 10%:

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[38] In order to do so, the command rreg for the statistical program STATA has been used. A model omitting those observations with a value superior to 0.1 has also been done. The results (in significance and coefficients) are almost the same to the ones obtained from the down weighting outliers regression (Table 5.3).

The intermediary (inter), the average rainfall (rain), the number of famines and scarcities (famine) and the type of settlement (settl).

This means that there appear to be two institutional variables and two CONTROL variables which are significant. The coefficient for inter shows that a variation from a land revenue system proportion in a district of totally non intermediary (*Ryotwari*) (0) to a totally intermediary land revenue system (*Zamindari* or *Mahalwari*) (1) leads to a decrease of 0.0078 rupees per capita in the hospital and dispensaries expenditure. With this change, the reduction of the per capita hospital and dispensaries expenditure represents a 17.15% of the mean expenditure of the sample used[39]. This result seems to confirm the original hypothesis that those districts with a majority of intermediary land revenue systems would have lower public health expenditure. The coefficient for the variable settl shows that if a district has a majority of its land temporary settled, its per capita expenditure in public health increases by 0.0072 rupees. This increase represents a 15.83% of the mean expenditure of the sample. This last results is also coherent with the hypothesis presented in Section III, in which it was argued that those districts with more land temporary settled would have a larger public health provision.

Regarding the rain variable, the results presented in Table 5.2 suggest that for an inch increase in the average rainfall of the district, the per capita expenditure in hospitals and dispensaries would be reduced in 0.00008 rupees. This represents a 0.17% of the average expenditure of the sample. This effect has an unexpected sign since more rain could mean larger agricultural productivity, and that, more revenue collected from the cesses and the land revenue. Finally, the famine variable indicates that an additional year of famine reduced the hospital and dispensaries per capita expenditure in a district by 0.00054 rupees, representing a 1.19% of the average expenditure of the sample. This result fits with the idea that low public health provision allowed for more famines. Also, the causality can be inverted: It might be the case that more famines in a district lowered its land revenue (and cesses), leading to a lower expenditure on public goods (including public health).

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[39] The mean was calculated without omitting or down weighting the outliers present in the sample. Hence, the percentages indicated regarding the effect on the per capita expenditure would be larger as long as this consideration was done.

Table 5.2. OLS regression model using a down weighting method for the outliers.

```
Robust regression                                    Number of obs =      152
                                                     F( 8,   143) =     5.90
                                                     Prob > F      =   0.0000
```

pcexp_tot	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
inter	-.0078435	.0026679	-2.94	0.004	-.0131172	-.0025699
rain	-.0000803	.0000341	-2.35	0.020	-.0001477	-.0000128
coast	.0024579	.0023524	1.04	0.298	-.0021922	.0071079
popagg	-.0008006	.0013756	-0.58	0.561	-.0035198	.0019185
brahman	-.0080896	.0212376	-0.38	0.704	-.0500697	.0338905
cfi	.0004658	.0077724	0.06	0.952	-.0148979	.0158294
famine	-.0005459	.0002698	-2.02	0.045	-.0010791	-.0000127
settl	.0072639	.0022516	3.23	0.002	.0028132	.0117146
_cons	.0292046	.0080236	3.64	0.000	.0133444	.0450648

Notes: P>|t| represents the p-value for each variable in the regression.

Finally, a dummy variable for all provinces has been introduced in a new model (Table 5.3). This has been done in order to test for an explicitly different public health expenditure between provinces and to check geographical factors in a way that not just the average rainfall and geographical qualities are considered but also area or spatial characteristics (mountainous areas, deltas and floodplains among others), similarly to what is done in Roy, T. (2014). The results obtained in Table 5.3 show that the majority of the dummy provincial variables appeared to be significant at a 10%, indicating a certain provincial effect on the public health expenditure. The control variable is the dummy for the Agra division, hence, the coefficients obtained must be compared with Agra's expenditure.

Table 5.3. Provincial dummies explaining the public health expenditure.

```
Robust regression                                    Number of obs =      156
                                                     F(  5,   150) =   16.93
                                                     Prob > F      =  0.0000
```

pcexp_tot	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
bengal	-.0004644	.0017894	-0.26	0.796	-.004	.0030712
central_provinces	.0057621	.0022842	2.52	0.013	.0012488	.0102755
madras	.0115588	.0021358	5.41	0.000	.0073386	.0157789
bombay	.01048	.0022419	4.67	0.000	.0060501	.0149098
punjab	.0125231	.0020064	6.24	0.000	.0085587	.0164875
_cons	.0160537	.0013319	12.05	0.000	.0134219	.0186854

Notes: P>|t| represents the p-value for each variable in the regression. The control variable for this regression is the dummy for the Agra division.

However, when other variables were additively taken into account, this provincial effect vanishes almost completely as can be seen in Table 5.4.

Table 5.4. Provincial dummies and the rest of the variables explaining the public health expenditure.

```
Robust regression                                              Number of obs =      152
                                                               F( 13,   138) =     6.76
                                                               Prob > F       =   0.0000
```

pcexp_tot	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
inter	-.0075493	.0072962	-1.03	0.303	-.0219761	.0068776
rain	-.0000552	.000033	-1.67	0.097	-.0001204	.00001
coast	.0027841	.002316	1.20	0.231	-.0017953	.0073636
popagg	-.000047	.0012204	-0.04	0.969	-.00246	.002366
brahman	.0344791	.0220242	1.57	0.120	-.0090693	.0780276
cfi	-.0015729	.006861	-0.23	0.819	-.0151392	.0119935
famine	-.0003344	.000244	-1.37	0.173	-.000817	.0001481
settl	.0027641	.0027714	1.00	0.320	-.0027159	.008244
bengal	.002675	.0031275	0.86	0.394	-.0035091	.008859
central_provinces	.0080116	.0028201	2.84	0.005	.0024354	.0135878
madras	.0061227	.0072355	0.85	0.399	-.008184	.0204293
bombay	.007421	.0073323	1.01	0.313	-.0070772	.0219192
punjab	.0129362	.0026027	4.97	0.000	.00779	.0180825
_cons	.0235434	.0100307	2.35	0.020	.0037096	.0433772

Notes: P>|t| represents the p-value for each variable in the regression. The control variable for this regression is Agra.

Analysing Table 5.4, it must be said that as the provincial effect partially vanishes with the introduction of institutional and geographical variables, this last variables' effect also tends to disappear. This could explain a certain relation between institutional and geographical variables, and the provincial effect as will be discussed in the following section.

VI.   Discussion

Taking into account the results previously presented, caution is granted in their interpretation, given the potential bias due to the sources used and time constraint related to this research. However, some ideas and preliminary conclusions can be underlined.

It appears to be that those institutions with a formal character (land revenue system and the type of settlement) had an important effect over the public health expenditure whilst the caste (informal institution) fragmentation seems not to have a significant effect. In this regard, during the middle years of the British crown rule, it seems to be that those institutions having an effect on the public revenue had a larger influence over

the provision of public health than those influencing the social cohesion and public policies consensus. The relevance of those formal institutions is definitely clear albeit not crucial, since a variation from a *Zamindari* or *Mahalwari* system permanently settled in a district to a *Ryotwari* system temporary settled represents a 33% of the mean expenditure of the sample (0.0151 rupees per capita).

The differences between the district board's medical expenditure (signalled in Section II) appear in the analysis made in the previous section. The results seem to support the idea that institutions such as the land revenue system and the type of settlement influenced the cesses and that, influenced the expenditure on public health[40]. However, some of the results obtained in this work could be influenced by potentially omitted variables influencing the public health expenditure of the provincial and/or central government. Also, the potential effect that the land revenue system or the type of settlement might have on the revenue of the provincial governments and, ultimately, on the public health expenditure in each district (through grants) must definitively be studied in further detail[41]. With the results obtained in this work, this last mechanism can, by no means, be discarded. One way or another, what appears to be suggested by the results of this work is that institutions (especially the formal ones) had an important role determining the expenditure (provision) of public health.

The dissimilarities between institutions in their impact on public health may lead to interesting interpretations regarding the origins of those institutions. As long as the land revenue system was exclusively implemented from an ancient tradition, its effect over the public coffers might be expected to be very important due to its persistence through a path dependence process. With this in mind, although being a completely subjective statement, the results obtained may provide some evidence strengthening the idea previously presented in this work: The land revenue system was neither an institution created totally for the British nor an institution apathetic to the past of time. For the caste system, the lack of significance of the fragmentation index and the Brahman variable may have two different interpretations. Either the caste system had no

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[40] This influence seems to be positive for the land revenue systems without intermediaries and also for the temporary settled districts (as is expected from Section III).
[41] The way in which grants were distributed could have an influence also on the public goods provision. This is not analysed in this work, although it should be in future investigation.

influence on the medical expenditure or the colonial influence on this institution was huge and its role explaining the public health provision did not appear until later[42]. Thus, the effective influence of each institution on the public health expenditure might present some information reading their historical roots.

On the other hand, the role of geography and famines appears to be less important than that of institutions when studying the case of public health expenditure at least (although definitely not meaningless). Measuring this geographical factor as the average rainfall, it appears as a statistically-significant variable, but its influence is relatively low (a 50 inches increase in the average rainfall only represents a reduction of public health expenditure of a 8.5% of the sample's mean expenditure). Furthermore, the sign of the coefficient for this variable is not the expected one, since a larger average rainfall would be expected to be beneficial for the productivity of land, and that, for the land revenue and cesses. When an "area approach" which tries to capture the effect of geographical differences between coastal areas and mountainous areas among others (like in Roy, T. (2014)) is made using provincial dummy variables (Table 5.3), there appears to be a certain provincial effect in the public health (medical) expenditure.

It is hard to know with precision what drives this provincial effect. However, it can be said that, although when introduced in a model without more variables, provinces seem to play a role in public health provision, this role disappears once the settlement type, the land revenue system and other variables (see Table 5.4) are taken into account. Hence, it could be said that public health expenditure differences were present among provinces and the effect of institutional and geographical variables appears to be (at least partially) driving this provincial effect. Generally speaking, the type of settlement, the land revenue system and the geographical characteristics were more or less common among all the districts within a province. To corroborate this last statement, the coefficient of variation (CV) has been calculated for the land revenue system variable (inter), the type of settlement variable (settl) and the average rainfall variable (rain) for observations within each province. As is shown in Table 6.1, the CV for the different variables (especially for the type of settlement (settl)) is relatively low. This low

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[42] This effect is shown nowadays in Baru, R. *et al* (2010: 50-51).

variability within provinces regarding institutional and geographical variables might reinforce the idea that those variables explain a certain provincial effect on the public health provision.

Table 6.1. Coefficients of variation (CV) for the variables inter settl and rain within each province.

Province	Bengal	Bombay	Central Provinces	Madras	Punjab	Agra
CV (inter)	0	2,06873	0,08979	1,18741	0	0
CV (settl)	2,23140	0	0	0	0	0,42916
CV (rain)	0,32712	0,69854	0,14674	0,69168	0,56197	0,34517

Source: Own elaboration.

Finally, the famine influence on the public health (medical) expenditure appears to be modest. Also, those districts with more famine years apparently had lower public health expenditures. This last statement could reinforce the hypothesis presented in Section III that the low investment in public health in certain districts might have allowed for more famine years. It could also be the case that, famine years lowered the collection of land revenue (and cesses), leading to a lower expenditure on public goods (including public health). However, it must be said that more evidence would be needed in order to assure the last two statements without hesitation.

VII. Conclusions

At the beginning of this work it was emphasised that the differences regarding public health (medical) expenditure in the British India of the early 20th Century were significant. The processes of decentralization during Lord Mayo's and Lord Ripon's viceroyalties allowed local governments, especially in the rural areas (district boards) where more than 90% of the population lived, to obtain resources and spend them in the provision of public goods such as healthcare.

In order to explain the differences among districts regarding the public health expenditure, the present investigation has taken into account several potential explanatory factors: Some institutional (the land revenue systems, the type of settlement or the caste system) and some which were related to geography or regional

particularities. Broadly, those districts with a *Ryotwari* system temporary settled seemed to present larger medical expenditures due to the larger revenue provided by those two institutions. Hence, the land revenue system and the type of settlement seem to have played an important role determining the differences in public health provision. Those districts without land revenue systems with intermediaries and temporary settled seem to have larger public health provision, as posited in Section III. On the other hand, the average rainfall and the number of famines from 1804 to 1904 seem to have a certain influence on the public health, but overall, a minor one. Regarding a potential provincial effect on public health, there appears to be significant differences between provinces regarding the public health expenditure. However, those differences seem to be, at least partially, determined by both, geographical and institutional factors characterizing the provinces.

There might be different mechanisms explaining the influence of institutions over the public health expenditure at the district board's level. This work signals mainly at one mechanism: The effect of land revenue systems and types of settlement on the tax rate and tax base of the cesses respectively, but it recognizes that there might be another mechanism explaining these effects. This last one, would imply the effect of land revenue systems and types of settlement on the land revenue and the provision of grants to district boards. In this work the previous mechanism could not be differentiated from the former, hence, the last one cannot be discarded.

The relevance of institutions explaining the differences in public health expenditure emphasises even more the relevance of the influence of the subcontinent's traditions and the British colonial rule over them. Thus, this work had no aim to precisely explain the origins and influences of the land revenue systems and the castes, but it definitely gave some clues on the importance of this topic over the role of institutions explaining the public goods provision. The intensity of each institution defining the public health expenditure patterns (and, potentially, in other public goods) might provide some evidence in the origin and influences of each institution.

Finally, this investigation might motivate future investigation on this topic. In this regard, it would be interesting to clearly be able to differentiate the two mechanisms previously presented (grants and cesses) through which the land revenue systems and the type of

settlement could have influenced the expenditure in public health at the district level in order to quantify its importance. Another interesting topic would be to identify, with more depth than in the present study, if there is any change on the influence each institution has on public goods depending on its origins and influences (either from the colonial power (Britain) or from the ancient traditions of the subcontinent). Also, it would be interesting that future investigations use data on other medical expenditure than that on hospitals and dispensaries.

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