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Are China's provincial boundaries misaligned?

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ABSTRACT

Using geographic information systems and digital elevation data, we investigate the hypothesis that the imperial Chinese state manipulated provincial borders to weaken the autonomy of Chinese regions. We find that China's present-day provincial borders, whose origin can be traced back to the thirteenth century, are highly misaligned with respect to physiographic features along China's North-South political fault line. Elsewhere, in regions that historically did not pose a fundamental threat to central authority, the degrees of misalignment are considerably lower. We interpret these findings as evidence of strategic manipulation of provincial boundaries. Our findings cast light on the spatial distribution of boundary misalignment and help identify the areas where the socio-economic ramifications of misalignment—such as recurring cross-border pollution and inter-community disputes—are likely to be present.

1. Introduction

Boundaries have long been subjects of interest to many spatially explicit fields such as urban planning (Lai, 2015), geopolitics (Fall, 2010; van Houtum, 2005), and ecology (Strayer, Power, Fagan, Pickett, & Belnap, 2003). They are generally perceived as entities over which contrasts take place. Investigating the underlying mechanisms that give rise to boundaries is critical to develop theories for explaining why these contrasts exist and shape our lives. In GIScience, the formalization of spatial boundaries and the choices of their representations have received significant attention (Burrough & Frank, 1996; Goodchild, Yuan, & Cova, 2007; King & Blackmore, 2013; Varzi, 2011). Central to these efforts is the recognition that spatial boundaries are created based on human perception and are therefore fiat and contentious by nature (Burghardt, 1996; Robinson, 2012; Smith & Varzi, 2000). An obvious example would be international boundaries that disregard ethnic and religious divisions and induce political, social, and economic conflicts (Alesina, Easterly, & Matuszeski, 2011; Michalopoulos & Papaioannou, 2016).

Instead of international boundaries, this article examines China's present-day provincial boundaries, which are a legacy of its imperial past and have remained mostly unchanged since the seventeenth century. While subnational boundaries exist in every corner of the world, they have been under-researched, with the exception of the literature on electoral gerrymandering in democracies.[1] Yet historically and today, regimes and politicians have manipulated domestic borders for reasons beyond winning elections. When the Romans overran Macedonia in the second century BC, they divided the kingdom into four republics to preempt a Macedonian revival (Hammond, 1989). In the 1970s, Saddam Hussein reorganized Iraq into eighteen provinces to keep minority ethnic groups divided (O'Leary, McGarry, & Salih, 2005). Likewise, interwar Czechoslovakia dissolved German Bohemia and the Sudetenland into the province of Bohemia to preempt an independence movement by its German-speaking residents (Coakley 2003).

While the incentive to "divide and rule" is likely to be greatest in large states and post-colonial states with heterogeneous populations, attempts to manipulate subnational administrative boundaries could theoretically occur in any country and under any kind of political system. In this paper, we seek to explore this potentially fruitful area of research by providing a rare quantitative study on the creation of boundaries for administrative rather than electoral purposes, using China's provinces as a case study. Specifically, we (1) propose a method to quantify the misalignments between China's provincial and physiographic boundaries, and (2) investigate the hypothesis made by prominent sinologists and Chinese scholars that these misalignments were deliberately created by the imperial Chinese state to prevent the provinces from developing into militarily and economically self-contained geographical units.

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[1] The literature on electoral boundaries is vast. For the most recent work, see, for example, Calvo and Rodden (2015), Edwards, Crespin, Williamson, and Palmer (2016), and Pavía and Cantarino (2017).

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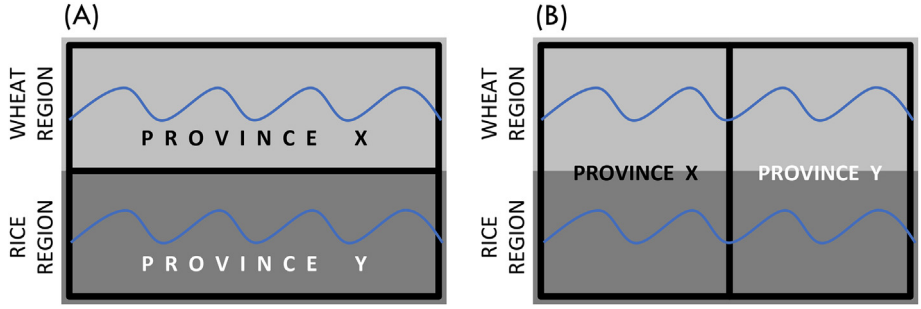

Fig. 1. Hypothetical example: (A) two differentiated provinces, each managing a region or river basin; (B) two identical provinces, each administering half of the rice-growing region/basin and half of the wheat-growing region/basin. The wavy lines indicate rivers.

Physiographic features such as elevation and water flow patterns play a central role in shaping socioeconomic interactions and regional identities (Salonen, Toivonen, Cohalan, & Coomes, 2012; Ullman, 1980). This is particularly true in China, whose civilization emerged along its rivers and whose people relied on river transport as their primary mode of transportation until the early twentieth century (Schran, 1978; Skinner, 1977). In Chinese historical scholarly discourse, there exists the longstanding hypothesis that the imperial Chinese state deliberately kept provincial and physiographic boundaries misaligned to "divide and rule" (Qian, 1955). Wang Shixing, a middle-ranked official, claimed in the sixteen century that the guiding principle of China's provincial demarcation was to reduce the autonomy of the provinces by making them "interlocked like a dog's teeth" (*quanya xiang zhi*) (Wang, 2006). Modern scholars have put forth similar arguments (Ge, 1985; Qian, 1955; Zhou, 2005). Kent Guy notes that China's provincial borders "ignored long-established Chinese cultural identities" and according to William Skinner, the "grossly imperfect" fit between provinces and regional urban systems in late imperial China indicates "high-level gerrymandering" aimed at "breaking up natural concentrations of economic power" (Guy, 2010, 9, 31; Skinner, 1977, 218, 343). Some Chinese scholars have called for an overhaul of the provincial boundaries to rectify the misalignments created in the past (Hu, 1945; Liang & Wang, 2005).

The phenomenon has contemporary implications because misaligned subnational boundaries, like their international counterparts, have important development consequences (Minghi, 1963; Rumley & Minghi, 1991). Poorly demarcated subnational boundaries may aggravate inter-community tensions—for example, fights over water usage between upstream and downstream communities—and generate cross-border coordination failures (Brochmann & Gleditsch, 2012; Fox, 2009; Justin & De Vries, 2017). Hence, understanding the origins and the spatial patterns of China's provincial boundary misalignment would be helpful in identifying the geographical areas where the socioeconomic ramifications of misalignment likely exist and where policy remedies may be needed.

We employ an interdisciplinary approach. Based on William Skinner's influential idea of conceptualizing China as a collection of physiographic macroregions (Skinner, 1977), we use Geographic Information Systems (GIS) and Shuttle Radar Topography Mission (SRTM) digital elevation data to create hypothetical provinces by two physiographic criteria: water management and land transportation. The two sets of hypothetical provinces are then employed as benchmarks to quantify the degree of congruence between each present-day province and its physiographic surroundings. This allows us to reconstruct the spatial patterns of provincial boundary misalignment in China and verify if the imperial Chinese state indeed demarcated the provinces with the intent to manipulate.

The rest of this article is organized as follows: In the next section, we provide a hypothetical example to illustrate what constitutes strategic manipulation of administrative boundaries. We then present our research method, followed by the results. In the discussion section, we examine our findings in light of China's past and present. Finally, we summarize the key points in the conclusion.

2. A hypothetical example

To illustrate what boundary manipulation constitutes, consider the following example of two physiographic regions belonging to the same country. Each region is drained by a river and surrounded by mountains. One region is wheat growing and the other is rice growing. If the central authority wishes to set up two provinces to administer them, how should it be done?

The straightforward solution is to make each region a province, as illustrated in Fig. 1A. Administrative efficiency is enhanced since the provincial authorities do not need to coordinate with each other to manage the rivers. Furthermore, each provincial authority can specialize in one task: promoting the growth of either wheat or rice. However, the arrangement has its disadvantages. First, the fact that the two provinces have different crop specializations and are self-contained as discrete water basins makes it easy for the provincial authorities to conceal information from the central government (Green & Stokey, 1983; Holmstrom, 1982). For example, if the rice-growing province reports a bad harvest and petitions for tax relief, the central government will not be able to verify the authenticity of the report with the other province, which does not grow rice. In addition, inequality between the two provinces may grow over time, which could strengthen centrifugal tendencies. For instance, if rice-growing technology consistently outpaces wheat-growing technology, as time passes the increasingly wealthy rice-growing province may wish to exit the political union to avoid permanently subsidizing the poorer wheat-growing province—-Catalonia's push for independence from Spain to avoid "fiscal mistreatment" provides a real-world example here (Feito et al., 2014).

Alternatively, the central authority could make the two provinces identical by letting each province administer half of the rice-growing region and half of the wheat-growing region (Fig. 1B). Under this arrangement, provinces will find it hard to conceal information from the central authority—if a province reports that it is hit by a severe flood or a bad rice harvest, the central government can verify the authenticity of the report by checking if the other province is experiencing similar difficulties. Furthermore, any long-run growth differentials between the two regions would no longer generate unequal tax burdens and the associated squabbles between provincial authorities. Residents of the faster-growing region may still desire secession, but they now lack a convenient political vehicle to articulate such desires.

Certainly, the benefits of weakening the regions' centrifugal tendencies come at a cost of lower efficiency. Intraregional affairs, such as