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Biogeographical conditions, the transition to agriculture and long-run growth

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ABSTRACT

We use new data on the timing of the transition to agriculture, developed by Putterman and Trainor (2006), to test the theory of Diamond (1997) and Olsson and Hibbs (2005) that an earlier transition is reflected in higher incomes today. Our results confirm the theory, even after controlling for institutional quality and other geographical factors. The date of transition is correlated with prehistoric biogeography (the availability of wild grasses and large domesticable animal species). The factors conducive to high per capita incomes today are good institutions, an early transition to agriculture, access to the sea and a low incidence of fatal malaria. Geographical influences have been at work in all of these proximate determinants of per capita income.

1. Introduction

What explains why some countries are rich today and some poor? Research has established that an important factor is the quality of a country's institutions (Acemoglu et al., 2001; Hall and Jones, 1999; Rodrik et al., 2004). Acemoglu et al. (2001) argue that better institutions evolved where Europeans chose to settle, which tended to be in areas where their mortality rate was lower. Using settlers' mortality as an instrument for institutional quality, they show that geography, as measured by latitude, has no independent effect on per capita incomes, once institutional quality is controlled for.

This view has been challenged by Sachs (2003) and Olsson and Hibbs (2005). Sachs shows that geographical factors remain significant if they are represented by an index of the risk of fatal malaria rather than by latitude. Rodrik et al. (2004) confirm this result, although in their view its significance is limited because malaria risk ceases to be statistically significant once a dummy for sub-Saharan Africa is included.

Our particular focus here is the contribution of Olsson and Hibbs (2005) [OH]. Inspired by the work of Diamond (1997), OH argue that countries endowed with favourable biogeography in prehistoric times, as indicated by a greater variety of domesticable large animals and wild grasses suitable for cultivation, made the transition to agriculture at an earlier date. An early transition gave these countries a lead in economic development that they have never entirely lost, contrary to the "reversal of fortune" argument of Acemoglu et al. (2002).[1] Although catching up with and overtaking other countries is possible, OH argue (p. 927) that "regions with a well-endowed natural environment, which consequently made the

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[1] To be precise, Acemoglu et al. (2002) argue that the reversal of fortune applies only to ex-colonies and not to all countries. We return to this point later.

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transitions to agriculture and industry comparatively early, should other things equal have higher per capita today than more poorly endowed regions where the transitions came later." They develop an index of biological conditions conducive to agriculture, and in the empirical section of their paper they show that this is strongly positively correlated with current per capita GDP and the date of transition to sedentary agriculture.[2]

This hypothesis suggests that geography works through history, by setting favoured countries on the path to development earlier. A limitation of OH's empirical work is that their dating of the transition to agriculture, which is based on Diamond (1997), is very imprecise and estimated only down to the regional level, as we discuss further below. Recently much more detailed estimates of the timing of this transition have been provided by Putterman and Trainor (2006), and these estimates differ quite substantially from those used by OH. Since the timing of the transition to sedentary agriculture is the crucial link in the Diamond–Olsson–Hibbs thesis, it is important to establish whether their theory is supported by the new data.

This is the issue which we address in this paper. First, we test whether the strong correlation between prehistoric biogeographical conditions and transition dates still holds with the Putterman–Trainor data. Then we test the second link in the argument, that current per capita income is correlated with the timing of the agricultural transition (OH do not actually test this, but only the correlation between prehistoric biogeography and current income, which leaves their empirical results open to the interpretation that geography affects development, but not necessarily through the timing of the agricultural transition). Third, we incorporate institutional quality along the lines of previous work, and we show that the time elapsed since the agricultural transition is a significant determinant of current per capita income even after controlling for institutions and other geographical variables. Fourth, we show that prehistoric biogeographical conditions are less strongly correlated with current per capita income than is the date of the agricultural transition, so this transition date is not simply acting as a proxy for some omitted geographical variable. In short, our findings are favourable to the Diamond–OH hypothesis. Finally, we consider whether the date of the agricultural transition is less significant for countries that were colonies for many centuries, as is implied by Acemoglu et al.'s (2002) argument that poorer colonies have overtaken initially richer ones because of their more "European" institutions.

The paper is organised in the following way. In Section 2, we discuss the new data on the transition to sedentary agriculture and test the correlation of transition dates with biogeographical conditions at the time. In Section 3, we introduce the model and data that we use to test the relationship between the date of the agricultural transition and current per capita income. Because of possible endogeneity of some of the independent variables, in Section 4, we describe our empirical strategy in some detail. Section 5 shows the main empirical results, whose robustness is tested in Section 6. In Section 7, we consider the evidence for a "reversal of fortune" among early colonies. The paper ends with a short conclusion in Section 8.

2. Transition to agriculture and biogeography

The starting point of our paper is the availability of new data on the transition from a hunter–gatherer existence to sedentary agriculture. Putterman and Trainor (2006) have produced detailed estimates of the timing of the transition to sedentary agriculture in 163 countries, using as the criterion the point at which the calorific intake from domesticated plants and animals is estimated first to have exceeded 50%. They undertook an extensive literature search in order to assemble "what appear to be current consensus estimates" of the date of the agricultural transition within each country, and they cite more than 40 different sources. Their dating refers in the main to the earliest transition date (they give the example of India being given the date of the transition in the valley of the Indus). Drawing on literature on the prehistory of Africa, they estimate the transition date as 4000 years ago for Ethiopia, and 3500 years ago for Mauritania and Ghana, with a gradual spread to other parts of West Africa, the Sahel and East Africa, followed eventually by southern Africa. There is archaeological evidence of agriculture at a much earlier date for Egypt (7200 years ago), from which it spread westwards along the Mediterranean shore. For the Americas they mostly assign dates between 4000 and 3000 years ago, but much more recent ones for most of the Caribbean islands and Canada (1500 years ago). For Eurasia, current research suggests that agriculture developed first in the Fertile Crescent (Iraq, Syria and Turkey) about 10,000 years ago, and in China about 9000 years ago, reaching the most distant points of the landmass (e.g. Norway and the UK) mostly by about 5000 years ago, and Japan 4500 years ago. For New Guinea the estimated date is 4000 years ago, but for New Zealand and Australia 800 and 400 years ago, respectively.

Putterman and Trainor do not make it clear exactly how they translate the archaeological evidence that they cite into their criterion of 50% of calories derived from agriculture, since it is doubtful if most of their sources expressed agricultural development in these terms. Nevertheless they have certainly made a serious attempt to track the spread of agriculture across continents, and in this respect their estimates are a great improvement on those used by OH, who ascribe the transition in 112 countries to one of only six dates, ranging from 9847 years ago (all of Europe) to 4960 years ago (all African countries). Moreover in the OH data "neo-European" countries (Australia, Canada, New Zealand and the USA) are rather arbitrarily ascribed the European transition date, which arguably biases correlations with current per capita

[2] Their index of biological conditions is the first principal component of two variables: the number of wild grasses with a mean kernel weight exceeding 10 mg known to exist in prehistory, and the number of domesticable mammal species weighing more than 45 g known to exist in prehistory.