Economic Modelling 33 (2013) 440–449

Contents lists available at SciVerse ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Costly technology adoption, redistribution and growth

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ARTICLE INFO

Article history:
Accepted 16 April 2013

Keywords:
Economic growth
Political economy
Technology adoption
Inequality
Redistribution

ABSTRACT

We study a political economy model which aims to understand the diversity in the growth and technology-adoption experiences in different economies. In this model the cost of technology adoption is endogenous and varies across heterogeneous agents. Agents in the model vote on the proportion of revenues allocated towards such expenditures. In the early stages of development, the political-economy outcome of the model ensures that a sub-optimal proportion of government revenue is used to finance adoption-cost reducing expenditures. This sub-optimality is due to the presence of inequality; agents at the lower end of the distribution favor a larger amount of revenue allocated towards redistribution in the form of lump-sum transfers. Eventually all individuals make the switch to the better technology and their incomes converge. The outcomes of the model therefore explain why public choice is more likely to be conservative in nature; it represents the majority choice given conflicting preferences among agents. Consequently, the transition path towards growth and technology adoption varies across countries depending on initial levels of inequality.

1. Introduction

The fact that policies and institutions are endogenous has been recognized in recent growth and development literature (Acemoglu, 2010; Huffman, 2007; Krusell et al., 1997; Lucas, 1990; Stokey and Rebelo, 1995). In the context of technology adoption – which has often been considered an important factor in economic development – one therefore has to consider whether redistributive revenues of the government may, in fact, be allocated towards reducing the fixed costs associated with productive technologies. To that end, this paper presents a political economy model in which the cost of technology adoption is *endogenous*. Specifically, the adoption cost is assumed to be a decreasing function of the amount of government revenue allocated towards cost-reducing research and development expenditures. Agents in the model vote on the proportion of revenues allocated towards such expenditures.

Several strands of literature provide inspiration for this study. Firstly, the early political economy literature involving voting by agents includes the work of Alesina and Rodrik (1994), in which inequality and growth are negatively related, suggesting that the political economy mechanism does not necessarily ensure that the best policies are chosen (also see Alesina and Perotti, 1994, for a comprehensive discussion regarding this issue). The conventional explanation for the negative relationship between inequality and growth that emerges in these models centers on the fact that, in a society with more unequal distribution of income, the poor will vote for a high level of taxation, which impedes investments and economic growth. In contrast to this idea, Li and Zou (1998) construct a model that produces a negative correlation between initial inequality and growth. Specifically, they show that, when government revenue is used to finance public consumption instead of production, poor agents in a more unequal society will vote for higher income taxation. However, depending upon the framework in question, diverse conclusions are possible in relation to these issues.

Secondly, the stylised facts that motivate this study are linked to the ongoing debate that was initially documented in Lucas (1993) and further discussed in Benabou (1996). This debate relates to the idea that in a very egalitarian society, the distribution of income plays a significant role in the take-off to modern economic growth. That this phenomenon is pertinent to some countries or regions while not for others is apparent from the empirical evidence (see for example, Zweimuller (2000) and references therein). A priori, then, the political environment may provide an underlying theoretical rationale for such differences.

Another issue in relation to the above point that has been explored to a very limited degree in this literature relates to the implications for *technology adoption* in the presence of the politico-economic determination of policies. A notable exception is the model developed by Krusell and Rios-Rull (1996). In a model with three-period lived agents they study the technology adoption process and how *vested interests* of agents account for policies that imply poor growth outcomes. Vested

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http://dx.doi.org/10.1016/j.econmod.2013.04.038

interests in their model arise due to the presence of different trade-offs faced by heterogeneous agents in relation to the technology adoption process. Agents operating the old technology benefit more from preventing the adoption of a new technology since they have not fully reaped the rewards from "learning by doing" that are associated with the old technology. While their model has a very rich technological structure, this complexity entails a simplification of agents' preferences which are assumed to be linear. The model constructed here, on the other hand, has more general preferences but a simpler technological structure. It is a political economy extension of Lahiri and Ratnasiri (2012), who show that, depending on initial conditions that relate to productivity differences between inferior and superior technologies, costly technology adoption can cause three alternative growth scenarios to emerge; they label these as 'poverty trap', 'dual economy' and 'balanced growth'. The 'poverty trap' emerges when both the inferior and superior technologies in existence are of a low quality and the productivity differences between them are 'small' in a sense that is quantified using various parameters of the model. The 'dual economy' emerges when these productivity differences are large, with the inferior technology exhibiting a productivity level that is 'low' while the superior technology enjoys a 'high' productivity. Finally 'balanced growth' is characterized by a situation in which all technologies are associated with 'high' productivity levels; in this case productivity differences do not matter as all agents end up adopting the superior technology in the long run.

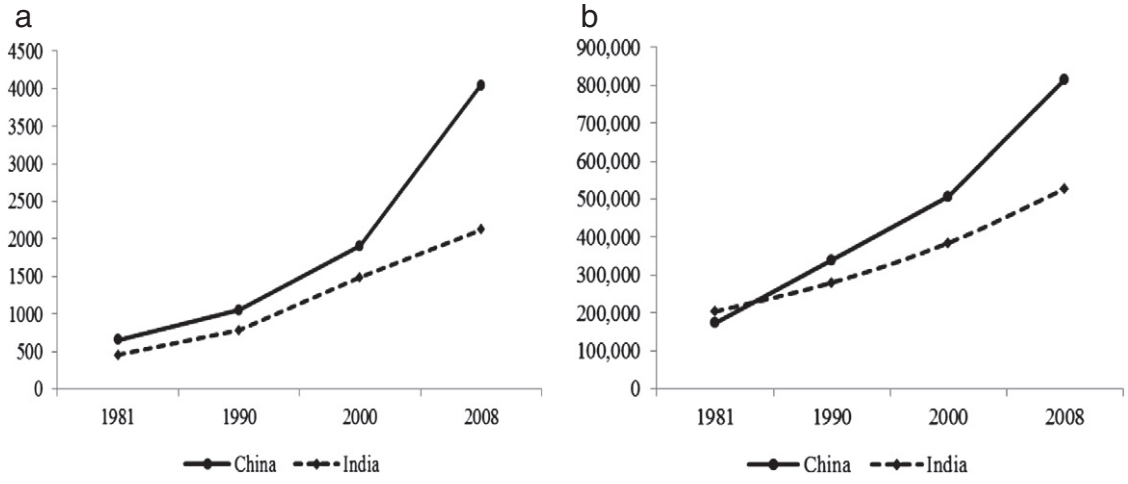
An obvious policy implication, then, is to use the tax-transfer mechanism to ensure that either of the following three outcomes occurs: (a) agents adopt superior technologies due to direct transfers from rich to poor agents which make superior technologies affordable; (b) the government makes educational expenditures that facilitate better use of existing technologies, so that productivity levels associated with all technologies increase; (c) the government reduces costs associated with the adoption of superior technologies through research and development expenditures. However, as stated above, such policies may or may not be implemented, given that agents in an economy are heterogeneous, with differing trade-offs on various policy-dimensions, and preferences of the majority may not reflect what is optimal from a *social* point of view. That is, the mix of redistributive expenditures that results from the political outcome may not be the same as the mix that is implemented by a social planner that maximizes the collective welfare of all agents in the economy. This in turn can delay the transition towards economic development, which, in terms of the model is characterized by the 'balanced growth' scenario.

Some empirical experiences of transitional economies such as India and China provide indirect evidence in support of this idea. In relation to agricultural technology adoption, in particular, the differences between China and India are striking. Both countries have invested substantial investment in research and development in agricultural technologies since the 1990s. However while China has sustained and even increased this effort, India has only maintained it (see Fig. 1(a)). In terms of outcomes, this has been reflected in an agricultural "productivity slowdown" in India. In China too, growth rates in productivity have been slower relative to the spurt experienced in the 1990s, but in contrast to India this slowdown is not as dramatic (see Lahiri and Ratnasiri, forthcoming). See also Fig. 1(b) which reflects the more dramatic increase in Agricultural GDP in China relative to India.

There is also a 'political economy' angle to these experiences. There is often a refrain, especially in popular media, but also in academic circles, that India, being a democracy, is in a weaker position to implement growth inducing policies, given that any policy passed by the government may have several vested-interest groups in opposition to it (see Mukherjee and Zhang, 2007). Typically, policy and institutional reforms affecting agriculture have not been as radical in India as they have been in China (Fuglie and Schimmelpfennig, 2010). For a further discussion of the role of conflicting interests in policy formation, see Krusell and Rios-Rull (1996) and Acemoglu and Robinson (2000).

In this paper we extend the Lahiri and Ratnasiri (2012) framework to explicitly examine such issues. We do this by incorporating a vote by the agents on a parameter that represents the mix between two types of redistributive expenditures, one which achieves redistribution through direct lump-sum income and wealth transfers from rich to poor agents, and another which reduces the cost of adopting superior technologies through research and development expenditures. Our objective is to examine whether the political process delays the adoption of superior technologies, thereby slowing the transition to economic development.

Interestingly, results here indicate that even in the absence of the type of technological trade-offs present in Krusell and Rios-Rull (1996) – which prevent adoption of new technologies because of vested interests of agents who have not fully reaped the 'learning by doing' benefits of old technologies – there can be a delay in the adoption of more productive technologies. This delay in the adoption occurs at the lower end of the income distribution which is characterized by reversals in the technology adoption and growth process. The



(Source: ASTI database as published in Beintema et al, 2012)

Fig. 1. (a) Agricultural research and development expenditure (Million 2005 PPP Dollars). (b) Agricultural GDP (Million 2005 PPP Dollars). (Source: ASTI database as published in Beintema et al. (2012)).