Journal of Macroeconomics 38 (2013) 465–480

Contents lists available at ScienceDirect

Journal of Macroeconomics

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

The dynamics of catch-up and skill and technology upgrading in China

Xi Chen [a], Michael Funke [a,b,*]

[a] Hamburg University, Department of Economics, Germany
[b] CESifo, Munich University, Germany

ARTICLE INFO

Article history:
Received 7 July 2012
Accepted 8 July 2013
Available online 25 July 2013

JEL classification:
D90
O31
O33
O41

Keywords:
China
Economic growth
Transitional dynamics

ABSTRACT

This paper accounts for China's economic growth since 1980 in a unified endogenous growth model in which a sequencing of physical capital accumulation, human capital accumulation and innovation drives the rise in China's aggregate income. The first stage is characterized by physical capital accumulation. The second stage includes both physical and human capital accumulation, and in the final stage innovation is added to the mix. Model calibrations indicate that the growth model can generate a trajectory that accords well with the different stages of development in China.

1. Introduction

China has achieved a remarkable rate of economic growth over the past three decades. Beginning in 1978, China embarked on a series of pragmatic, market-oriented reforms that have led to an economy increasingly reliant on markets and price signals for allocating productive resources. This has delivered major improvements in Chinese living standards. Nowadays, China is considered a global powerhouse and one of the fastest-growing emerging market economies in the world.[1] Since the first economic reforms were introduced in 1978, China's real GDP has grown 8–10% a year on average. China is already the world's second-largest economy and is striving to create additional multinational firms with 'global-challenger' ambitions. Based on these facts, China's past, current and future economic catch-up and evolution are the subject of intense study.

Our paper is part of the voluminous literature on transitional dynamics and specifically models on Chinese growth. The economic growth literature has long recognized that the accumulation of physical capital and knowledge along with R&D-based technological progress are the key drivers of economic growth. The first strand of research was inspired by Solow's (1956) neoclassical growth model. Since technology is exogenous in that model, the emphasis in empirical studies based on this model is usually on physical capital accumulation. The second strand of research, inspired by Uzawa (1965) and Lucas (1988), sees economic growth as the result of human capital accumulation. The third strand of research, founded on the

* Corresponding author at: Hamburg University, Department of Economics, Germany.
E-mail addresses: xi.chen@wiso.uni-hamburg.de (X. Chen), michael.funke@uni-hamburg.de (M. Funke).

[1] Subramanian (2011) has computed a dominance index based on a weighted average of a country's GDP, its status as a creditor, and its trade. According to this index, China has already pulled ahead of the US.

0164-0704/$ - see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jmacro.2013.07.002

contributions of Romer (1990) and Grossman and Helpmann (1991), assumes that technological innovations (R&D) by profit-maximizing agents drive economic development.

In this context it is worthwhile mentioning that Funke and Strulik (2000) have moved a step towards a unified endogenous growth model that integrates these separate lines of research on economic growth.[2] The motivation for the modelling framework is the observation that economic growth appears to progress in different phases. Prior to this contribution, human-capital based growth models and R&D based growth models were studied separately. Funke and Strulik (2000) have suggested that a typical advanced economy goes through three endogenously determined development phases: physical capital accumulation, human capital accumulation, and finally R&D. They provide a theory of development in which the transitional dynamics of the endogenous growth model reproduces this stylized fact and endogenously determines the two critical junctures.

The paper by Funke and Strulik (2000) has triggered a genuine and vivid line of research. Researchers have attempted to identify other sequences of economic development and have presented extended models that improve the fit of the models to data from various countries. In what follows, we briefly touch on the nature of the model extensions. Gómez (2005) has analysed the equilibrium dynamics of the model. Iacopetta (2010) has presented a unified growth model that can generate a trajectory in which R&D precedes human capital accumulation. In a similar vein, Gómez (2011a,b, 2012) has proposed an extended growth model incorporating an externality in the R&D sector. By adding this new feature, the model is also able to generate adjustment dynamics in which the innovative stage precedes the human capital formation. Sequeira (2008) has incorporated a human capital erosion effect in the growth model, claiming that this effect improves the model-data fit. The underlying intuition is that some type of human capital depreciates due to new technologies. Sequeira (2011) has added R&D spillover to the framework and has derived the equilibrium and stability properties of such a model. Finally, Iacopetta (2011) has introduced a unified growth model which matches the long-run US data.

Our paper is also part of the recent literature highlighting the key mechanisms of China's rapid growth. This literature is still in its infancy but growing. Song et al. (2011) have recently analysed Chinese economic growth from two different perspectives: (i) high economic growth has been supported by a sustained expansion of private firms and thus a reallocation of capital and labour within the manufacturing sector; and (ii) nonwithstanding a high growth rate, financial reforms have been sluggish and state-owned firms still have better access to credit markets. Since high-growth private firms have limited access to finance, they need sufficiently high savings. Our modelling framework below captures several other complementary features of the Chinese transition.

The outline of the paper is as follows. The next section gives the underlying unified growth model. Section 3 analyses the properties of the balanced growth path and the dynamics of the model. Section 4 presents some numerical simulations and discusses the adherence of the model to China's growth trajectory. In Section 5 we turn to a sensitivity analysis. Finally, Section 6 concludes.

2. Model ingredients and motivation

To fix ideas, this section explains the cornerstones of the endogenous growth model framework in the spirit of Funke and Strulik (2000) and Gómez (2005, 2011a,b) and derives the model's equilibrium and stability properties. We also add imitation and international R&D spillovers to the growth model set-up. Cutting-edge economies make move ahead by inventing new products and techniques, developing and emerging market economies grow by assimilating know-how from elsewhere via FDI. Starting in the 1980s, China has attempted to obtain advanced technology from advanced economies and to use it to establish domestic innovation capability. Under its so-called "market for technology" policy, China has evolved as the largest recipient of FDI among the developing countries. The hope is that a single model could incorporate all these features and still be tractable.

2.1. Consumption and education

We first describe the household optimization problem. Households with an infinite time horizon maximize the intertemporal utility function

$$\int_0^\infty \frac{C^{1-\theta}}{1-\theta} e^{-\rho t} dt, \tag{1}$$

where C denotes consumption of final goods, $0 < \frac{1}{\theta} < 1$ defines the intertemporal elasticity of substitution and $\rho > 0$ denotes the time preference rate. Since the Chinese capital account is closed, private agents cannot save or borrow abroad. The population size is normalized to unity so that all aggregate quantities are per capita quantities.[3] Market clearing in the labour market implies that total labour supply H can be devoted to production (H_Y), education (H_H) and innovation (H_n):

[2] Brock and Durlauf (2001) have used the term 'openendedness' to refer to this set of multiple, overlapping theories emphasizing different growth channels such that the truth of one theory does not imply the falsehood of another.

[3] Thus, we do not consider the demographic changes which are underway in China. Over the medium term, demographics will switch from supporting growth to acting as a drag. The reason is that the Chinese fertility rate is well below the replacement rate as the result of the one-child policy and increasing opportunity costs of child rearing. On the other hand, continued reallocation of labour from agriculture will support labour force growth in manufacturing and services.