What Drives Economic Growth across Countries? Productivity vs Capital Accumulation

Kevin P Chen[1,*], Baiyi Li[2], Xinran Tong[3]

[1]Shanghai American School Puxi Campus, Shanghai 201106, China,
[2]Department of letter and science, University California Berkeley OF California, 94720 USA,
[3]Imperial College London, London SW72AZ, UK,

*Correspondence author email: kevin02px2023@saschina.org
lby0512@berkeley.edu
xt322@ic.Uk

Abstract. In recent decades, many countries have seen improvement in their economic conditions. Why do some countries experience rapid economic growth, others stagnate, and others catch up to other economies in quick succession? All of these questions are crucial to understanding history and the modern day. We collect the data and do some analysis and speculating about those economic phenomena to clarify the countries' economic conditions. The economy has been a hot topic, so our work will be valuable and practical.

Keywords: Economic, Growth, Country

1 Introduction

Over time, output per capita has improved frequently in many countries worldwide. Although some countries were not affluent several decades ago, their economic conditions are promoted a lot after some reformation or innovation. In addition, some countries' economies suffered from the disasters grievously, but they caught up quickly [1]. Therefore, understanding the sources of output growth is essential for assessing the future growth potentials of these economies [2]. It is also essential for understanding how economies that have not grown in the past can ring about economic growth [3].

This paper uses the neoclassical production function approach to decompose output per capital growth into $(\frac{Y_t}{L_t}) = A_t(\frac{Y_t}{L_t})^a$. We do so for the following countries: China, America, Germany and Japan. We look at these countries because the United States is the technology leader, while China has been one of the great catch-up and development successes of recent decades. Japan and Germany are also highly advanced economies but suffered in terms of the destruction from World War II, which allows analyzing a catch-up process of a different kind [4]. We compare the levels of total factor productivity across countries to assess to what extent countries have been able to Cash up to the technology frontier [5]. After we get data and results, we make some deduc-

H. Mallick et al. (Eds.): ICEMCI 2022, AEBMR 231, pp. 1929–1934, 2023.
https://doi.org/10.2991/978-94-6463-098-5_217

tions of countries' data about their advantages and disadvantages and what they could do to increase their economic conditions. It will be clearer of each country's economic conditions after the analysis of data [6].

This research focuses on the countries' productivity and general economic functions [7]. The goal is to analyze and explain the economic conditions of today in these countries compared with past historical data. Our data is gathered from the Penn World Table (insert link) [8]. In addition, the goal is to learn what factors we can speculate have led to economic growth under certain conditions [9].

2 Conceptual Framework

This part will lead you through exactly how we conducted our investigation.

2.1 Definition of Variables

Let *Y* be the total production (the actual value of all goods produced in a year). Let L be the labour input (the total number of person-hours worked in a year). Let K be the capital input (a measure of all machinery, equipment, and buildings; the value of capital input divided by the price of capital). Let A be the total factor productivity (total output/total input). Let α and 1-α be the output elasticities of capital and labour, respectively. These values are constants determined by available technology. Let t be time.

2.2 Steps for Decomposing Output Growth

We start with the neoclassical Cobb–Douglas production function, which is given by

$$Y_t = A_t(K_t)^a L_t^{(1-a)} \tag{1}$$

We divide equation (1) bu hours Lt and then take the logarithm. We then compute the changes in log values in some period t to some base period(t=0):

$$Log\left(\frac{Y_t}{L_t}\right) - Log\left(\frac{Y_0}{L_0}\right) = Log\left(\frac{A_t}{A_0}\right) + aLog\left(\frac{K_t}{L_t}\right) - Log\left(\frac{K_0}{L_0}\right) \tag{2}$$

Output per hour $\left(\frac{Y_t}{L_t}\right)$ and capital per hour $\left(\frac{K_t}{L_t}\right)$ can be observed using our data, but the productivity level at is unobserved and need to be computed.

$$Log\left(\frac{Y_t}{L_t}\right) = Log A_t + aLog\left(\frac{K_t}{L_t}\right) \text{ Log } Y_t/L_t \tag{3}$$

2.3 Data collection

We collected data from the Penn World's Table (PWT, Version 9.1), and we used the data in China (1970-2017), Germany (1950-2017), USA (1950-2017) and Japan (1950-2017). We used RGDPO as our baseline output measure (Y_t). We deflate the

capital stock (serried cn in the PWT) with the price level for capital (serried pl_n in the PWT) and use it as our measure of the capital stock (K_t). We compute hours (L_t) by multiplying total employment (serried emp in the PWT) with average hours per employed person (serried avh in the PWT).

The data is available at the following link

https://www.rug.nl/ggdc/productivity/pwt/?lang=en at the University of Groningen.

3 Result

Table 1 shows one of our main results. It performs the growth accounting exercise and decomposes growth in output per hour into the contribution from growth in total factor productivity (A) and contributions from capital deepening.

Table 1. Decomposing growth rates in output per hour (Annual growth rates)

	Year	Y/L	A	(K/L)^alpha	% Contribution of A	% Contribution of (K/L) ^alpha
Germany	1950-2017	0.018	0.017	0.001	92.943	7.057
China	1970-2017	0.017	0.004	0.013	24.955	75.045
United States	1950-2017	0.008	0.010	-0.002	120.690	-20.690
Japan	1950-2017	0.018	0.016	0.002	86.657	13.343

In the table, counties Germany, China, and Japan have the approximate result on growth in output per hour, and almost double contrast to the United States. That represents almost twice as much output per hour in these three countries as in the United States.

Moreover, Germany's output per hour is mainly contributed by total factor productivity, which is nearly 9 to 1. In China, the main contribution comes from capital accumulation, with the ratio between the two variables approaching 1 to 3. America's figures are fascinating because its capital accumulation is harmful, affecting the country's output per hour. Japan's data are predominantly accounted for by growth factor productivity.

Figure 1 shows the evolution of the total factor productivity estimates from 1950 to 2017 for the countries considered. In 1950, it can be seen that the United States took first place with a value of 1.84, followed by Germany and then Japan (as the data of China can only be collected from 1970). In the following 67 years, the increasing A rate in both United States and Japan showed similar trends, but Japan never caught up with the US. However, there was a sharp increase in the data of Germany, overtaking which the United States in 1988 but began to fluctuate and then fall since 2005. As for China, TFP growth was significantly lagging that of the other countries, despite its level being lower to start with.

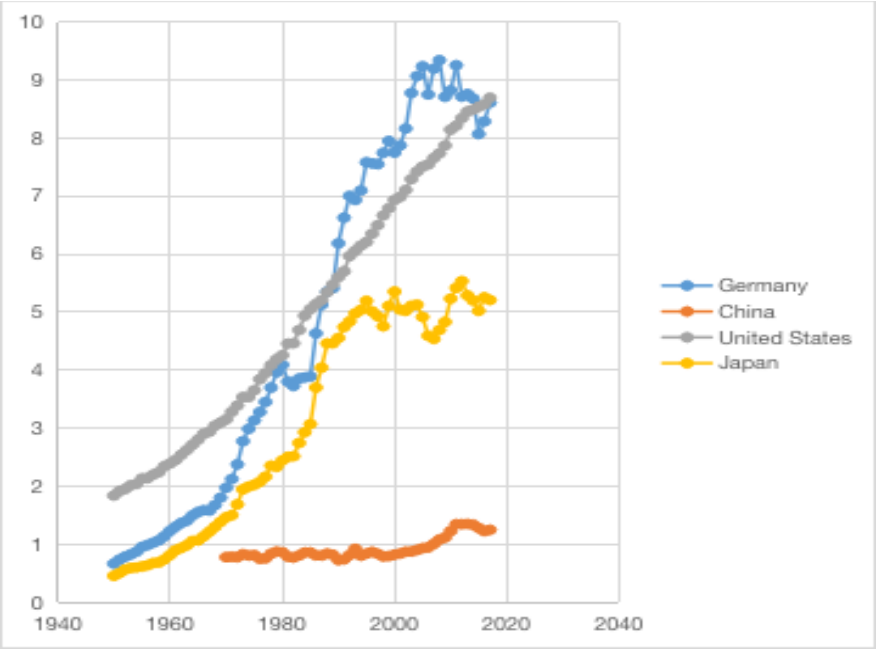

Fig. 1. the evolution of the total factor productivity estimates from 1950 to 2017

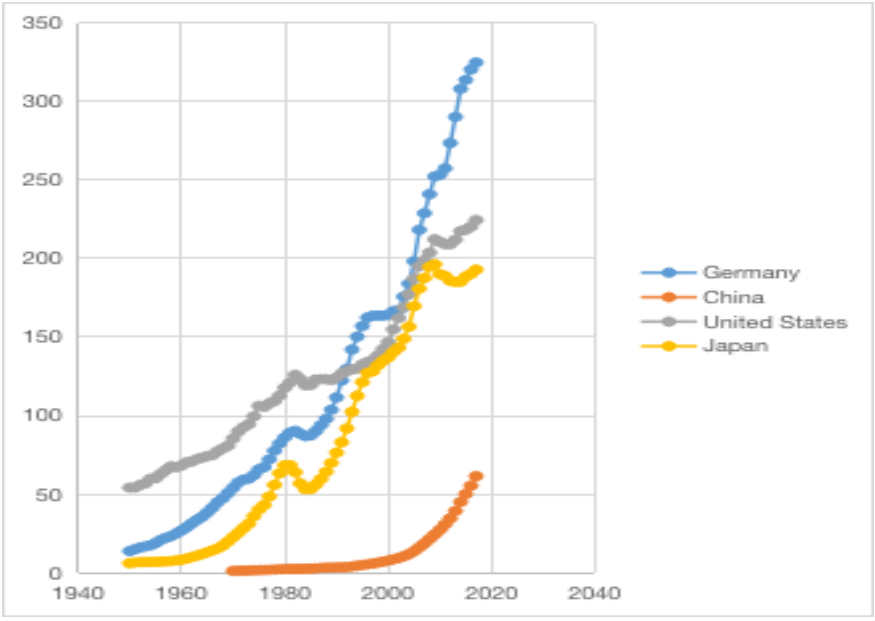

Fig. 2. the evolution of the capital-to-labor ratios over time

Figure2 shows the evolution of the capital-to-labor ratios over time. The general

trend of the four countries on it is not very far from that of TFP. Unless Germany's growth was significantly high, and catching up in capital-to-labour is clearly visible for China in recent years.

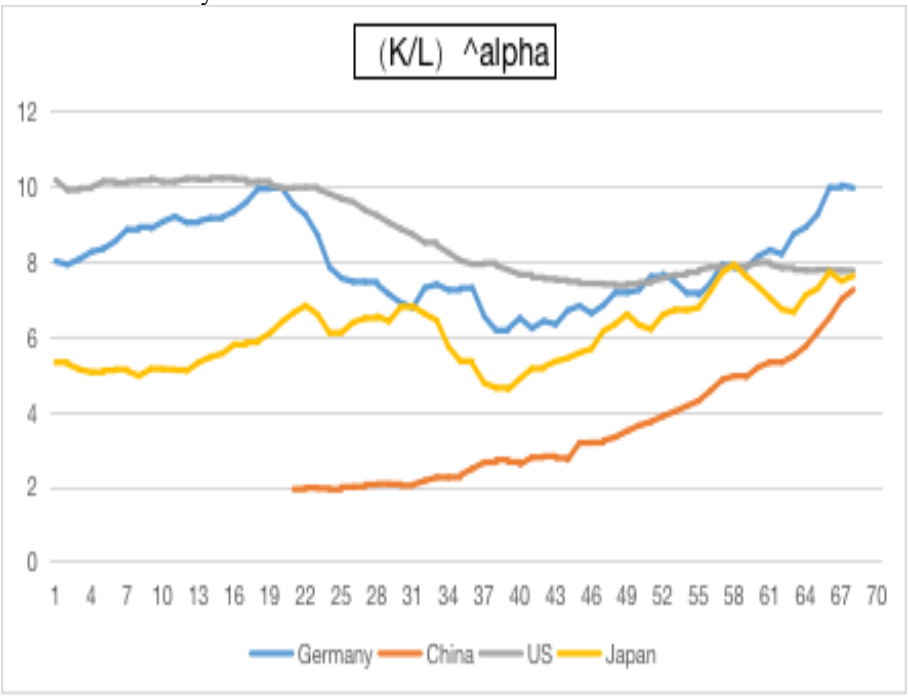

Fig. 3. the capital-to-labor ratios power alpha

Figure3 shows capital-to-labor ratios power alpha, and the alpha we choose is the average value among four countries. In this graph, growth is very smooth over three countries and growth in the US even displayed a downward trend. It was overtaken by Germany in 2006 and is estimated to surpass Japan and China after 2007. It must be highlighted that although China remains last in this graph, it shows a surprisingly strong upward trend [10].

4 Conclusion

To sum up, the analysis of the economic conditions around the world gives insight into their economic potential and their past. For example, after analyzing the economy of the USA, Germany Japan, the Growth of output mainly depends on the enhancement of total factor productivity. However, in China, it is the increase in the labour force that boosts output. As a result, China needs to attach importance to technological progress in order to obtain long-term and sustainable development.

References

1. “PWT 9.1.” University of Groningen, 26 Sept. 2019, www.rug.nl/ggdc/productivity/pwt/?lang=en.
2. Robert, J, Barro. Economic Growth in a Cross Section of Countries[J]. Quarterly Journal of Economics, 1991.
3. Org Z . A Contribution to the Empirics of Economic Growth.
4. Putnam R D . The Prosperous Community: Social Capital and Economic Growth. 1993.
5. Thomas F , Prescott E C . Economic Growth and Business Cycles[M]. 1995.
6. Link C , Alesina A , Zler S , et al. Political Instability and Economic Growth[C]// Harvard University Department of Economics. Harvard University Department of Economics, 1996.
7. Vernon, Henderson. The Urbanization Process and Economic Growth: The So-What Question [J]. Journal of Economic Growth, 2003.
8. Alesina A , Rodrik D . Distributive Politics and Economic Growth[J]. NBER Working Papers, 1991.
9. Devarajan S , Swaroop V , Heng-Fu Z . The composition of public expenditure and economic growth[J]. Journal of Monetary Economics, 1996, 37.
10. Long J , Summers L H . Equipment Investment and Economic Growth[J]. The Quarterly Journal of Economics, 1991.