# Productivity and Sources of Economic Growth in China and the United States Farm Sectors—A Bilateral Comparison

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## Abstract

This paper provides estimates of relative levels of farm sector productivity for China and the United States, spanning the 1985-2013 period. We also decompose agricultural growth into the contributions of input growth and productivity growth. The results show that while TFP growth has always been the major driver of the U.S. agricultural output growth, input growth has played a much more important role in China's agricultural growth, especially during the early period (1985-1995). The trend of relative productivity level between the two countries show that the US-China agricultural productivity gap has shrunk, especially in the later years. It indicates that China's agricultural productivity is catching up with that of the United States.

## Introduction

China and the United States are two major producers and consumers in the world food market. Sustained agricultural productivity growths in these two countries are especially critical for global food security. China has experienced fast economic growth since it implemented a series of rural reform and open policies after 1978. Given that China and the U.S. are in different development stages measuring the relative productivity level and comparing the sources of agricultural growth of these two countries can inform agricultural policy decisions. The objectives of this paper are: first, comparing levels of output, input, and productivity in China and the U.S.; second, understanding the sources of output growth in these two countries; and third, examining the gap between China and U.S. agricultural productivity levels.

## Method and Data

Output is defined as gross production leaving the farm, as opposed to real value added. Inputs are not limited to labor and capital, but include intermediate inputs as well. We measure total factor productivity (TFP) growth for China and U.S. farm sectors using the Törnqvist index approach. We further decompose agricultural output growth into its sources of growth (Jorgenson, and Griliches (1967) and make comparisons.

In order to measure the relative levels of output, input, and total factor productivity (TFP) between China and the U.S. farm sectors we estimate prices of output and input for China farm sector relatively to the U.S. agriculture under a purchasing power parity concept (e.g., see Eichhorn and Voeller (1983), and Jorgenson and Nomura (2007)). We then obtain indexes of relative real output and relative real input between the two countries by dividing the nominal value of output and input with relative output price and input price, respectively.

In the farm sector, land is a productive asset and its quality can be distinct from one region to another. In this study we adjust for relative land quality differences between the two countries based on hedonic shadow value approach (Ball et al. (2016). The land quality estimate of China relatively to the U.S. is estimated using the shadow values of land attributes from the U.S. estimates and China's land characteristics data.

We draw data from various sources for China and the US agricultural output and input (see details in Wang et al. (2013) for China estimates, and Ball et al. (2016) for the U.S. estimates), spanning the 1985-2013 period.

## Results

In 2013 China's agricultural production was nearly four times its 1985 level, and grew at an average annual rate of 4.9%. With input growing at an average rate of 2.4% per year, the average annual rate of TFP growth in China is 2.5% during 1985-2013, which has surpassed the U.S. TFP growth rate of 1.31% per year over the same period of time. Distinctly, while both input and TFP have grown strongly in China's farm sector input growth has declined by 0.07% per year on average in the U.S. that TFP growth accounts for most of output growth in the U.S. farm sector (chart 1).

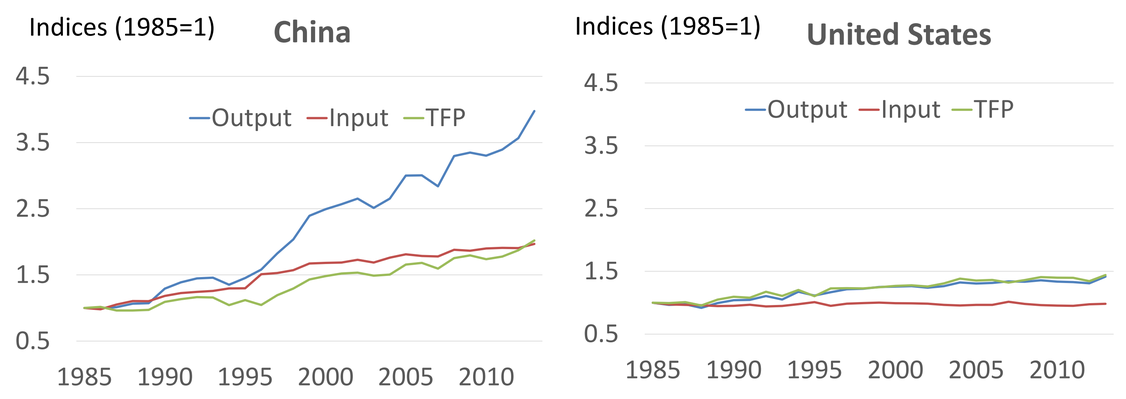


**Chart 1.** Agricultural output, input and TFP growth in China and the United States

## Discussion

While aggregate input use continues to grow in China and continues to be flat or decline in the U.S. labor use has declined in both countries. Intermediate goods growth is the main contributing factor to the strong input growth in China's farm sector over the entire study period (table 1). However, in the latter period (1996-2013) the major source of China's agricultural output growth has shifted from input growth to TFP growth (table 1). Using U.S. TFP in 2005 as the base the trend growth of the relative TFP levels in these two countries show that the TFP gap has shrunk over time, which is consistent with the "catch-up" hypothesis (chart 2).

| | China | | | U.S. | | |
|---|---|---|---|---|---|---|
| | 1985-2013 | 1985-1995 | 1996-2013 | 1985-2013 | 1985-1995 | 1996-2013 |
| **Output growth** | 4.93% | 3.74% | 5.43% | 1.24% | 1.08% | 1.13% |
| **Sources of growth** | | | | | | |
| **Input growth** | 2.42% | 2.60% | 1.56% | -0.07% | 0.09% | 0.19% |
| **Labor** | -0.33% | 0.25% | -0.68% | -0.28% | 0.08% | -0.36% |
| **Capital (excluding land)** | 0.18% | 0.07% | 0.24% | -0.20% | -0.62% | 0.03% |
| **Land** | 0.21% | -0.09% | -0.12% | -0.02% | -0.04% | -0.02% |
| **Intermediate goods** | 2.36% | 2.37% | 2.11% | 0.44% | 0.67% | 0.55% |
| **TFP growth** | 2.51% | 1.14% | 3.87% | 1.31% | 0.99% | 0.95% |

Source: Authors' calculation

**Table 1.** Sources of growth

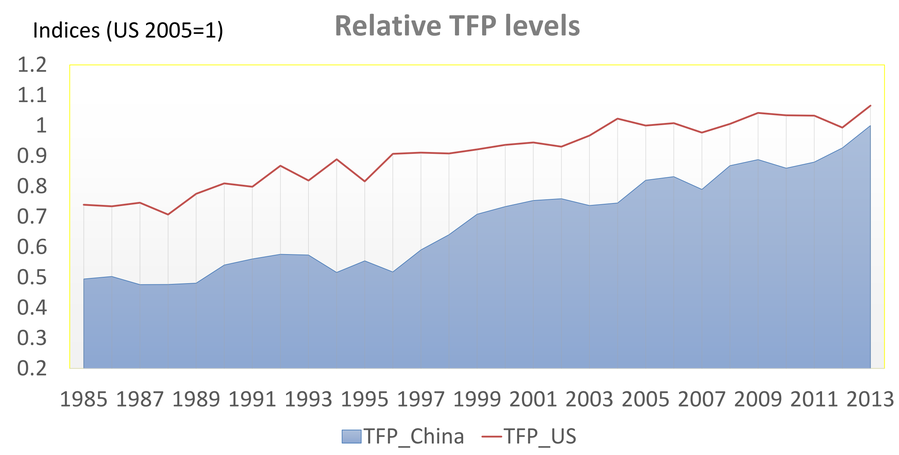


**chart 2.** Relative productivity levels between China and the U.S.

## Conclusions

The purposes of this paper have been to provide bilateral comparison of levels of TFP for China and the United States, and to examine the potential differences in the sources of growth in these two countries given that the U.S. is a developed country and China is a developing country. The results show that while input growth has accounted for most of China's output growth in early years TFP growth has played a more significant role in recent years. China's TFP level is catching up with the U.S. with a much higher growth rate over the study period.

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The views expressed are those of the authors and should not be attributed to the Economic Research service or USDA.

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