Five-Year Plans and Chinese Provincial Agricultural Productivity

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Overview

- China's average Total Factor Productivity(TFP) increased from 1.9 percent after the opening and reform policy in 1978 to 4.21 percent in the 1990s and grew as high as 3.5 percent which is almost the twice average of the global level during 2001 to 2015 (GAP report, 2018). The marvelous growth was attributed to the application of the Five-Year Plans(FYPs) (Mao and KOO, 1996; Lin,1992; Lin and Wang, 2005).
- In the past seven decades, thirteen FYPs have been made and completed to promote production development.
- Though effects of individual policies have been measured, few attempts have been made to assess the comprehensive effects of FYPs for far.

Objective

- Calculate Malmquist productivity index across Chinese provinces given the research period
- Evaluate application of FYPs on provincial productivity in China

Importance and Impacts of the Five-Year Plans

- Various reform policies including household responsibility systems, price, market and planning reforms contributed up to 48.6 percent of output growth(Lin, 1992).
- The Five-Year Plans are credited with having made a major impact to Chinese agricultural modernization. Schneider and Sharma (2014) reported that owing to supportive policies about agricultural modernization from the 10th FYP, China's agricultural industrialization greatly developed, and the sales revenue of national level dragon head agriculture enterprises reached in 5.7 trillion RMB in 2011.

Data

- Production data comes from China's National Bureau of Statistics and includes output quantities of crop and livestock commodities, input quantities of total planting areas of farm crops, labor, capital, fertilizer, pesticide and energy between 2000 and 2019.

Models and Methodology

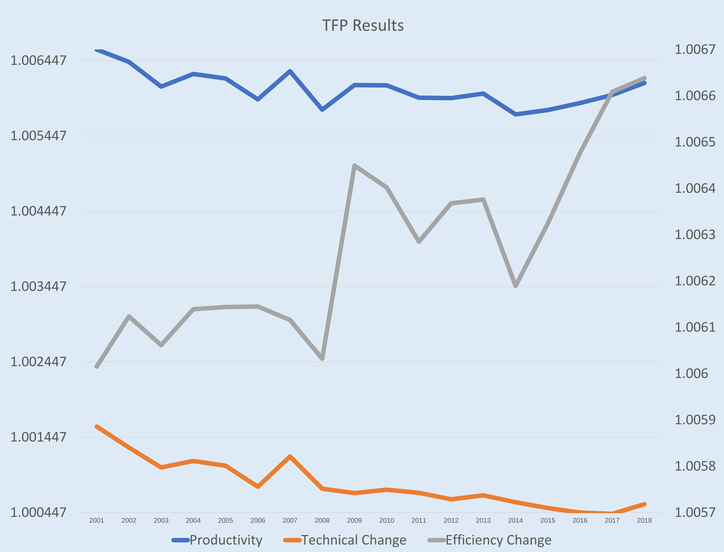
- The model used is the Malmquist productivity index (Fare et al, 1994) which can be discomposed into technical efficiency and technical progress and calculated using Malmquist Data Envelopment Analysis (MDEA).

- Productivity Change from A to (A') $= \frac{TFP_t}{TFP_{t-1}} = \frac{\frac{y_t}{x_t}}{\frac{y_{t-1}}{x_{t-1}}} = \frac{\Delta y}{\Delta x}$

- $\mathrm{OPM}_{t-1}^{t} = \left(\frac{D_0^t(x^{k,t}, y^{k,t}}{D_0^{t-1}(x^{k,t-1}, y^{k,t-1})}\right) \times \sqrt{\frac{D_0^{t-1}(x^{k,t}, y^{k,t})}{D_0^t(x^{k,t}, y^{k,t})} \times \frac{D_0^{t-1}(x^{k,t-1}, y^{k,t-1})}{D_0^t(x^{k,t-1}, y^{k,t-1})}}$

•Two steps of calculation: first, we calculate the TFPs across provinces; second, we examine how successful the application of FYPs from 2000 to 2018 on TFP.

TFP calculation results from 2000 to 2019



Conclusions

- The average TFP calculation results indicate the technical growth has decreasing trend which is the major reason why the productivity growth is slightly in decline.
- 11th ,12th , and 13th FYPs are all negatively significant in comparison with the base 10th FYP. They decrease the productivity and technical progress on average by 4.43% and 3.94%,respectively. In addition, there are no significant effects of FYPs on the technical efficiency for the period of 2005 – 2019.
- The estimation results of FYPs application is consistent with the TFP calculation results.
- With the growth of farmer's income, the farmers show willingness to invest agricultural production and therefore it influences positively on the technical progress.
- Clearly, insufficient fiscal expenditure from governments on agriculture, the limited educated level of farmers and the shrinking population of farmers hinder the development of agricultural growth.
- Also, considering the impact of agricultural mechanization on the scale of land management, the fundamental agricultural policy "household responsibility systems" (issued in 1978, contract extended in 1997 and 2018,respectively) confirms the stability and continuity of this policy. But 135 million out of 200 million rural households have less than 1 acre (China's agricultural census, 2006). The large number and small scale of land operation is hard to standardize agricultural production (Gale and Hu, 2011) and meet the requirements of agricultural modernization.

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Results

Effects of Five-Year-Plans on Chinese Agricultural Productivity

	Productivity		Technical Progress		Technical Efficiency	
	No FE	Fixed Effects	No FE	Fixed Effects	No FE	Fixed Effects
FYP_11	-0.0407***	-0.0658***	-0.0408***	-0.0541***	0.00494	-0.00587
	(-0.0131)	(-0.0165)	(-0.00945)	(-0.0119)	(-0.0115)	(-0.0146)
FYP_12	-0.0474***	-0.0946***	-0.0289**	-0.0577***	-0.0151	-0.0307
	(-0.0178)	(-0.0261)	(-0.0128)	(-0.0188)	-0.0156	(-0.0231)
FYP_13	-0.0448**	-0.0915***	-0.0485***	-0.0772***	0.0091	-0.00644
	(-0.0215)	(-0.0298)	(-0.0155)	(-0.0215)	(-0.0188)	(-0.0263)
IntenPro[1]	-0.0028		-0.0034		0.00086	
	(-0.0104)		(-0.00746)		(-0.00908)	
FiscalSuppport[2]	0.00284	0.00595	0.00355	0.0062	-0.0011	-0.00023
	(0.00862)	(-0.00891)	(-0.00621)	(-0.00642)	(-0.00755)	(-0.00786)
Urban[3]	0.0645	0.0544	0.053	0.0319	0.00076	0.0136
	(-0.0518)	(-0.0648)	(-0.0373)	(-0.0467)	(-0.0454)	(-0.0572)
AgriContri[4]	0.0633	0.202	-0.0123	0.0493	0.0858	0.167
	(-0.0906)	(-0.221)	(-0.0653)	(-0.159)	(-0.0795)	(-0.195)
Education[5]	-0.0019	0.0332	-0.0033	-0.00397	0.00259	0.0422
	(0.00723)	(-0.0295)	(-0.00521)	(-0.0213)	(-0.00634)	(-0.0261)
AgriInfra[6]	0.00850*	0.0250*	0.0106***	0.012	-0.0018	0.00665
	(0.00506)	(-0.0146)	(-0.00364)	(-0.0105)	(-0.00443)	(-0.0128)
LnIncome[7]	0.0204	0.012	0.0149	0.00956	0.00563	0.00246
	(-0.0133)	(-0.0161)	(-0.0096)	(-0.0116)	(-0.0117)	(-0.0142)
Intrade[8]	-0.0017	0.0168	-0.0006	0.0265**	-0.0013	-0.00857
	(0.00384)	(-0.015)	(-0.00276)	(-0.0108)	(-0.00336)	(-0.0132)
Constant	0.821***	0.275	0.855***	0.540***	0.957***	0.708***
	(-0.0995)	(-0.25)	(-0.0717)	(-0.18)	(-0.0872)	(-0.221)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

1. Agriculture intensive provinces
2. Proportion of fiscal spending from governments on agriculture
3. Urbanization rate which refers the proportion of urban population
4. Value added of the agriculture over the provincial GDP
5. Average educated levels for of farmers
6. Agricultural infrastructure which refers farmers' investment on agricultural fixed assets
7. Per capita income
8. Chinese general imports and exports of agricultural products

Discussion

- Why the 11th , 12th ,and 13th FYP have deterioration effects on the TFP?
- Natural disasters are one main determinant hindering agricultural development. And the agricultural policy is better to tackle this issue with the help of agricultural insurance.
- The possible reason why they have deterioration effects on the TFP can be that they mainly targets the strategy structural adjustment of agricultural sector but lack sufficient supportive measures.
- We can estimate if the unexpected output such as agricultural carbon emissions works in the decline of production growth.