

Mechanization in smallholder farming and its impact on Chinese food economy

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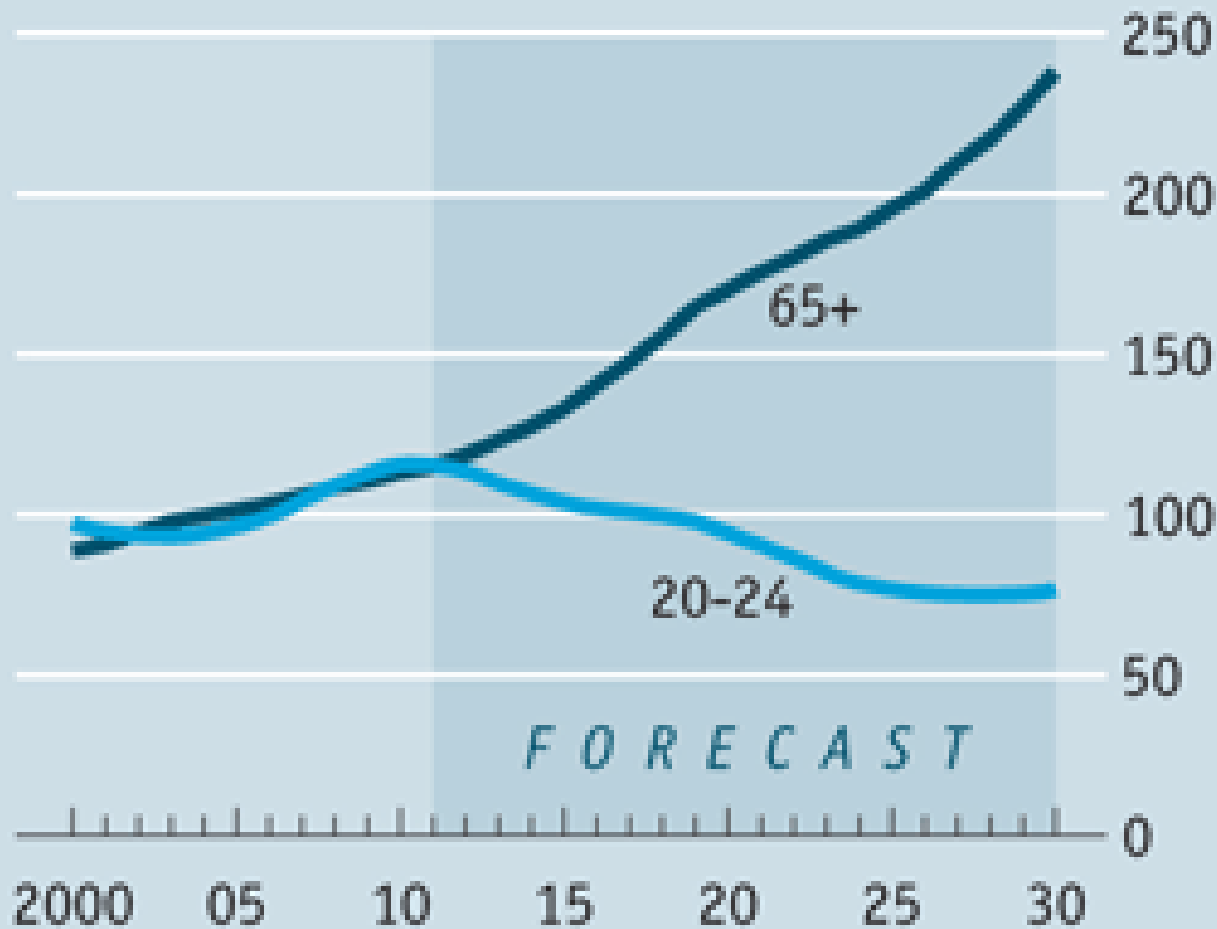
Eurasian Food Economy Forum, IAMO, June 22, 2017

Headwind Facing Chinese Agriculture

- Aging
- Rising wages
- Small farm size

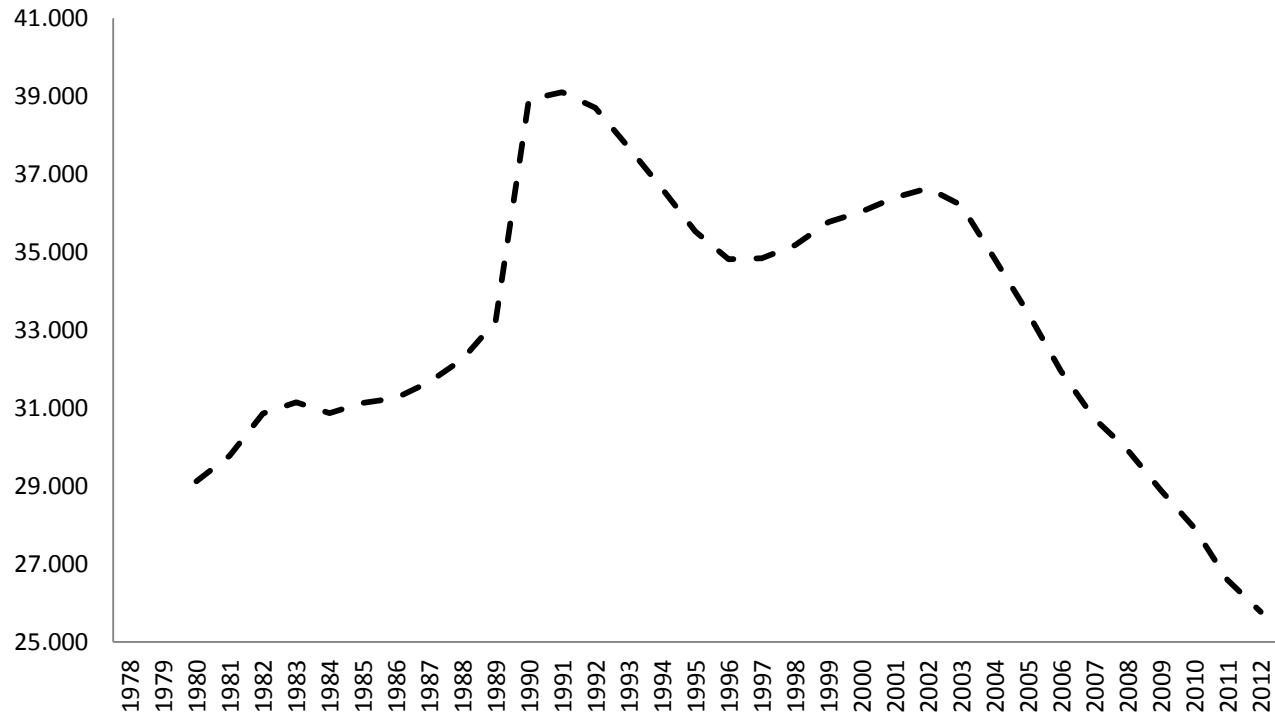
The burden of ageing

China's population by age group, m



Source: The Brookings Institution

Number of Agricultural Labor

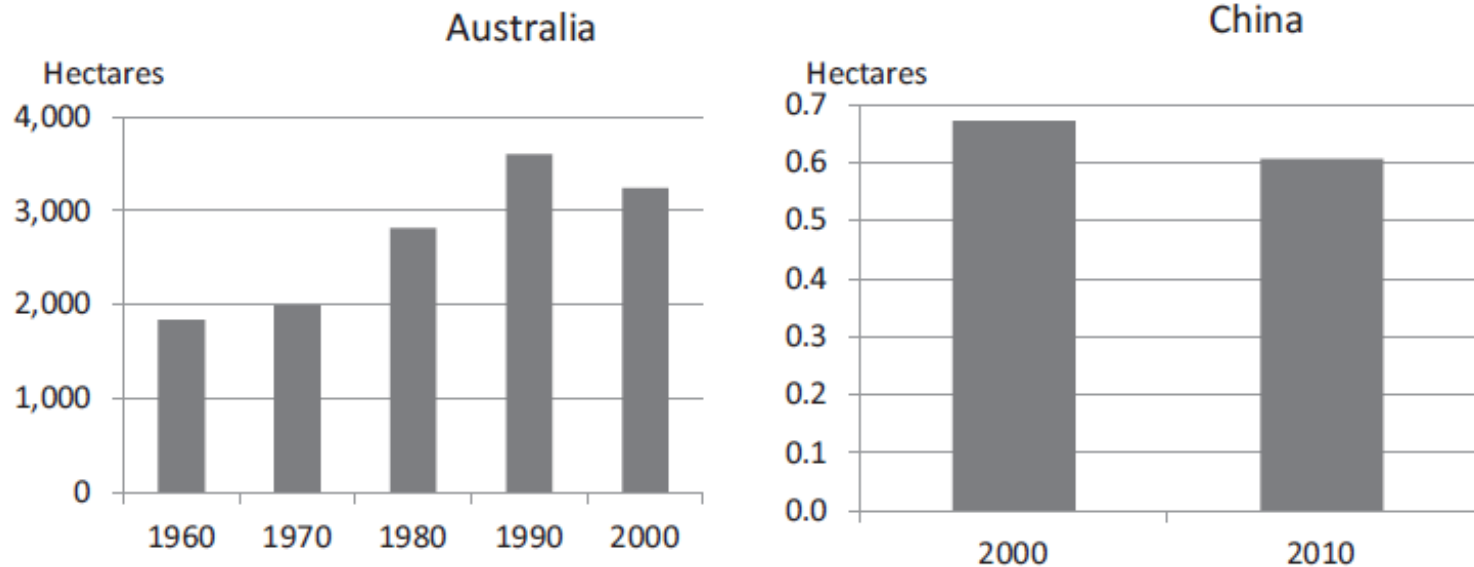




Wages in five Asian counties

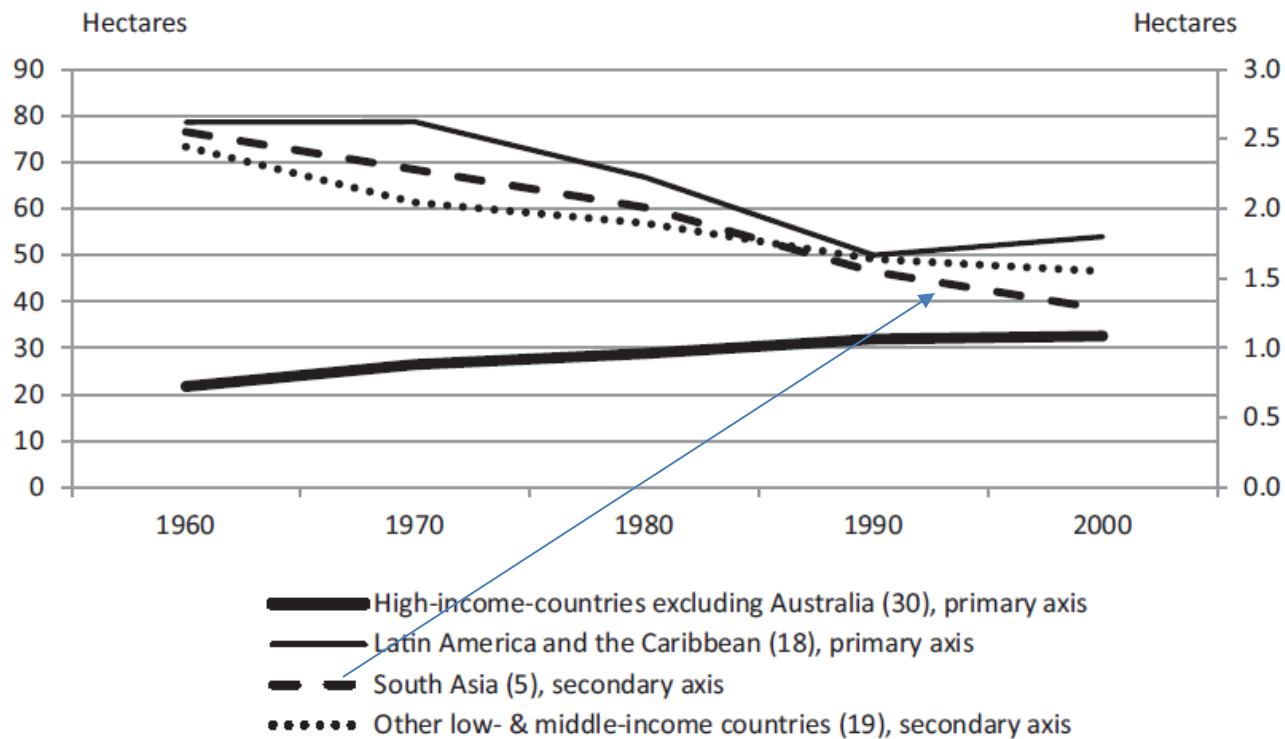


Farm Size in Australia and China



Lowder, Skoet, and Raney (World Development, 2016)

Farm Size from 1960 to 2000



Lowder, Skoet, and Raney (World Development, 2016)

Yet, China's Agriculture has performed quite well

- Yields (tons per hectare) went up from about 2.5 in 1978 to 4.3 in 2000 to 5.3 in 2012 (China Statistical Yearbook 2013, NBS).
- According to Jin, Huang and Rozelle (2009), the TFP for staples has grown at an annual rate of more than 2% since 1978; the annual growth rate of TFP for horticulture and livestock lies between 3% and 5%.

How to Reconcile the Conundrum?

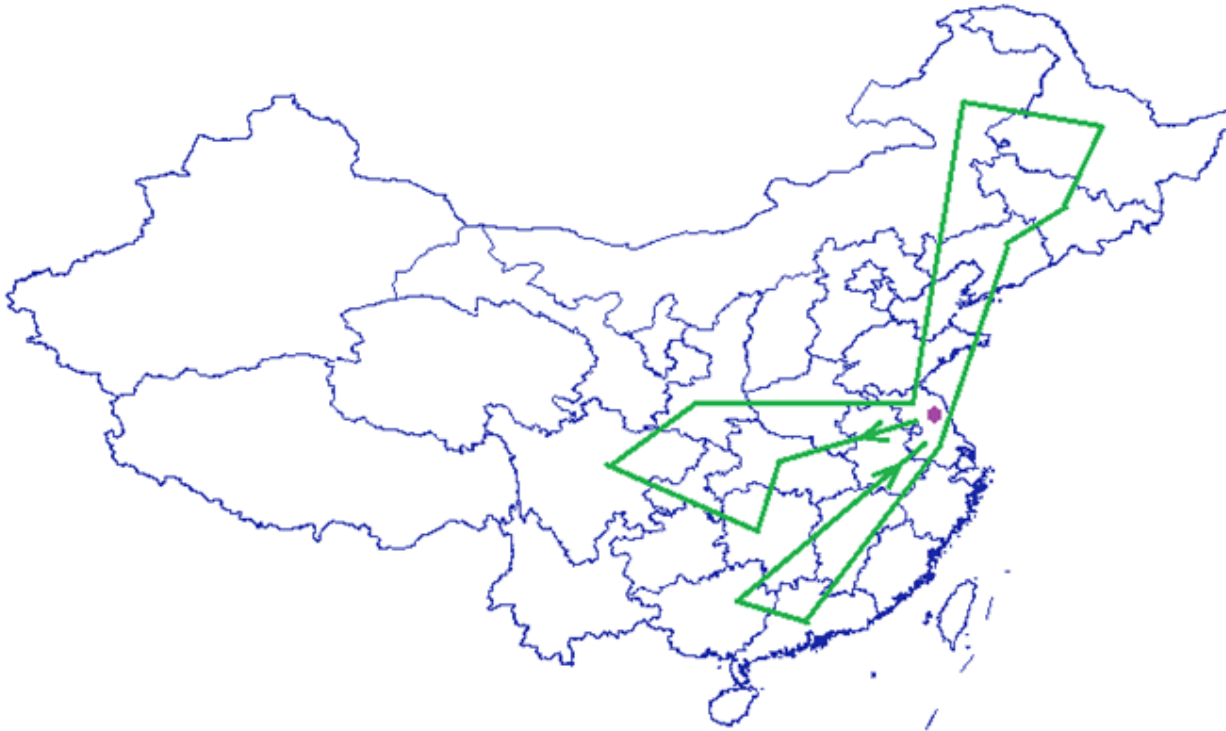


May, 2009, Sichuan Province

Distance from Peixian to Zizhong County: 1,079 miles (about San Francisco to Denver)

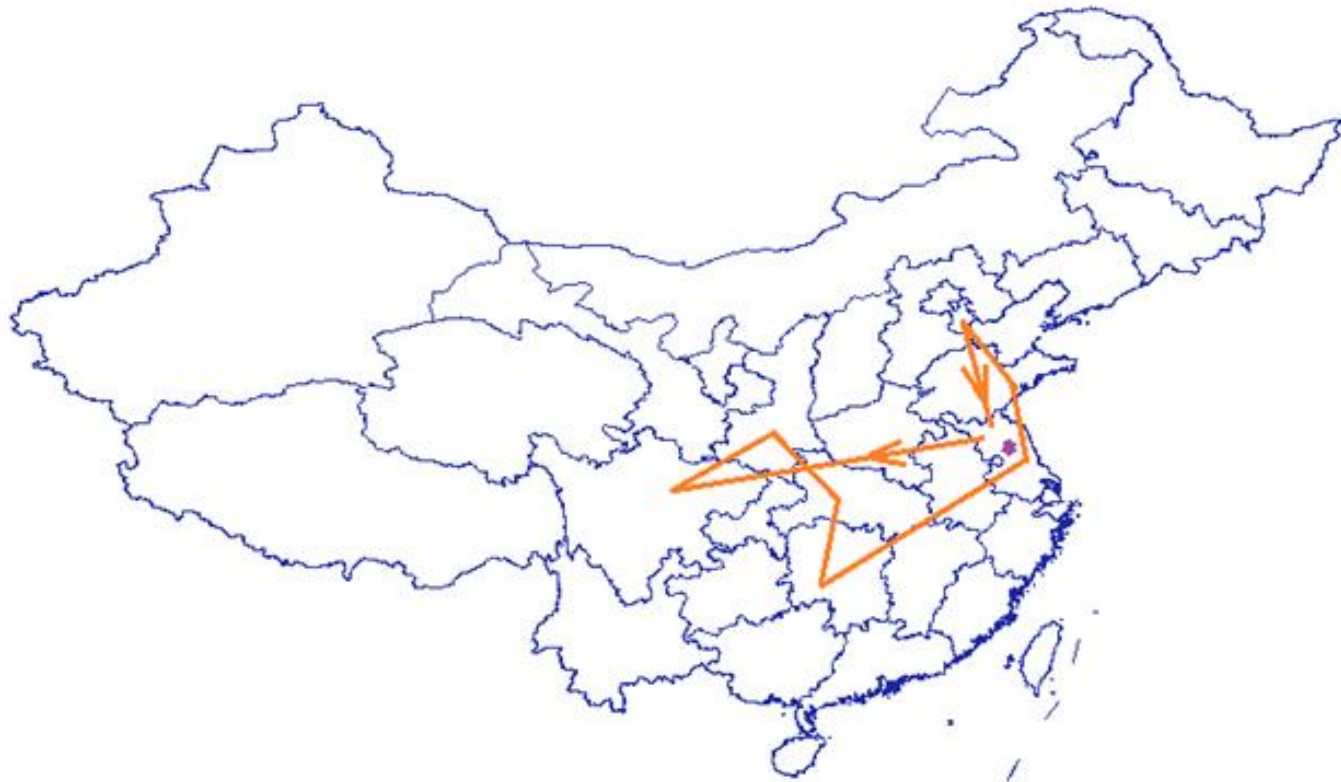


A Rice Harvesting Route



From the mid July to the end of November:
Hunan → Hubei → Sichuan → Shannxi → Jiangsu →
Shanghai → Inner Mongolia → Northeastern
provinces → Jiangsu → Guangdong → Guangxi

A Wheat Harvesting Route

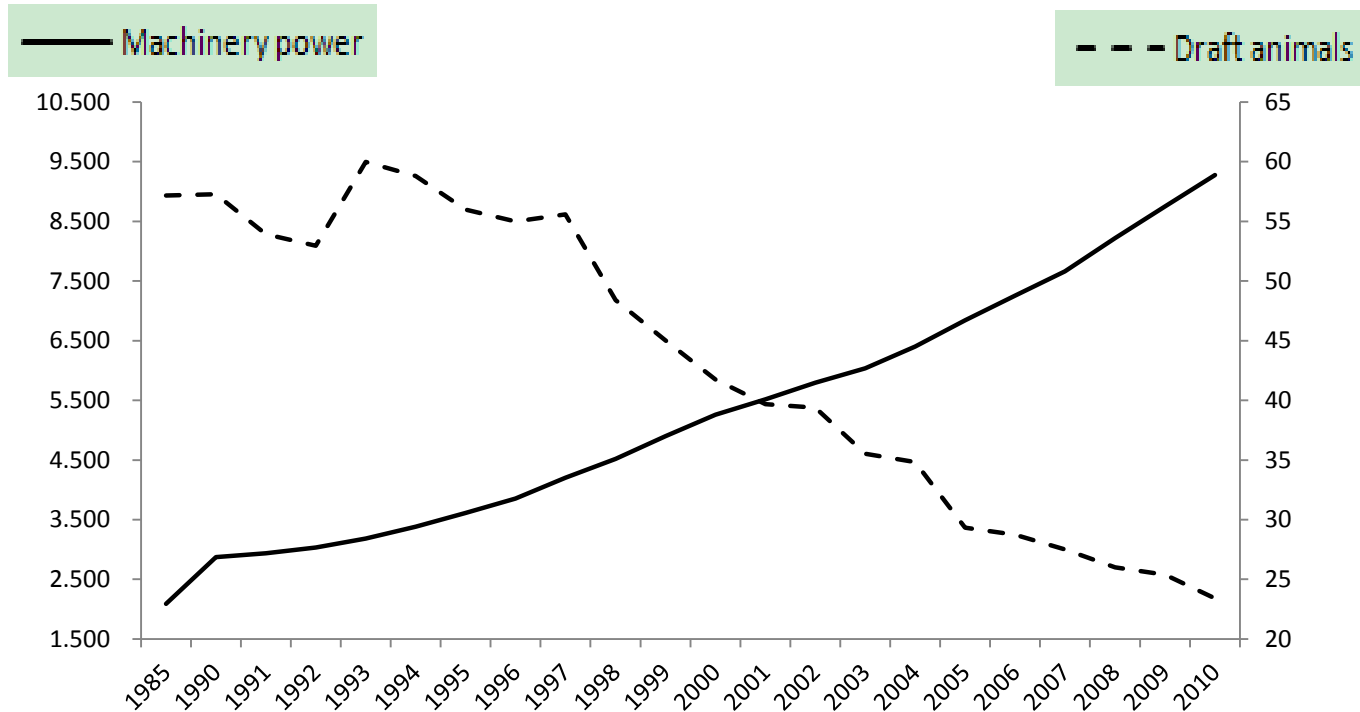


Early April to early July:
Sichuan→Shannxi → Hunan→ Hubei→ Jiangsu→
Shandong→ Tianjin

Answers to the Conundrum

- Agricultural production is divisible.
- Some steps of production, such as ploughing and harvesting, can be outsourced to others.
- Even in the US, migratory harvesting and pollination service are popular.
 - Steven Chang “The Fable of Bees: An Economics Investigation” JLE (1973)
 - Muth, Mary K., Randal R. Ruckers, Walker N. Thurman, and Ching-Ta Chuang. “The Fable of Bees Revisited: Causes and Consequences of the U.S. Honey Program.” JLE (2003).
 - Nordhaus “The Beekeeper’s Lament”

Machinery Power and Draft Animal



Conditions for Outsourcing

- Market size: The division of labor is limited by the extent of the market (Stigler, JPE 1951).
- Machinery cost: combines are much more expensive than attached disc ploughs.
- Asset specificity: tractors have multi-functionality, while combines don't have.
- High labor cost.

Rice Production Steps

Economics text book: Cobb-Douglas or CES production function
Labor+capital+land+other inputs → Rice

Traditional rice production:

Land preparation → planting → weeding → irrigation
(draft animals or labor) (labor) (labor) (pumps or rain-fed)

→harvesting → threshing → drying
(labor) (labor, animal, or threshers) (labor)

Current practice in China:

Land preparation → planting → weeding → irrigation → harvesting+threshing
(Tractors) (most by hand) (herbicide+labor) (pumps) (combine harvester)

Rice Harvesting: National Market

- Rice is planted in many parts of China, mostly in flat areas. Thereby migratory labor-cum-machine service providers can travel up to 8 months to recoup the high cost of combines, which have no other uses.
- In a small country, such as Japan, migratory harvesting is not feasible because of low regional variations in seasons.

Use of Mechanization in Rice Production

Year	Variable	Using machinery	Hiring mechanization service
2012	Plow	86	82
	Plant	10	91
	Harvest	74	99
2008	Plow	72	80
	Plant	6	96
	Harvest	52	98

Based on authors' complementary survey attached to RCRE survey in 2013.
Zhang et al. (2017)

Ploughing market is mostly local because the ploughs attached to tractors are much cheaper and tractors can be used for other purposes in the slack seasons.



Maize

- Unlike in the US, maize is widely planted on the marginal land in China.
- In some areas, it is impossible to use machinery due to steep slopes.

Guizhou Province



Maize Harvesting

- The traditional maize combines used in the US are not applicable in China because of high heterogeneity in heights and spacing across farms.
- Indigenous maize combines have been developed in the past several years. But the repairing cost is still very high.

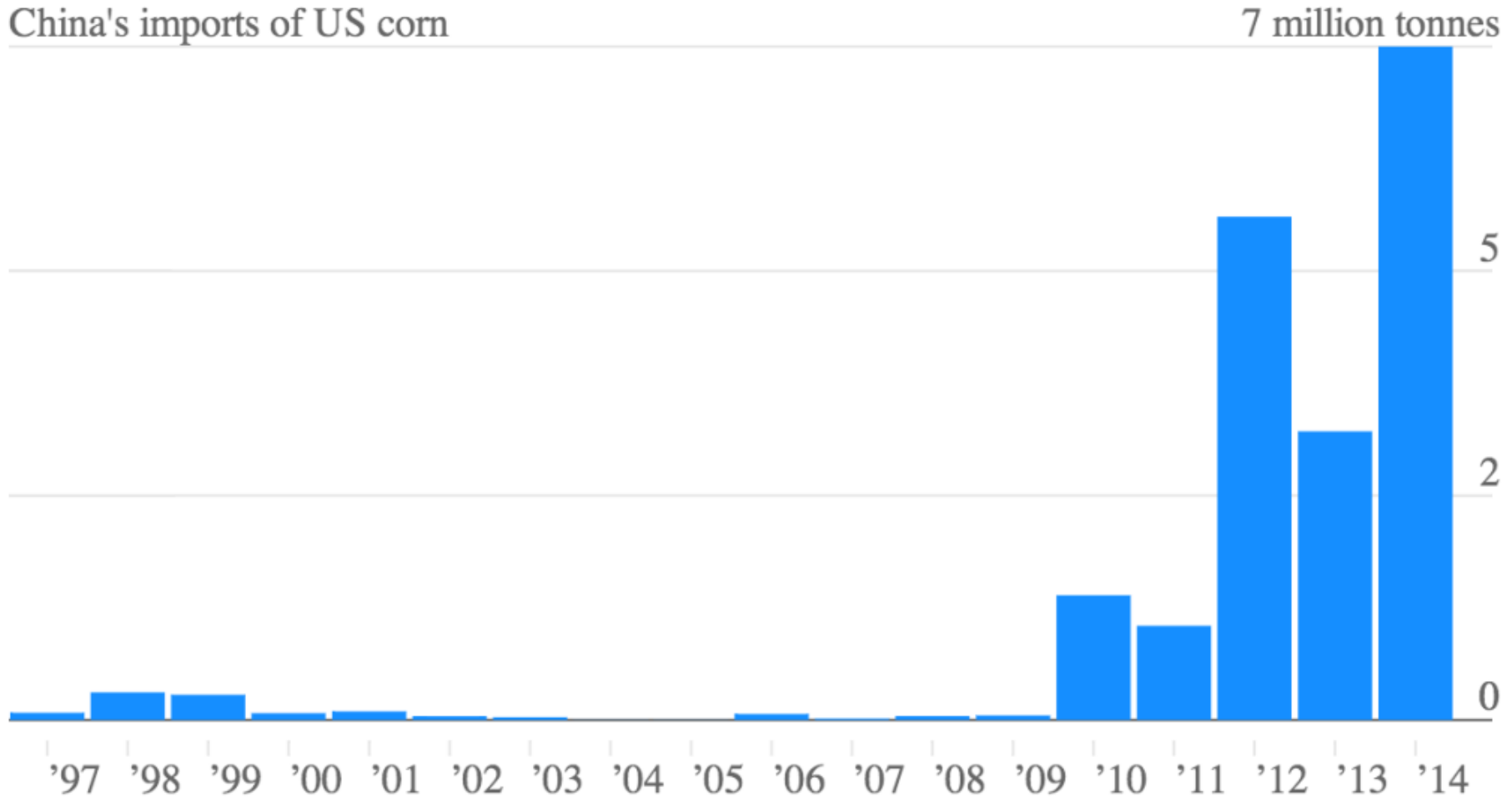
Maize Harvesting

Year	Variable	Using machinery	Hiring mechanization service
2012	Plow	62	74
	Plant	48	63
	Harvest	28	99
2008	Plow	55	70
	Plant	41	67
	Harvest	14	94

Combine harvesting for maize is still quite low

China's Import of Corn

China's imports of US corn



Quartz | qz.com

Data: USDA, Foreign Agricultural Service

Degree of Mechanization by Crop

	Land preparation	Planting	Harvest
Wheat	High	High	High
Rice	High	Low	High
Maize	High in plain area; Low in hilly area	High in plain area; Low in hilly area	Still low

Local

Local

Cross-region

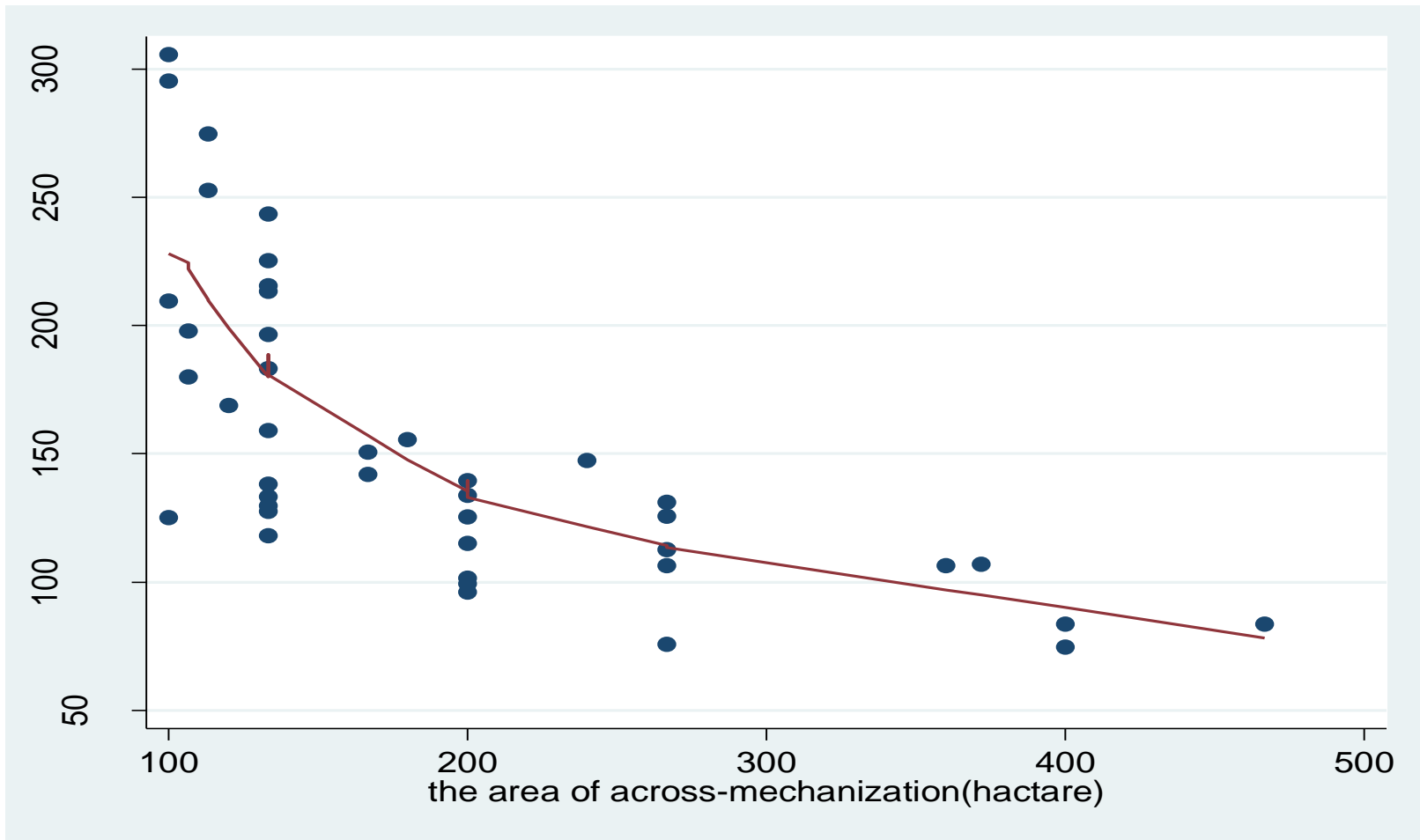
Cross-Regional Mechanization Harvest Service

- Often clustered;
- 3-4 operators per team; Traveling in flocks (average 10 trucks) with combines on the top;
- Chasing production seasons for up to 8 months (average half year);
- Charging fee only half of the cost of hiring labors (about US\$200 per hectare).

Peixian Cluster

- 36 rural mechanization cooperatives;
- 2,100 combine harvesters (mainly for wheat and rice);
- 1,100 are engaged in cross-province harvest service.
- Cross-regional harvest service started in 1998 with 50 combines largely supported by the county agricultural mechanization bureau.

The Scale Economy of Cross-Regional Mechanization Service



Advantage of Traveling in Groups

- Better coping with harassment and extortions from local gangs;
- Greater bargaining power with local agents thanks to large scale of harvesting;
- Pooling spare parts for repairing (even bringing a service truck);
- Sharing the search cost (like scout bees)

Income and Cost Per Team (RMB)

Variable	Median
1. Net income (\$)	14,286
2. Total costs (\$)	22,540
a) Repair and maintenance	3,175
b) Employee wages	7,937
c) Telephone	317
d) Food/lodging while traveling	4,762
e) Gasoline/diesel	6,349
3. Area served (hectares)	133
4. Days working away from home	179

About six times of rural per capita income in Jiangsu Province.

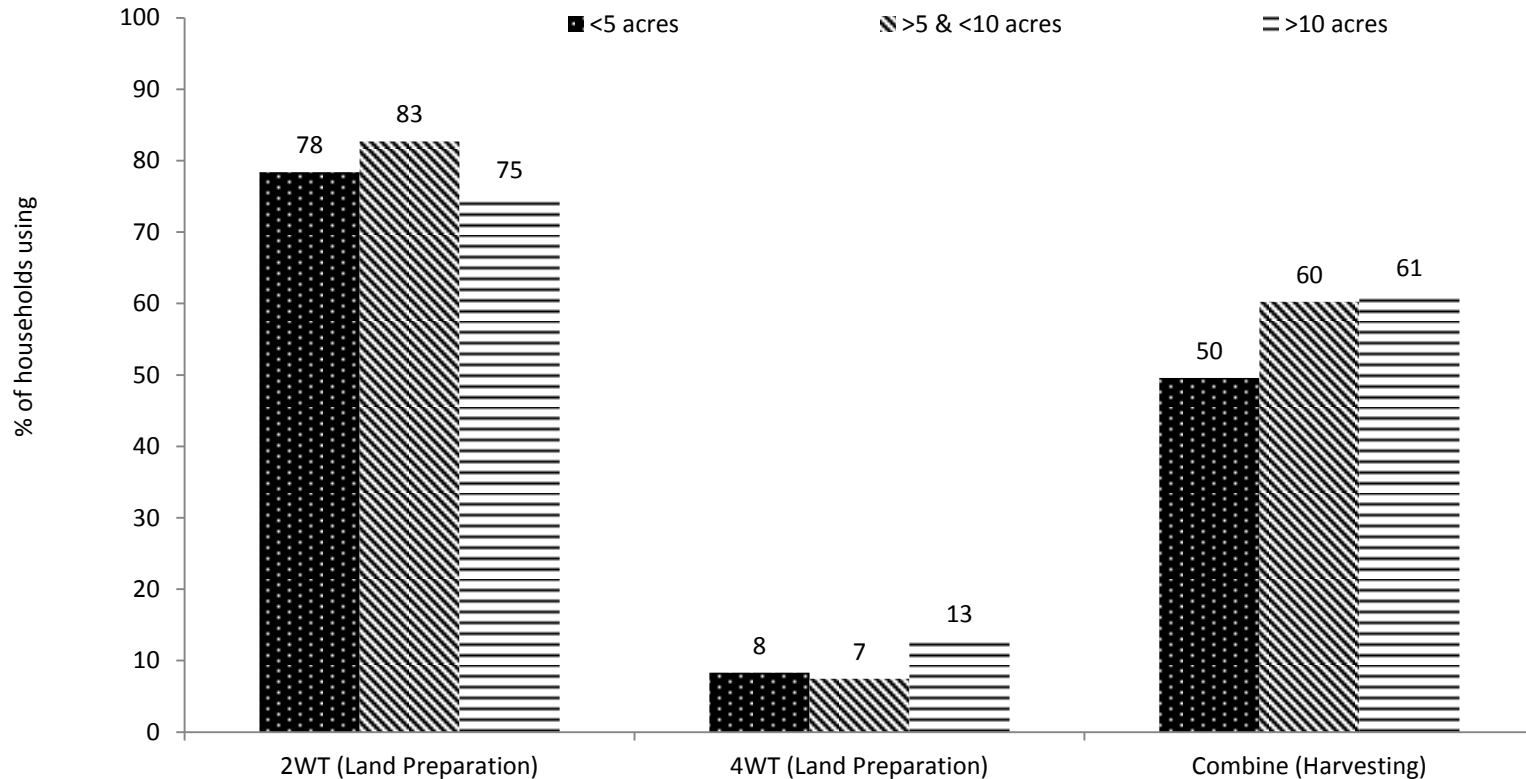
Role of Government

- Central level:
 - Machinery purchase subsidy;
 - Waive highway tolls.
- Local level:
 - Distributing harvest calendars;
 - Training, inspection;
 - Conflict resolution for those on the road;
 - Setting up cell phone group message platform

Conclusions and Implications

- Lack of production scale has been regarded as a major constraints of smallholder farmers in developing countries, particularly in Asia.
- We show that agricultural production is divisible and some steps of production can be sourced to specialized service providers, such harvesting service, which run at a much larger scale.

Share of Households Using Machinery for Land Preparation And Harvesting in Myanmar, by Farm Size Group (2015/16)



The use of machinery has little to do with farm size thanks to the active ploughing and harvesting service market.

Implications

- Collier and Dercon (2009) argue that African agriculture's future lies in large farms because smallholder farmers lack sale of production.
- Is there a future for smallholder farmers in Africa?

Teff threshing in Ethiopia



JAN/23/2013

Migratory plowing service:
The driver drives tractors for three months
and combines for three months.



Second ploughing after mechanized ploughing in Ethiopia

