Referee Report for JEEA MS 9485

What the Paper Does

The paper under review addresses the following question. Consider the aggregate production function for the agricultural sector for each region:

$$Y_i = A_i X_i^{\beta} (K_{Ai}^{\alpha} L_{Ai}^{1-\alpha})^{1-\beta},$$

Parameter β governs the elasticity between regional agricultural output and land input. Does this elasticity differ between topical and non-tropical area?

The key identification strategy is that, assuming free factor mobility, it is straightforward to show that labor-to-land ratio should be proportional to land productivity (A_i). Intuitively, more people choose to work in a region if its land is more fertile. Hence the authors estimate the elasticity between land productivity $\log(A_i)$ and labor-to-land ratio $\log(L_{Ai}/X_i)$ across regions and the coefficient of the linear regression is exactly β.

The paper measures land productivity using GAEZ data and labor-to-land ratio from various sources. Then the authors estimate β separately for tropical and non-tropical regions, and find that it is substantially larger for non-tropical regions. They also show that (as expected) this elasticity is important to structural transformation using a two-sector model.

I think this paper makes an important contribution since this elasticity has never been clearly estimated in the literature. Earlier works, as the authors cited, typically use aggregate data and come to different conclusions. This paper under review uses much richer micro data which are prepared in a very careful way.

Major Concern

My biggest concern is on the assumption of free factor mobility, which is key to the identification. Consider the scenario where agricultural output is mobile across regions but factors of input are not. This is the case of, say, China (due to the *hokou* system that restricts labor mobility). In this case, the labor-to-land ratio is exogenous and is largely independent of the land productivity, and therefore our estimate of β can be biased downwards.

This can be a systematic problem for the following reason. We generally think that factor misallocation is worse in poor countries which makes the labor-to-land ratio less responsive to

land productivity in poor countries. Since there are more poor countries in tropical areas, the estimated β can be more biased downwards in tropical areas. That is exactly consistent with this paper's result that $\beta_{\text{tropical}} < \beta_{\text{temperate}}$.

The authors show in Appendix A.3.1 and A.3.2 that their results remain true even without assuming free factor mobility, but in the arguments they still assume that factors are mobile between agricultural and non-agricultural sectors, and/or agricultural output is immobile across areas, both of which are unlikely to be true. In the China case that I described above, labor is immobile while output is mobile.

One solution to address this problem is that one can look at the wage dispersion within regions (both among farmers and rural-urban comparison) and see if it is indeed larger among tropical areas. IPUMS-international has some of this information but it may not be complete.

Other Concerns

I have some other concerns that I document below.

- Could you please give readers a sense in how to map the land elasticity differences between climate types into elasticity differences between rich and poor countries? The latter seems to be important in any two-sector models. It will be nice to provide a table that includes coefficients for a list of countries. (Country-level coefficients come from aggregation from region-level coefficients and inevitably have some problems but they are still informative for macroeconomists who work on cross-country comparison.) I imagine that it would be well-cited and used.

- On page 9 and 10: You use calories to compare crops, and the crop suitability also focuses on crops like wheat or rice. Hence your study is more on food crops. How about those cash crops in this case? In particular you constructed the suitability index by weighting crops according to their cultivated area. Food crops may have larger cultivated area than cash crops, and then drive the index. It will be great to know the results for cash crops only as they are more market-oriented and may contain some different story.

- Page 21: you assume that agricultural and non-agricultural goods to be substitutes, which seems odd. In particular, you write "...the expenditure share of non-agriculture rises while also having *lower* prices" in the footnote. This is not quite correct as you may

2

see from Figure 10 of Herrendorf et al. (2013). (Of course it depends on whether you assume value added or gross consumption approach, but I think your model maps into the value added approach better as there is no intermediate inputs.) Most papers in the structural transformation literature assume agricultural and non-agricultural goods to be *complements*, if not *Leontief*, rather than *substitutes*. See, for example, Gollin et al. (2002), Gollin et al. (2007), Herrendorf et al. (2013), Yang and Zhu (2013), among others. Assuming $\varepsilon < \gamma$ does not affect your main results, but some predictions of the model may go in the wrong direction, such as Proposition 1(b). I think one solution would be to use the Stone-Geary preferences instead, such as the one in Kongsamut et al. (2001), Restuccia et al. (2008), or Herrendorf et al. (2014). Let me make it clear that I do no mean that this Stone-Geary preferences setup is better than that of Boppart (2014). Rather, the Stone-Geary setup is more commonly used in the literature and hence it provides a better comparison that readers are more familiar with. In this case, you assume the elasticity is unity (Cobb-Douglas) to be simplicity. I understand that the Stone-Geary setup may not have a close-form solution, but the numerical solution should be very simple and some numerical experiments like Gollin et al. (2007) can be helpful for readers to see the impact of β.

- Page 21: Why do you assume an exogenous factor income shares? You implicitly create a wedge in the first order condition, whose role is not transparent.

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