Measuring Interactions among Agricultural Productivity, Trade Openness, Agricultural GDP, and Income in Korea (1972- 2007)

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Agriculture in South Korea has developed in line with the progress of the national economy. While agriculture used to be the backbone of the country's economy, it has become a smaller component of national income. Even with the decline, the agricultural sector is still crucial for the country's rural economy as 7 percent of the economically active population lives in rural areas, where agriculture provides most employment opportunity (Statistics Korea 2010). Given the importance of the agricultural sector, the South Korean government has expanded the public funds allocated to the agricultural sector to sustain agricultural growth. The support for the agricultural sector has increased further since the country opened its agricultural market through the Uruguay Round of General Agreement on Tariffs and Trade of multilateral negotiations (the "Uruguay Round") that was completed in 1997. The change of South Korean agricultural structure seems inevitable as liberalizing agricultural trade continues and its corresponding agricultural policies have been restructured. This paper applies the directed graph and times series model to measure interactions among agricultural productivity, trade openness, agricultural GDP, and income in South Korea during the period of 1972– 2007.

TFP (Total-factor productivity): A variable which accounts for effects in total output not caused by inputs

(1) $TFP = \frac{Y}{Z}$, where Y is total product and Z is total input

(2) $\frac{dTFP}{dt} = [\ln Y(t) - \ln Y(t-1)] - [\ln Z(t) - \ln Z(t-1)]$

where $\ln Y(t) - \ln Y(t-1) = \sum_{i=1}^{9} \bar{\theta}_i [\ln y_i(t) - \ln y_i(t-1)]$

where $y_i(t)$ is total product of i^{th} category of agriculture (i=1,..9)* during time t and $\bar{\theta}_i$ is weight of i^{th} category of agriculture between t and t-1

where $\ln Z(t) - \ln Z(t-1) = \sum_{j=1}^{4} \bar{s}_j [\ln z_j(t) - \ln z_j(t-1)]$

where $z_j(t)$ is total input of j^{th} category (j=1,..4)** during time t and $\bar{s}_j$ is weight of j^{th} category between t and t-1

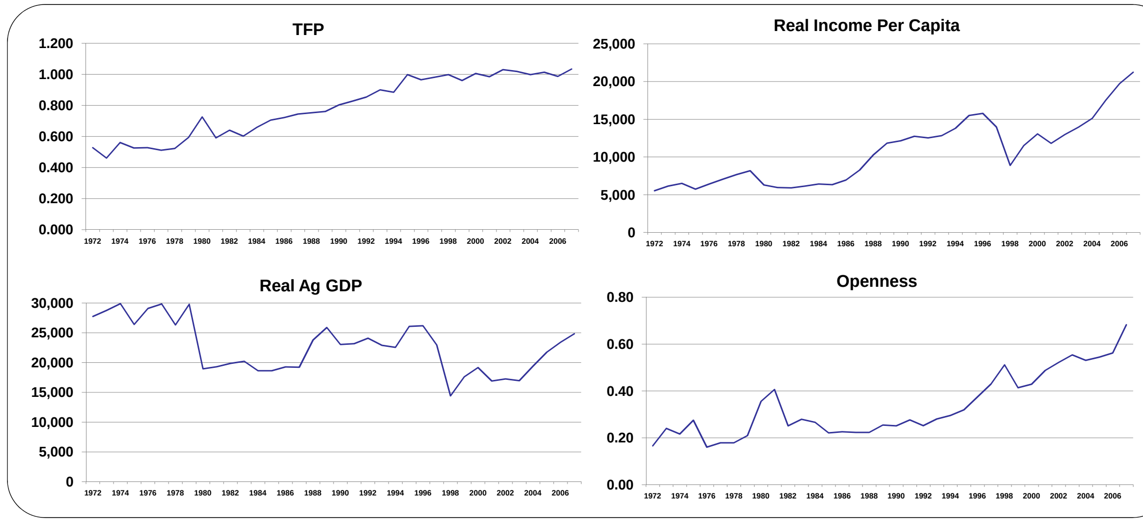
Real Ag GDP ($1,000,000): Real Ag GDP adjusted by exchange rate

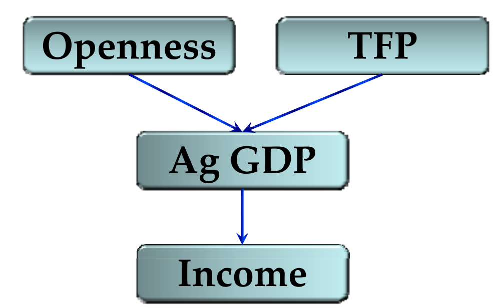
Real Income Per Capita ($1,000,000): Real income divided by population

Openness: (Ag including livestock exports + Ag including livestock imports) / Nominal Ag GDP

* The 9 agricultural categories consist of rice, barley, grains, legumes, potatoes, fruits, vegetables, livestock, and others including specialty crops such as cottons and sesame, tobaccos and ginsengs, and silkworms.

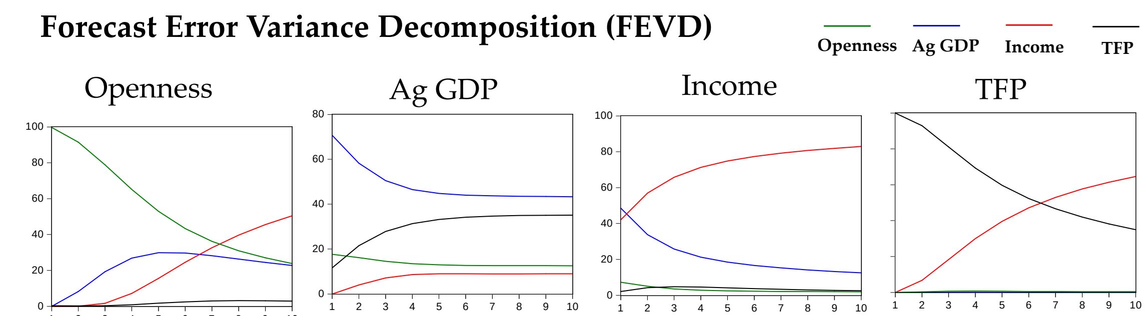
** The 4 inputs consist of labor, capital, fertilizer, and land.





The **directed graph** is generated based on the correlation matrix of the residuals from the vector autoregression (VAR) equations of those four variables. The graph suggests that, in the contemporaneous period, agricultural productivity and trade openness are exogenous. Shocks in agricultural productivity and trade openness affect agricultural GDP and the impacts pass through to the national income per capita.

Forecast Error Variance Decomposition (FEVD)



The variance in agricultural GDP is explained by the shocks in itself and agricultural TFP initially, however, in the long run, the impact of productivity significantly increases while national income also contributes to the agricultural GDP. For national income, although the forecast error variance is primarily explained by itself and agricultural GDP in the early stage, the impact of agricultural GDP quickly declines in the outer period. The variances in trade openness and agricultural productivity are primarily affected by national income in the long run.

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