Final Project Report

CEE-598-Globalization of Water

Causal Impact of Trade Openness on Agricultural Variables

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Introduction

Global Trade has become an important element of human sustenance and greatly impacts both social and economic sectors. It has a noticeable impact on both Manufacturing and Agricultural sector. In *Dang et al.,* we saw the causal impact of globalization of trade on the nutrient use of nations through Trade Openness. The driving force behind studying the casual impact Trade Openness on agricultural variables comes from the work of *Dang et al*. The agricultural variables of interest are namely, Area harvested, Production and Yield. To develop a relationship between Trade Openness and Agricultural variables, linear regression was used. But, as we saw in the *Dang et al.,* OLS approach is not effective to study the relationship between quantities of interest because of endogeneity bias. To bypass this bias, I used 2SLS Instrument Variable approach Similar to this work, I performed Panel Data Analysis for a period from 2002-2014 (Number of Observations=2411) which provides better check for unobserved heterogeneity with country and time fixed effects. In the next section, I will be talking specifically about the methodology used, which will be followed by results and conclusion.

Methodology

This section will be divided into two sections. The first section will address the Data used and its sources, and the section will be based on the methods used to exploit that data in a panel analysis to obtain the desired relationship between quantities of interest.

Data

Agricultural Variables

Agricultural variables which we are considering are Area Harvested, Production and Yield. To extract data for 193 nations over all the crops the grown by nations world-wide, I used the FAOSTAT *(FAOSTAT, 2018)* database. Area Harvested is given in Hectares (ha), Production in tonnes and Yield in Hectograms/Hectare (hg/ha).

Trade Openness

Trade Openness is defined as summation of a country's total export and import over its GDP. It is expressed mathematically for a nation as $T = (E + I)/GDP$, where T is Trade Openness, E is export, I is import and GDP is Gross Domestic Product. To obtain the data for all these variables, I used World Bank Data portal *(World Bank, 2015).* All these values are in dollars ($)

Bilateral Trade

Annual Bilateral trade data was obtained from International Monetary Fund (IMF), Direction of Trade Statistics (DOTS) *(International Monetary Fund, Direction of Trade Statistics (DOTS), 2015).* The Bilateral trade values are in Dollars ($).

Geography

A lot of cross-sectional variables were used in the trade openness estimation, which includes, national land area, distance between a pair of nations, landlocked dummy variable and border

dummy variable. Data for these variables were extracted from GeoDist database *(Mayer and Zignago, 2011)*. Precipitation, Temperature and Latitude Data was obtained from World Bank Data portal *(World Bank, 2015).* Population data was taken from United Nations Population Division *(United Nations Population Division, 2015)* which is in thousands. The capital stock data is at current PPPs (in mil. 2011 US$) from *Feenstra et al. (2015).*

Trade Agreements

World Trade Organisation (WTO) accessions were provided by WTO *accessions* (2018) and Regional Trade Agreements (RTA) were made available from the *Regional Trade Agreements Information System (RTA-IS) (2018).* From these agreements, dummy variables were created to imply for a specific year if a nation is in regional agreement with the other and if a nation is a member of WTO.

IV method

The avoid endogeneity bias, Instrumental Variable approach has been used in a 2-Stage Least Square method. The variables we have are divided into sections, namely, Dependent, Independent and Control Variables. Dependent variables are the agricultural variables, Independent variable is the Trade Openness and control variables are log of area per person ($log(A_{ct}/P_{ct})$), log of capital stock per person ($log(ck_{ct}/P_{ct})$, log of population ($log(P_{ct})$), Precipitation and temperature, where c stands for a nation and t stands for a specific year. Also, the instrument variable is the constructed trade openness. The rationale behind having an Instrument variable is that the dependent can only impact the independent (explanatory) variable through the Instrument variable which results in removal of endogeneity bias.

In first stage (Equation 1), We estimate the trade openness through constructed trade openness, fixed country and time affects, and Control variables. In second stage (Equation 2), we take the estimated trade openness from equation 1 and put it in the equation to obtain the relationship between agricultural variables and Trade openness. Important thing to note here is that control variables remain the same in both the equations.

$$T_{ct} = b_0 + b_1 \hat{T}_t + \boldsymbol{b_2^T X_{ct}} + \alpha_c + \alpha_t + u_{ct} \quad (1)$$

$$Log(A_{ct}) = c_0 + c_1 \tilde{T}_{ct} + \boldsymbol{c_2^T X_{ct}} + \alpha_c + \alpha_t + v_{ct} \quad (2)$$

The relationship for estimated bilateral trade is given below

$$\tau_{ij} \equiv log \frac{tij}{GDPi} \quad (3)$$

$$= a_0 + a_1 log(D_{ij}) + a_2 log(P_{it}) + a_3 log(P_{jt}) + a_4 B_{ij} + a_5 B_{ij}\, log(D_{ij})$$

$$+ a_6 B_{ij}\, log(P_{it}) + a_7 B_{ij}\, log(P_{jt}) + a_8 log(D_{ij}) log(P_{it}) + a_9 log(D_{ij}) log(P_{jt})$$

$$+ a_{10} wto_{it} + a_{11} wtojt + a_{12} rta_{ijt} + \alpha i + \alpha j + \alpha t + e_{ij}$$

Constructed trade openness is estimated from this relation by the summation of estimated bilateral trade.

$$\hat{T}ij = \sum_{j \neq i} exp(\hat{\tau}ijt) \quad (4)$$

Results

Table 1 shows the casual impact of Trade openness on Agricultural variables (Area Harvested, Production and Yield). As seen from the results, Trade openness is negatively related in for all the agricultural variables and is statistically significant except for yield (p=0.2559). This is line with both the intuitional expectation and the results from *Dang et al.,* where also, the nutrient use was negatively related with trade openness. This means, increase in Trade openness results in decrease of agricultural variables.

Discussion and Conclusion

The causal impact of trade openness on agricultural variables is negative as per the results. But still another case that wasn't covered in this work in the concept of comparative advantage, which could have an impact on these relations, as can be seen from Dang et al., as well. In conclusion, I would like to say that this is a preliminary work which requires further extension to provide a better ground for establishing the casual relationship between Trade openness and Agricultural variables.

Table 1

Independent Variable	Dependent Variable	Coefficient	Std. error	P-Value
Trade Openness	Area Harvested	-0.2942	0.1280	0.0216
Trade Openness	Production	-0.2815	0.1319	0.0329
Trade Openness	Yield	-0.1467	0.1291	0.2559

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