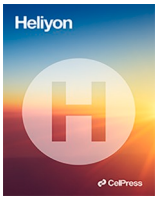
Heliyon 10 (2024) e24635

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



Research article

Impact of global trade agreements on agricultural producer prices in Asian countries

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ARTICLE INFO

Keywords:
Free trade
Producer prices
Economic
Social
Infrastructure

ABSTRACT

Following global trade agreements, Asian countries have been highly aggressive in implementing free trade. These conditions will impact all sectors, including agriculture. This study aims to examine the impact of the General Agreement on Tariffs and Trade (GATT), World Trade Organization membership (WTO), and the Doha Round implementations on agricultural producer prices in Asian countries (PPI). The study was conducted using secondary data from 1991 to 2020. The data for 28 Asian countries were analyzed using the first difference General Method of Moments (GMM). The results show that implementing the GATT raises the PPI, but implementing the WTO has the reverse impact. PPI is unaffected by the Doha Round. Inflation, exchange rate, value-added, human capital, and land area equipped for irrigation are all positive contributors to PPI. Several recommendations are made to increase PPI in Asian countries: increasing commitment to agricultural fair trade, increasing agricultural value-added, improving educational opportunities for agricultural business players, and prioritizing agricultural infrastructure investment.

1. Introduction

The global economy is now more open compared to four decades ago, allowing for the easy movement of goods and services. In several developed countries, economic globalization (EG) increased by 77% in East Asia, 55% in Europe and Central Asia, and only 41% in North America. Developing countries also aim to strengthen their position in the global economy. Latin America and the Caribbean showed a 56% growth in EG, followed by the Middle East and South Asia with 50% and 60% increases, respectively, and Sub-Saharan Africa with 52% [1]. This situation remains controversial because of economic globalization's harmful impact. Meanwhile, many countries have traditionally used trading support policies such as income support for producers, price stabilization, public preventive care, and strategic control [2]. Therefore, the World Trade Organization (WTO) was created to ensure that trade flows as smoothly, predictably, and freely as possible.

The WTO was founded in 1995 as the General Agreement on Tariffs and Trade (GATT) successor. GATT and the WTO have contributed to developing a strong and profitable trading system through trade negotiations or rounds. The early discussions focused

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https://doi.org/10.1016/j.heliyon.2024.e24635
Received 14 November 2022; Received in revised form 27 December 2023; Accepted 11 January 2024
Available online 14 January 2024

mostly on tariff reductions, while the following rounds included anti-dumping and non-tariff measures [3]. Despite having a perfect concept, breaches of several WTO agreements continue to occur regularly [4]. The major international economies boosted protectionist policies dramatically [5]. Many countries use tariffs to stabilize prices and reduce welfare losses [6]. They also use the quantity-based safeguard to reduce imports and increase domestic output [7].

Despite increasing violations of WTO agreements, Asia remains aggressive in implementing free trade policies [8]. Asian position is critical since the global economic recovery has shifted from Europe and North America to Asia [9]. In 2017, Asia accounted for 38% of world exports and 31% of global imports [10]. International trade also helped the fast industrialization of Asian countries with a significant comparative advantage in manufacturing [11].

One of the sectors that have become a popular topic regarding economic openness and are expected to be able to eliminate poverty is agriculture. Many agreements and policies have been launched to encourage agriculture to adopt an open economy/, such as the elimination of domestic production support mechanisms, direct government involvement, and barriers in agricultural decision-making [4,12], labor market reform [13], land reform and farm reorganization [14], and the establishment of market and collective-action institutions [15].

As a result, agricultural product exports have increased more than fivefold in the previous three decades [16], global food investment increased by 10% between 2013 and 2018 [17], and domestic agriculture supplies increased [18]. WTO accession also reduces the prevalence of rural nonfarm poverty, mainly owing to wage increases for unskilled labors in rural nonfarm businesses [19]. This certainly contradicts what other studies state EG has failed to alleviate poverty in Asia. For example, India has 78.7 million rural people living in extreme poverty, Yemen has 21 million, Afghanistan has 16 million, and Pakistan has 10 million [20]. This difference is what makes it interesting and is also the research gap (Fig. 1). Moreover, making agriculture more open needs a big effort. Agriculture is still the most difficult sector to negotiate in international trade agreements and frequently encounters market distortions [21]. On the other hand, many countries also view agriculture as a critical sector that needs protection because it provides food [22,23], income and foreign exchange earnings [22], employment [24], and rural net cash income [25].

Based on the explanation, an important question will arise: what is the impact of global trade agreements (GATT, WTO implementation, and Doha Round) on agricultural producer prices in Asian countries? This study aims to determine the impact of GATT, WTO, and the Doha Round implementations on agricultural producer prices in Asian countries.

This study contributes to the existing literature in two different ways. First, this study is unique in that earlier studies attempted to investigate the influence of WTO access or economic openness on agricultural production [26], quality [27], food security [28], employment [26], value-added [29], diversification and supply chain [30], trade [31], FDI [27], and technology [27] but nothing has to do with agricultural producer prices. We also include other domestic economic factors as determinants of agricultural producer prices. Second, we back up our findings using a better research methodology that employs the first difference generalized method of moments (GMM). This method helps us to overcome the possibility of sampling bias, autocorrelation, heteroscedasticity, and endogeneity [32,33] (Fig. 1).

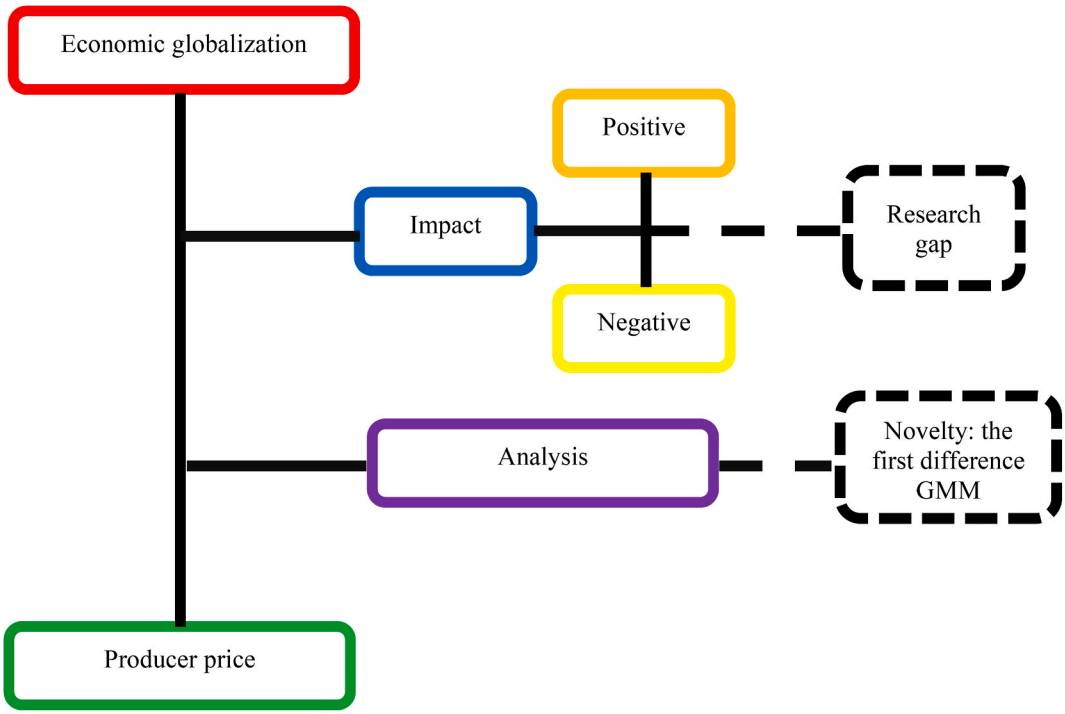

Fig. 1. Roadmap of the research.

In the next section, we will discuss the theory underlying this study, literature review and hypothesis formulation (Section 2). Section 3 will present the data collection and data analysis process. Next are the results (Section 4) and discussion (Section 5) of this study. The final section explains the conclusions, recommendations, and limitations of this study.

2. Theory, literature review, and hypothesis

2.1. Tariff theory

The comparative advantage theory shows that countries will benefit from trade. A country is better off focusing on the area with the highest efficiency advantage. This theory is founded on the assumption that there are no tariffs (free trade) [34]. Free trade will benefit every individual (or resident of a country) without harming another individual (or resident of another country). The trick is for each country to maximize welfare (in the Paretian sense) from its endowment of production factors and techniques [35].

On the other hand, the mercantile theory also encourages a country to control trade by imposing different trade restrictions, such as tariffs [36]. Tariffs have remained a feature of the political and economic landscape despite the proliferation of trade agreements. Meanwhile, quotas and non-tariff barriers that raise domestic prices are becoming more popular than ever [37].

Mankiw [38] investigated the theoretical implications of imposing a tariff. The three primary impacts on the domestic economy are thus: (1) making consumers worse off; (2) making producers better off; and (3) increasing government income (Fig. 2). The imposition of import tariffs (t) will raise the price of imported products ($P_w = P_{d1}$), followed by an increase in the price of domestic products ($P_{d2} = P_w$). Furthermore, customers will be forced to reduce the number of products they purchase (Q_4 to Q_3) and reduce their surplus (consumer loss). Finally, domestic price increases will encourage producers to create more products (Q_1 to Q_2) and increase the producer surplus. Another critical point is government income due to pricing and product differences during tariff implementation. However, applying tariffs causes inefficient market and resource allocation (deadweight loss).

The imposition of tariffs also causes an increase in the prices of factors that are used intensively in producing goods. The price increase causes income redistribution from factory owners who have imported products to those who make substitute products. This condition also leads the owners of the factors used by the export industry to lose real income. If the effects of tariffs are redistributed, the total impact might be an increase in welfare for export producers, given that foreign demand for exports is not perfectly elastic [35].

The opposite happens when the tariff is removed (free trade) so that the domestic price becomes the same as the world price ($P_{d1} = P_w$). At the same time, producers will reduce output (Q_2 to Q_1) and consumers can buy more products (Q_3 to Q_4). That way, the production surplus will fall while the consumer surplus will rise [38]. Free trade has also increased world welfare, albeit in a very modest percentage compared to the tariff imposition period [39].

Krugman and Obstfeld [36] suggested that tariffs be applied carefully because they could harm many countries. Therefore, many economists suggest that each country calculate its effective rate of protection. This measures the total effect of the entire tariff system on the value added per unit of output in each industry when both intermediate and final goods are imported. Tokarick [40] has projected the consequences of the tariffs. If the tariff rate exceeds twice the optimal level, the home country will be more disadvantaged. In contrast, foreign countries will be more disadvantaged if the domestic tariff is less than twice the optimal level.

2.2. Literature review and hypothesis

The Havana Charter suggested the establishment of the International Trade Organization to facilitate international trade based on nations' comparative advantages. Finally, it was decided to form the General Agreement on Tariffs and Trade (GATT) to uphold liberal policy ideals. From April 1947 through December 1993, the GATT had eight rounds, each having important achievements and outcomes [41]. The ratification of the Uruguay round in April 1994 marked the end of GATT-sponsored multilateral trade negotiations. The World Trade Organization (WTO) took over the role of the GATT in January 1995 [42]. The WTO brings credibility, transparency,

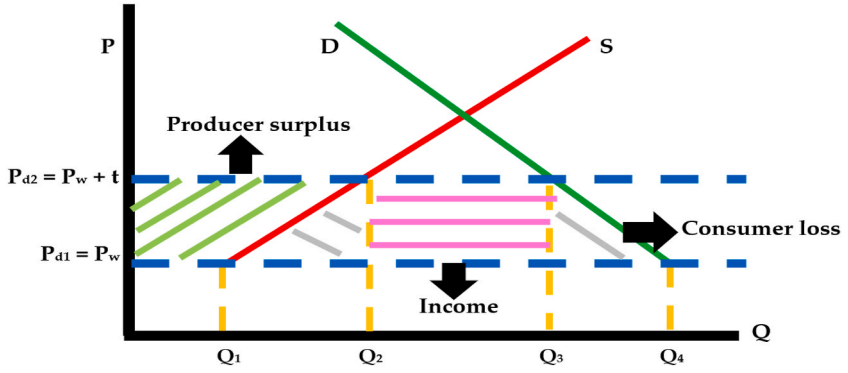

Fig. 2. Impact of import tariffs. *Source:* created by author based on [36].

and predictability to agriculture, which is critical to the effective running of supply chains [43].

One of the important agreements formed during the Uruguay Round and became one of the important footholds for the WTO is the Agreement on Agriculture (AoA). The AoA's long-term objective is to develop a fair and market-oriented agricultural trading system, launch a reform process through the negotiation of support and protection pledges, and create improved and more operationally effective rules and regulations [44]. Most of the countries who signed that agreement have now implemented these rules and have begun to reduce protectionism gradually [45]. However, the AoA harms the economy of developing countries, for example, an increase in income inequality [46]. Moreover, fluctuations in global agricultural exports increased with the implementation of the AoA [12]. This prompted another international agreement: the Doha Round, which consisted of several stages (Table 1).

The three major areas of negotiations for the Doha Round of trade talks are, first, expanding service industries across borders; second, reducing agricultural supports (subsidies and protections); and third, lowering industrial tariffs [48]. WTO members with agricultural import sensitivities would prefer that any formulae used to decrease tariffs be less severe in their structure and adjusted with more extensive flexibilities. Eliminating various import tariffs will affect producer prices because of its ability to produce quality and efficient products. It will also influence the drop in production factor and domestic prices in most developing and developed countries [6,18]. The commitment to eliminate agricultural export subsidies comes next. It includes not just outright subsidies, but also programs like export credits, state trading businesses, and food aid that can have the same effect [47].

Based on the tariff theory and previous studies, we formulate the following hypotheses:

Hypothesis 1. GATT, WTO, and Doha Round implementations will decrease Asian countries' agricultural producer prices.

Domestic factors also influence producer prices. The first is the economic condition of a country, which includes inflation, income per capita, credit, deposit interest rates, exchange rates, and agricultural value added. Inflation increases production costs and prices, and deteriorates product competitiveness [49]. Inflation was associated with excessive monetary growth, namely the money supply grows faster than the rate of growth in real output. However, non-monetary experts link inflation to a consequence of rising costs and prices to maintain high levels of production and employment [50]. In the agricultural sector, inflation will increase the price of factor production, such as fertilizer, pesticide, and seed [51]. As a result, the producer price will increase. Belton and Nair-Reichert [52] also stated that growing food inflation has resulted in higher consumer and producer prices. Furthermore, a country's economic progress will influence its agricultural circumstances [53]. For example, a country moving toward industrialization will gradually increase per capita income. Hence, consumers are willing to buy agricultural products even though the prices are higher than previously [54].

Some empirical investigations have examined the positive impact of domestic credit on increased agricultural output and farmers' welfare [55]. Unfortunately, small farmers use credit from informal channels for their farming activities and this makes them have to sell the product at a low price [56,57]. Meanwhile, high deposit interest rates will cause the real sector to move slowly. This is because people will be more interested in putting their money in the bank than in running a business or investing it. As a result, there will be less domestic output, more imported products, and lower producer prices [58].

Exchange rates are the next economic factor that substantially impacts producer prices. A strengthening exchange rate will increase producer prices [59]. The product value added is the last economic factor that affects the producer price. Quality, which can be represented in the product value-added, significantly increases producer prices in the agricultural sector [60].

Based on the literature review regarding the economic conditions, we formulate the following hypothesis:

Table 1
Key events in the Doha Round.

Date	Event
14 November 2001	The round was launched by the Doha Ministerial Declaration.
1 February 2002	The Trade Negotiations Committee (TNC) agrees on how to organize the negotiations; chairs for the negotiating groups are chosen two weeks later.
31 March 2003	Members miss deadlines in the agricultural and services talks.
13 August 2003	The European Community and the United States released a joint agricultural text that was soon criticized sharply by other agricultural exporters.
August 2003	The G20 forms in opposition to the joint EC–US agricultural proposal.
10–14 September 2003	The Fourth Ministerial Conference in Cancún failed, with agriculture and Singapore issues being the most controversial topics.
2 August 2004	The "July Package" creates a partial framework for the conclusion of the round.
1 January 2005	The original deadline for completing the round is missed.
13–18 December 2005	The Sixth Ministerial Conference in Hong Kong produced an agreement to eliminate agricultural export subsidies, but other agricultural issues are stalled.
30 April 2006	Negotiators miss the NAMA and agriculture deadlines set in Hong Kong.
24 July 2006	Director-General Pascal Lamy suspends the negotiations after a G6 fails to break an impasse on agriculture.
31 January 2007	Mr Lamy calls for a full resumption of negotiations at a meeting of the TNC.
12 April 2007	G4 talks begin in Delhi focusing on concrete priorities and sensitivities.
21 June 2007	The G4 process breaks down at a meeting in Potsdam.
8 February 2008	The chairs of the NAMA and agriculture negotiating groups issue revised drafts.
21–29 July 2008	A mini-ministerial in Geneva comes close to solving the round but fails when the Indian and US ministers disagree on an agricultural safeguard and other issues.
6 December 2008	The chairs of the negotiating groups' issue revised drafts.
21 April 2011	The chairs of the negotiating groups' issue status reports.

Source: [47].

Hypothesis 2. Inflation will increase Asian countries' agricultural producer prices.

Hypothesis 3. GDP per capita will increase Asian countries' agricultural producer prices.

Hypothesis 4. Domestic credit to the private sector will increase Asian countries' agricultural producer prices.

Hypothesis 5. Deposit interest rate will decrease Asian countries' agricultural producer prices.

Hypothesis 6. The exchange rate will increase Asian countries' agricultural producer prices.

Hypothesis 7. The product value added will increase Asian countries' agricultural producer prices.

Aside from economic issues, the social condition impacts agricultural producer prices. Increasing employment will increase the average labor costs of agricultural production. Therefore, rising wages of agricultural labor will affect a decrease in producer prices [61]. Meanwhile, increased human capital encourages agricultural business players to think rationally, which raises producer prices [62], creates products as efficiently as possible [63], and responds to consumer demand [64]. Producers can also easily understand and apply the new technology to the agricultural industry [65]. Finally, infrastructure condition plays a vital role in agricultural growth. Farmers with access to irrigation, transportation, and information can obtain better price conditions through informal and official channels [57].

Based on the literature review regarding the social and infrastructure conditions, we formulate the following hypothesis:

Hypothesis 8. The number of employments in agriculture, forestry and fishing will decrease Asian countries' agricultural producer prices.

Hypothesis 9. Human capital will increase Asian countries' agricultural producer prices.

Hypothesis 10. Land areas equipped for irrigation will increase Asian countries' agricultural producer prices.

3. Materials and methods

3.1. Data collection

This study begins by collecting data on the agricultural producer prices of Asian countries during the GATT, WTO, and Doha Round implementations. We also include several variables in this study that indicate the internal economic, social, and infrastructure conditions in a country. Following that, we collect data on Asian countries from 1991 to 2020 will be conducted. We chose agriculture in Asia as the object of this study because agricultural commodities are the major sources of exports for Asian countries [66], Asian agricultural contribution to GDP has more than doubled because of global trade [67], and Asia contributes to around one-third of all agricultural and food production and consumption worldwide [68].

This study includes 28 countries that are sampled because they are Asian agricultural producers [69]. Afghanistan, Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, India, Indonesia, Iran, Iraq, Japan, Jordan, Lao PDR, Lebanon, Malaysia, Myanmar, Nepal, Pakistan, the Philippines, Qatar, the Republic of Korea, Saudi Arabia, Singapore, Sri Lanka, Syrian Arab Republic, Thailand, Vietnam, and Yemen are among them. The study's variables and data sources are shown in Table 2. All data sources are available to the public and can be accessed for free by all researchers.

Table 2
Variables and data sources of the research.

Variable	Symbol	Data source	Ex. Sign
Asian countries' agricultural producer prices.	PPI	FAO (https://www.fao.org/faostat/en/#data)	
Inflation, GDP deflator (annual %)	INF	World Bank (https://datatopics.worldbank.org/world-development-indicators/)	+
GDP per capita (current US$)	GDP	IMF (https://www.imf.org/en/Data)	+
Domestic credit to the private sector (% of GDP)	CRED	World Bank (https://datatopics.worldbank.org/world-development-indicators/)	+
Deposit interest rate (%)	DEP	Trading Economics (https://tradingeconomics.com/)	–
Official exchange rate (LCU per US$)	EXR	Federal Reserve Economic Data (https://fred.stlouisfed.org/)	+
Value-added deflator (Agriculture, forestry and fishery) US $	VAD	FAO (https://www.fao.org/faostat/en/#data)	+
Employment in agriculture, forestry and fishing (000 persons)	EMP	ILO (https://www.ilo.org/global/statistics-and-databases/lang–en/index.htm)	–
Human capital index	HCI	Penn World Table (https://www.rug.nl/ggdc/productivity/pwt/?lang=en)	+
Land area equipped for irrigation (1000 ha)	IRRI	FAO (https://www.fao.org/faostat/en/#data)	+
Dummy GATT	D_{GATT}	WTO (https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm)	–
Dummy WTO	D_{WTO}	WTO (https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm)	–
Dummy Doha Round Development Agenda	D_{DDA}	WTO (https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm)	–

Source: prepared by authors

3.2. Data analysis

We used cross-sectional and time-series data to evaluate the relationship between PPI (the dependent variable) and the explanatory variables. Therefore, Equation (1) below is:

$$PPI = f(INF, GDP, CRED, DEP, EXR, VAD, EMP, HCI, IRRI, D_{GATT}, D_{WTO}, D_{DDA}) \tag{1}$$

The empirical analysis begins with unit root testing before the estimation. One type of test is used to evaluate the stationarity of the variables, including Augmented Dicky-Fuller [70]. The null hypothesis is that all the panels contain a unit root

$$\Delta Y_{it} = \alpha Y_{it-1} + \sum \beta_{it} \Delta Y_{it} - j + X_{it}\delta + v_{it} \tag{2}$$

where Y_{it} is the pooled variable, X_{it} is an exogenous variable, v_{it} is the error term.

Following that, we performed dynamic panel data analysis to avoid serial correlation and heteroscedasticity issues that lead to biased and inconsistent estimates, commonly known as endogeneity problems [71]. There are two types of dynamic panel data: the first difference Generalized Method of Moments (GMM) and system GMM (sys-GMM), but we will utilize the first difference GMM [72,73].

Equation (1) can be re-written as a dynamic model:

$$\begin{aligned} PPI_{it} = {} & \beta_0 + \beta_1 PPI_{it-1} + \beta_2\, INF_{it} + \beta_3 GDP_{it} + \beta_4 CRED_{it} + \beta_5 DEP_{it} + \beta_6 EXR_{it} \\ & + \beta_7 VAD_{it} + \beta_8 EMP_{it} + \beta_9 HCI_{it} + \beta_{10} IRRI_{it} + D_{GATT} + D_{WTO} + D_{DDA} \end{aligned} \tag{3}$$

where: α_t is PPI time-specific fixed effect, η_i is the country-specific effect, and v_{it} is the error term.

The coefficient on the lagged dependent variable, β_1, is likely to be biased upward since it is positively correlated with η_i. Arellano and Bond [72] suggest that GMM estimator first-differences eliminate the country-specific effect and use all possible lagged levels as instruments. The first difference GMM estimators will be used in this study and may be defined as follows using a system of equations [73,74]:

$$\begin{aligned} & PPI_{it} = \beta_0 + \beta_1 PPI_{it-1} + \beta_2\, INF_{it} + \beta_3 GDP_{it} + \beta_4 CRED_{it} + \beta_5 DEP_{it} + \beta_6 EXR_{it} \\ & + \beta_7 VAD_{it} + \beta_8 EMP_{it} + \beta_9 HCI_{it} + \beta_{10} IRRI_{it} + D_{GATT} + D_{WTO} + D_{DDA} + \alpha_t + U_{it} \end{aligned} \tag{4}$$

where U_{it} is the random term and $U_{it} = \eta_i + v_{it}$.

$$\begin{aligned} \Delta PPI_{it} = {} & \beta_0 + \beta_1 \Delta PPI_{it-1} + \beta_2 \Delta INF_{it} + \beta_3 \Delta GDP_{it} + \beta_4 \Delta CRED_{it} + \beta_5 \Delta DEP_{it} + \beta_6 \Delta EXR_{it} \\ & + \beta_7 \Delta VAD_{it} + \beta_8 \Delta EMP_{it} + \beta_9 \Delta HCI_{it} + \beta_{10} \Delta IRRI_{it} + D_{GATT} + D_{WTO} + D_{DDA} + \Delta U_{it} \end{aligned} \tag{5}$$

The estimate of the equations system in (5) and (6), using two sets of instruments $Z_i = Z_D + Z_L$ is known as the first difference GMM estimation. Z_D is an instrument for the model in the first difference and Z_L is an instrument for the model at a level.

The test uses the Arellano-Bond for autocorrelation, with a null hypothesis of no autocorrelation [71], and Hansen and Sargan created a test statistic with the null hypothesis that all instruments are exogenous or valid as a group [75]. Thus, a higher test statistical probability value favors the null hypothesis. If the Sargan or AR(2) tests are violated, the first difference GMM estimations are likely unreliable.

In this study, we will employ 4 models of the first difference GMM. The first is the autarky model, which occurs when countries do not trade with one another. In this case, we will not use dummy variables. The second model is one in which Asian countries solely engage in the GATT implementation (D_{GATT}) and no other accords. Asian countries are expected to solely observe WTO implementation (D_{WTO}) under the third model. Finally, each country is expected to participate exclusively in the Doha Round Development Agenda (D_{DDA}) in the fourth model.

Table 3
Descriptive analysis.

Variable	Mean	Std. Deviation	Min.	Max.
PPI	66.13	37.02	0.02	332.37
INF	9.26	21.61	−30.20	396.44
GDP	8500.36	14349.66	22.80	85075.99
CRED	52.40	46.88	1.27	217.76
DEP	7.96	6.14	−18.23	38.00
EXR	1937.87	4985.83	0.01	42000
VAD	76.63	29.73	11.29	253.69
EMP	25289.60	68202.23	1.05	392615.04
HCI	2.08	0.77	0.30	4.35
IRRI	6919.80	16021.15	1.00	74542
GATT	0.15	0.35	0	1
WTO	0.13	0.33	0	1
DDA	0.46	0.50	0	1

Source: Author's computation using R (2022).

4. Results

The summary of statistics for the data used in our estimation is presented in Table 3. Each variable in this study has a different mean and standard deviation. The average PPI for all Asian countries between 1991 and 2020 is 66.13, which is still far below the optimal value (100). This demonstrates that farmers in several Asian countries are still not receiving the best prices for their products. In this study, the country with the highest PPI was Iran (332.37) while the lowest was Iraq (Fig. 3). The variable with the highest mean and standard deviation is EMP. The dummy variables have the lowest mean and standard deviation because the variation in value is only between 0 and 1, The correlation matrix among variables was illustrated in Table 4. The correlation among the explanatory variables was generally moderate. And no occurrences of multicollinearity. The lesser correlation coefficient value of 0.8 demonstrates this. Other correlation analyses demonstrate no multicollinearity in this study because the Variance Inflation Factor and Tolerance (VIF) values are less than 10 (Table 5).

We used the ADF unit root test to determine the data's stationarity. Table 6 shows that not all of the dependent and explanatory variables are stationary at the level. PPI, INF, GDP, CRED, DEP, EXR, VAD, EMP, and HCI are integrated at the level using the panel data unit root tests method. The remaining variable is incorporated into the first difference: IRRI. The non-stationary variable was transformed into a stationary series before being employed in the first difference GMM analysis since non-stationarity can lead to spurious regression. Hence, the IRRI variable was transformed into stationary variables initially.

Before performing the first difference GMM analysis, we must ensure that the estimated parameters are unbiased and consistent. The way is to meet two conditions in terms of the Sargan and Arellano–Bond tests. The Sargan test of overidentifying restriction revealed that the instruments in our model are relevant and valid. At the same time, the Arellano–Bond test results for AR(2) indicate that null hypothesis is accepted cause the p-value more than 0.05. Overall, the specification tests indicate that the first difference GMM estimates are reliable. Thus, we can conduct the first difference GMM analysis.

Table 7 shows the results of the first difference GMM analysis of four models from this study. The first model is an autarky regime, the second is GATT implementation, the third is WTO agreement implementation, and the last model is DDA implementation. Even though the explanatory variables have different values in each model, they all exhibit the same sign of significance and influence on the PPI.

The lagPPI has a significant positive impact on the PPI. This suggests that the previous year's increase in producer prices will increase Asian countries' agricultural producer prices this year. Like the lagPPI, the INF variable positively and significantly influences Asian countries' agricultural producer prices. This condition shows that our second hypothesis is likewise proven.

The next explanatory variable, GDP, has no significant effect on the dependent variable. This means that our third hypothesis is

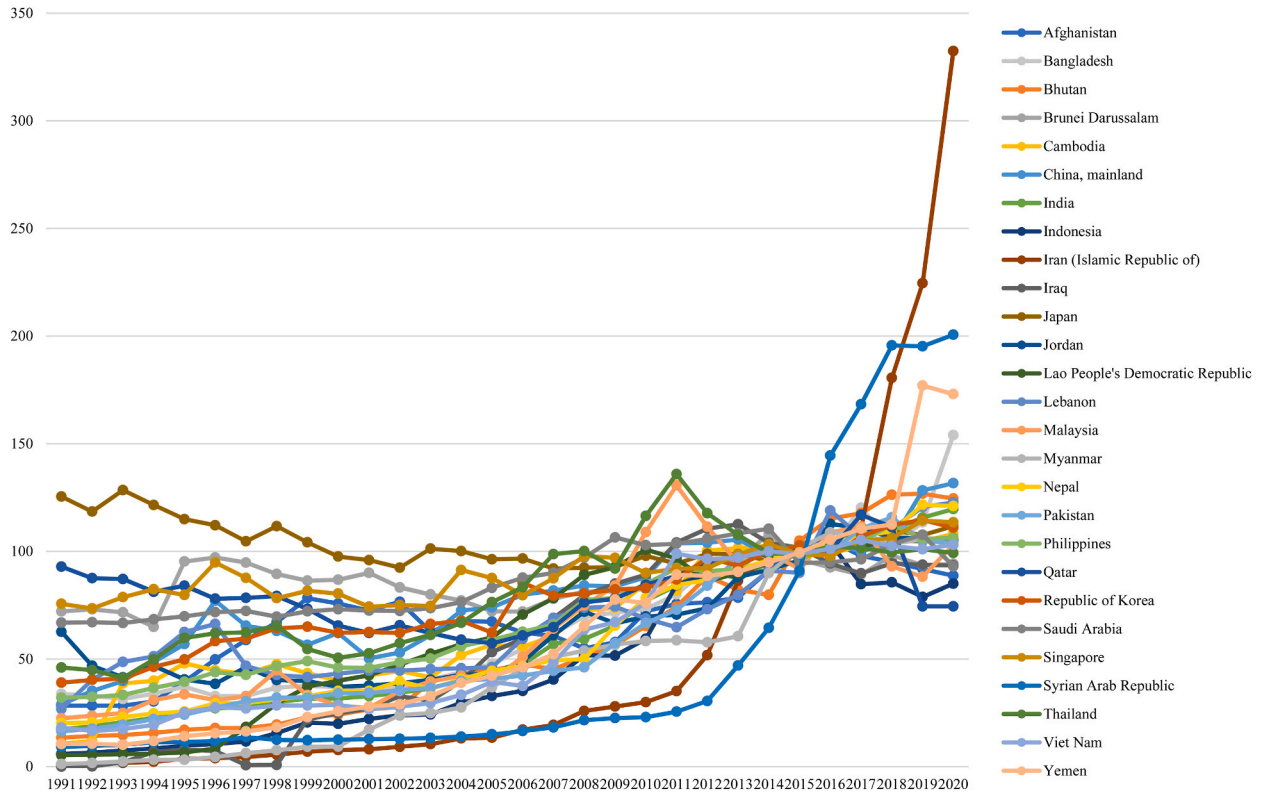

Fig. 3. Asian countries' agricultural producer prices.

Table 4
Correlation analysis.

	PPI	IRRI	INF	GDP	CRED	DEP	EXR	VAD	EMP	HCI	GATT	WTO	DDA
PPI	1.000												
IRRI	0.032	1.000											
INF	−0.233	−0.033	1.000										
GDP	0.352	−0.161	−0.157	1.000									
CRED	0.402	0.143	−0.231	0.431	1.000								
DEP	−0.344	−0.103	0.229	−0.374	−0.464	1.000							
EXR	0.145	−0.038	0.091	−0.150	−0.025	0.203	1.000						
VAD	0.673	−0.082	−0.202	0.364	0.325	−0.339	0.101	1.000					
EMP	−0.015	0.719	−0.044	−0.163	0.164	−0.109	−0.038	−0.157	1.000				
HCI	0.366	0.003	−0.165	0.562	0.582	−0.448	0.040	0.373	0.016	1.000			
GATT	−0.180	0.013	0.009	−0.051	0.014	0.066	−0.116	−0.020	0.097	−0.137	1.000		
WTO	−0.158	0.002	−0.038	−0.003	0.091	0.043	−0.109	−0.098	0.006	0.105	−0.157	1.000	
DDA	0.148	0.103	−0.094	0.190	0.154	−0.314	−0.063	0.101	0.099	0.297	−0.270	−0.250	1.000

Source: Author's computation using R (2022)

Table 5
Multicollinearity test with variance inflation factor and tolerance.

Variable	VIF
IRRI	7.062
INF	1.105
GDP	1.742
CRED	1.816
DEP	1.621
EXR	1.218
VAD	1.459
EMP	7.446
HCI	2.165
GATT	1.278
WTO	1.263
DDA	1.427

Table 6
ADF stationarity test.

Variable	At Level	1st difference	Conclusion
PPI	−8.74**	-	Stationary
INF	−7.37**	-	Stationary
GDP	−5.49**	-	Stationary
CRED	−4.82**	-	Stationary
DEP	−5.39**	-	Stationary
EXR	−4.82**	-	Stationary
VAD	−9.55**	-	Stationary
EMP	−3.55*	-	Stationary
HCI	−4.47**	-	Stationary
IRRI	−3.07	−9.25**	Stationary

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.
Source: Author's computation using R (2022)

unsupported. Similarly, fifth explanatory variable, DEP, show no influence on PPI, ruling out our following the hypotheses. CRED has a negative impact on PPI, which contradicts with the fourth hypothesis in this study. EXR and VAD were the following two variables that showed a significant and positive impact on PPI, which means that an increase in EXR and VAD can lead to an increase in Asian countries' agricultural producer prices. Hence, our sixth and seventh hypotheses have been proved.

The EMP variable has no significant influence on the dependent variable, indicating that the study's eighth hypothesis is unsupported. HCI is the following social variable and has a positive and significant effect on the first and second models. On the other hand, HCI in the third and fourth models does not influence the dependent variable. Finally, the last explanatory variable in this study, IRRI, has the same effect as HCI, which is significant and positive, but only in the first and third models. The findings of the two explanatory variables analysis show that the ninth and tenth hypotheses are proven.

In this study, the three dummy variables had varied impacts on the PPI. The first dummy variable in this analysis, GATT, has a significant and positive influence. This demonstrates that GATT increases PPI when compared to the autarky condition. The WTO has the opposite impact, indicating that Asian countries' agricultural producer prices are lower than the autarky condition. The last dummy variable in this study, DDA, did not influence PPI. In other words, Doha Round does not influence agricultural producer prices in Asian countries.

In addition to the first difference GMM, the Fixed Effect Model (FEM) is used in this work to investigate robustness (Table 7). FEM analysis, in general, provides coefficients that point in the same direction as the first difference GMM, despite having differing levels of significance. This demonstrates that the findings of this study's analysis are consistent even under varied conditions.

Based on the results of the analysis in Table 8, not all of our hypotheses have been proven. The following hypotheses have been supported: 1, 2, 6, 7, 9, and 10. Meanwhile, the following hypotheses are unsupported: 3, 4, 5, and 8.

5. Discussion

5.1. Asian countries' agricultural producer prices

Asian countries' agricultural producer prices (PPI) showed an increasing trend between 1991 and 2020 (Fig. 3). This finding is supported by the first difference GMM analysis, which shows that lag(PPI) has a positive and significant impact on PPI (Table 7). The acceleration of the PPI increase occurred in the early 2000s. Several countries that experienced a very significant increase in PPI in the last 3 decades include Iran (more than 200 times), Myanmar (100 times), the Syrian Arab Republic and Lao People's Democratic Republic (22 times), Indonesia (17 times), and Bhutan (10 times). However, some countries experienced a decline in PPI, namely

Table 7
Determinant factors of Asian countries' agricultural producer prices.

Variable	Model 1				Model 2			
	the first difference GMM		FEM		the first difference GMM		FEM	
	Coef.	Std. error	Coef.	Std. error	Coef.	Std. error	Coef.	Std. error
LAG(PPI_{t-1})	0.846*** (23.964)	0.035	–	–	0.864*** (19.812)	0.044	–	–
INF	0.059*** (11.172)	0.005	0.038 (1.071)	0.035	0.054*** (8.053)	0.007	0.039 (1.104)	0.035
GDP	−0.00006 (−0.412)	0.0002	−0.0009*** (−6.018)	0.0001	−0.00005 (−0.252)	0.0002	−0.0009*** (−6.007)	0.0001
CRED	−0.085* (−2.301)	0.037	−0.083. (−1.722)	0.048	−0.050* (−2.163)	0.023	−0.082. (−1.713)	0.048
DEP	0.025 (0.599)	0.042	0.040* (2.258)	0.018	0.033 (0.673)	0.049	0.038* (2.104)	0.018
EXR	0.001* (2.456)	0.0005	0.002*** (7.540)	0.0003	0.002*** (3.569)	0.0005	0.002*** (7.574)	0.0003
VAD	0.189*** (7.219)	0.026	0.580*** (16.535)	0.035	0.188*** (5.665)	0.033	0.585*** (16.446)	0.036
EMP	0.0003 (1.572)	0.0002	0.0001 (1.344)	0.00007	0.0003 (1.583)	0.0002	0.0001 (1.287)	0.00008
HCI	4.887* (2.106)	2.436	0.0006*** (10.817)	0.00006	4.094. (1.995)	2.052	0.0005*** (10.337)	0.00005
d(IRRI)	0.002. (1.752)	0.001	0.0007 (1.452)	0.0005	0.002 (1.373)	0.001	0.0006 (1.154)	0.0005
GATT	–	–	–	–	1.585*** (3.883)	0.408	2.542 (0.788)	3.228
WTO	–	–	–	–	–	–		
DDA	–	–	–	–	–	–		
Number of Observations	784		784		784		784	
Arellano–Bond test for AR (1)	−0.2638		–		−0.2687		–	
Arellano–Bond test for AR (2)	−0.3978		–		−0.4330		–	
Sargan test	18.365		–		18.734		–	
Prob. Sargan test	0.563		–		0.474		–	
Variable	Model 3				Model 4			
	the first difference GMM		FEM		the first difference GMM		FEM	
	Coef.	Std. error	Coef.	Std. error	Coef.	Std. error	Coef.	Std. error
LAG(PPI_{t-1})	0.834*** (15.104)	0.055	–	–	0.821*** (13.443)	0.061	–	–
INF	0.064*** (5.358)	0.012	0.041 (1.162)	0.035	0.062*** (5.108)	0.012	0.038 (1.081)	0.035
GDP	−0.00007 (−0.309)	0.0002	−0.0009*** (−6.420)	0.0001	−0.00003 (−0.106)	0.0003	−0.0009*** (−6.004)	0.0001
CRED	−0.099 (−1.594)	0.063	−0.113* (−2.317)	0.049	−0.101. (−2.015)	0.050	−0.085. (−1.742)	0.049
DEP	0.038 (0.394)	0.097	0.032. (1.744)	0.018	0.095 (1.164)	0.081	0.039* (2.148)	0.018
EXR	0.0007 (0.786)	0.0006	0.002*** (7.783)	0.0003	0.001 (0.857)	0.001	0.002*** (7.535)	0.0003
VAD	0.166*** (4.048)	0.041	0.573*** (16.376)	0.035	0.165*** (3.288)	0.050	0.581*** (16.497)	0.035
EMP	0.0003 (0.890)	0.0003	0.00008 (1.096)	0.00007	0.0002 (0.782)	0.0003	0.0001 (1.289)	0.00008
HCI	5.531 (1.001)	5.525	0.0005*** (10.381)	0.00005	5.662 (0.941)	6.016	0.0006*** (10.744)	0.00005
d(IRRI)	0.004. (1.766)	0.002	0.0005 (1.096)	0.0005	0.004 (1.531)	0.002	0.0006 (1.369)	0.0005
GATT	–	–	–	–	–	–	–	–
WTO	−1.455. (−1.720)	0.846	−7.697*** (−3.245)	2.372	–	–	–	–
DDA	–	–	–	–	−8.708 (−0.919)	9.479	−0.471 (−0.266)	1.770
Number of Observations	784		–		784		–	
Arellano–Bond test for AR (1)	−0.2585		–		−0.2699		–	
Arellano–Bond test for AR (2)	−0.3604		–		−.03786		–	
Sargan test	15.583		–		16.916		–	
Prob. Sargan test	0.622		–		0.596		–	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.
Source: Author's computation using R (2022). *Source:* Author's computation using R (2022)

Table 8
Supported or Unsupported the hypothesis of this study.

Hypotheses	Note
Hypothesis 1: GATT, WTO, and Doha Round implementations will decrease Asian countries' agricultural producer prices.	Supported
Hypothesis 2: Inflation will increase Asian countries' agricultural producer prices.	Supported
Hypothesis 3: GDP per capita will increase Asian countries' agricultural producer prices.	Unsupported
Hypothesis 4: Domestic credit to the private sector will increase Asian countries' agricultural producer prices.	Unsupported
Hypothesis 5: Deposit interest rate will decrease Asian countries' agricultural producer prices.	Unsupported
Hypothesis 6: The exchange rate will increase Asian countries' agricultural producer prices.	Supported
Hypothesis 7: The product value added will increase Asian countries' agricultural producer prices.	Supported
Hypothesis 8: The number of employments in agriculture, forestry and fishing will decrease Asian countries' agricultural producer prices.	Unsupported
Hypothesis 9: Human capital will increase Asian countries' agricultural producer prices.	Supported
Hypothesis 10: Land areas equipped for irrigation will increase Asian countries' agricultural producer prices.	Supported

Japan. In 1991, the PPI in Japan was 125.47, dropping to 111.7 in 2020.

Agricultural development in Asia has been directed by specialization, intensification, and scale expansion. This is done to achieve large-scale economies and highly efficient technical production. In addition, the government implemented a price support policy for agricultural inputs and outputs to aid agricultural development [76]. This has caused agricultural producer prices to rise over the last three decades. However, this increase has an adverse influence, particularly the rise in food prices. Of course, this goes against the government's desire to implement a low-price food policy for the poor. The second effect is an increase in wages in other economic sectors, which reduces industrial profits [77].

Each country in Asia has a different policy to address this issue. Some countries allow product prices to follow a market system, allowing farmers to obtain prices based on market conditions. Others regulate land use for certain crops to keep production and prices affordable to consumers. The country also has the authority to limit agricultural export volumes [77]. These various policies make the PPI values between countries different as shown in Fig. 3. The causes of these differences are discussed in detail in the following subsection.

5.2. Impact of the GATT, WTO, and Doha round on Asian countries' agricultural producer prices

No country can afford to isolate itself from global trade because the consequences would be disastrous. Countries that are trying to isolate themselves from global trade still need to issue a response to global food price fluctuations [78]. However, the benefits of participating in global trade will outweigh the disadvantages of not doing so. Table 7 shows that the increase in lagPPI in Asian countries under autarchy conditions (Model 1) is lower than during economic openness (Models 2, 3, and 4). That is, economic liberalization has a positive impact on agriculture in Asian countries.

During GATT implementation, market liberalization encourages farmers to specialize more, increasing agricultural land productivity while maintaining or improving environmental standards and competitiveness. Farmers can also diversify their output to meet the varying needs of local and global consumers [76] and produce technology and knowledge spillovers that boost Asian countries' agricultural total potential [28]. These steps enable farmers to obtain a decent price for their products.

Several studies have been conducted on the success of Asian farmers in increasing their product prices or income during GATT implementation. Asian country with socialist ideologies, such as Viet Nam, has implemented reforms known as Doi Moi since the mid-1980s. Land ownership in Vietnam, which the government had previously controlled, has been returned to farmers. Markets for agricultural inputs and outputs have also opened up [79]. As a result, Vietnam became the largest exporter of rice and other cereals (mainly maize), coffee, cocoa, cashew nuts, and pepper [80]. Another Asian socialist country, China, transitioned from a centralized economy to an open market economy. The country focuses on increasing exports, so modern wheat, corn, rice, and cereal varieties are growing [81]. Farmers in Thailand increase their income by exporting various food products such as rice and maize [78].

The Indian government made agriculture more open to foreign investment during the implementation of GATT. Farmers can improve their cultivation capacity, reduce poverty and hunger, and improve the carrying capacity of the environment [82]. In Indonesia, agricultural liberalization is implemented through reductions in import tariffs, domestic subsidies, and export subsidies on agricultural commodities [83].

Although it appears to be binding, GATT implementation can be tricked by many countries. For instance, consider the implementation of a producer price support policy. This policy sets a reasonable price for producers and purchases surplus from them at that price. When prices fall as a result of good harvests, the government will buy in large quantities at a price that protects producers [84]. This type of policy dramatically benefits farmers. The proof, increased farm-level price support in India effectively kept domestic producer prices higher than they should have been [78]. The governments of Indonesia and the Philippines subsidize importable commodities and set prices above market prices. The goal of government intervention is to help domestic consumers while also protecting agriculture from foreign competition [85]. Many countries are also opposed to tariff reductions due to high levels of protection and structural issues in the agricultural sector [86]. They believe that if they do not take precautions, their producer price volatility will rise as global price volatility rises [7].

Many issues remain unresolved in agricultural trade that were not addressed during GATT implementation, such as export subsidies, tariff and non-tariff barriers, including quantitative restrictions, dispute resolution, and so on. Many countries are still debating the best system for regulating the nature of policy measures used to protect farmers, the overall level of assistance available in different

countries, and the likely consequences of reducing assistance [86]. Several food-safety regulations also act as a barrier to agricultural product entry into importing countries [87].

These problems and violations have made many countries agree to take a more serious approach to establishing fair agricultural trade. This intention is realized through the establishment of the WTO, which makes agricultural trade supervision more stringent. The implementation of the WTO agreement will be followed by a gradual dismantling of input and output price support for producers [76]. Domestic supports are classified as "green," "blue," or "amber" in WTO terminology, depending on how much they distort trade and production. Subsidies in the "Green Box" must not distort trade; they are typically not targeted at specific products but include direct income supports for farmers that are not dependent on current production levels or prices. The Green Box category also includes programs for environmental protection and regional development. As a result, Green Box subsidies are unrestricted. Domestic support measures that are deemed to distort production and trade are classified as being in the "Amber Box." This assistance is subject to limitations. The "Blue Box" is an "Amber Box with Conditions Attached" that is intended to reduce distortion [88]. For example, producer subsidy equivalents in Japan were 40% at the time of GATT implementation but were drastically reduced during WTO implementation [86].

WTO members, including Asian countries, will also open their markets to other countries' products, services, and investments [89]. They have pledged to transform all border protection measures into import duties (tariff equivalents) and then gradually decrease them (by 36% for developed countries and 24% for developing countries in 1995-2000) [44]. The Indian government, for example, announced that quantitative restrictions (QRs) on 715 items would be removed, allowing them to be freely imported without a license [90]. Sri Lankan policymakers have taken advantage of the WTO implementation window to lock in the ongoing trade reform process at low duty levels, remove all non-tariff measures, and reduce tariffs on agricultural imports [91]. Various WTO dispute meetings were also held to resolve agricultural trade conflicts. As an example, China has filed a lawsuit against Australia over anti-dumping and countervailing duty measures on wine and barley. China was also sued for imposing tariff rate quotas on certain agricultural products. Similarly, other countries have sued India over sugar and sugarcane policies [92].

Asian countries are also implementing domestic reforms to prepare themselves for global competition better. For example, Japan implemented radical agricultural economic reforms. Instead of continuing to give the Japan Agricultural Cooperatives and Fisheries Cooperative Association a monopoly (as a special privilege), the Abe administration gave companies the freedom to own farmland anywhere in Japan and the opportunity to win fishing rights through a bidding system [93].

These policies have caused agricultural producer prices in Asian countries have fall (Table 7). Qin [18] has disclosed trade liberalization cut the domestic price of agricultural products. The elimination of support in the importing country increases demand for imports, resulting in domestic prices equal to global prices [86]. For example, China relies heavily on international pork supplies. The Chinese domestic pork market and the pork price industry stock market are highly correlated with the global pork price [94].

The difference in the analysis results between GATT and WTO implementations demonstrates that the WTO agreement has strict rules governing member countries' agricultural policies. There are solid internal pressures for domestic agricultural policy reform in the significant subsidizing countries and some progress has already been made. This reform's goal was to reduce overall agricultural protection and shift support measures away from direct producer price support and toward income assistance for certain disadvantaged producers [86]. Another example is that agricultural export subsidies are permitted under the commitments made during GATT implementation. However, export subsidies are prohibited during WTO implementation, whereas production subsidies are actionable if they harm domestic industry. The remaining subsidies are deemed non-actionable [95].

Although many people think that the WTO has not been fully effective in creating fair trade so there is a need to strengthen commitment through DDA, our study shows the opposite. DDA has no significant impact on agricultural producer prices in Asian countries. The values and policies developed during the WTO implementation have effectively encouraged Asian countries to take strategic steps to create fair agricultural trade. As a result, DDA is only a means of strengthening the commitments agreed upon during WTO implementation [96]. Three main things in DDA: improvements in market access, reductions in export subsidies, and reductions in trade-distorting domestic supports have been carried out during the implementation of the WTO [97]. However, when compared to WTO implementation, DDA does not significantly reduce domestic agricultural support in Asian countries. According to OECD [98], Vietnam and India saw an 11% drop in support between WTO and DDA implementation, Japan 10%, Korea 6%, and the Philippines saw no change. In fact, Indonesia increased its support by 11%, while China increased its support by 8%. Bigger and wealthier countries made no significant changes during the DDA implementation because they tend to prefer bilateral or regional trade agreements [88].

5.3. The other factors affecting Asian countries' agricultural producer prices

Agricultural producers' price stability is highly dependent on economic factors [99]. Hence, we will discuss domestic economic conditions after discussing the impact of GATT, WTO, and DDA implementations. According to our findings, inflation (INF) causes an increase in the PPI. Domestic inflation has caused domestic agricultural input prices to rise faster than international input prices. The increase will encourage production costs to rise, causing producer prices to rise as well. Cost increases generally result in a reduction in supply, and given the relatively inelastic demand for food, this will be transmitted to consumers with higher food prices [100]. Indeed, the change in PPI exceeds the change in consumer prices (CPI) [101]. The phenomenon of the increase in EXR was able to increase the PPI in Asia. Domestic prices must react in lockstep with changes in global prices and exchange rates [102], The last economic factor that had a positive impact on the PPI in Asia was VAD. The same happened in Brazil, where increasing value added was essential for raising agricultural producer prices [103]. Logically, the increase in value-added will improve the product quality and farmers will get a reasonable price. In this way, agricultural producer prices will also increase significantly.

GDPand DEP are two economic factors that do not affect PPI while CRED has negative effect on PPI. The rise in Asian GDP was mostly related to the growth of the industrial sector and the reduction in agricultural performance. This phenomenon has been observed in several countries, such as Vietnam [104], China [105], and Japan [106]. In these countries, the increase in GDP is used to purchase non-agricultural products. Meanwhile, food consumption will remain relatively stable, resulting in stable agricultural producer prices. The next variable, farmers' access to credit, has negative affect on the PPI. Farmers have difficulty accessing credit from banks because they do not understand the procedures, lack collateral, have high loan interest rates, or their business is considered infeasible [107]. They often borrow money from traders and informal institutions. In exchange, farmers will sell their products at a low price to financiers. This situation shows the ineffectiveness of credit performance and distribution in helping farmers. The deposit interest rate does not affect the PPI. The same context exists in Senegalese agriculture where producer prices remain low and unaffected by macroeconomic conditions, including deposit interest rates [108]. Abuoliem et al. [109] reveal that the deposit interest rate is unrelated to the producer price index.

The social factors in this study had a different impact on the PPI in Asia. Our findings indicate that changes in agricultural employment (EMP) do not affect the PPI. Because agricultural labor productivity in Asia has not yet reached its peak, the changes will not affect the PPI. Another reason is that changes in EMP can be substituted by capital. Farmers in many Asian countries have increased their use of labor-saving and capital-intensive technologies [86]. Another social factor, human capital, is an important factor in raising PPI. Improving human resource quality allows producers to think rationally to develop the best actions, services, and strategies for farming, product processing, and marketing access [110], implement and adopt innovations and technology [111], achieve program objectives [112], and certify their products [110]. For example, Indonesian educated farmers can produce more and use production factors more efficiently than the average farmer [113]. Educated pig farmers in India can implement hygienic management practices and sell their products at higher prices [114]. Farmers in Thailand who receive extensive education can improve their access to village development grants, modernize their farms, and start small businesses [115]. Increasing human capital for policymakers has been shown to stabilize agricultural producer prices and make farming more profitable [99].

The last explanatory variable, IRRI, has been shown to increase agricultural producer prices. The same condition happens in Africa, where public investment, including infrastructure, can raise agricultural producer prices [116]. Infrastructure development, particularly irrigation, will increase agricultural productivity, land use, and farmer incomes, and alleviate rural poverty [77,103]. Irrigation is also vital in some of the countries we studied, such as Yemen, Iraq, Pakistan, and Afghanistan, which have long faced water scarcity [117].

6. Conclusions

The effects of global trade agreements on agricultural producer prices in Asian countries (PPI) have varied: 1) the PPI will rise during the GATT implementation period. At this period, many countries could still violate the agreement on the rules for establishing free trade; 2) the PPI will fall during the WTO implementation cause the agreement has strict rules and reduced various subsidies, tariffs and non-tariff barriers. This demonstrates that our findings are consistent with the tariff theory where eliminating different price supports and trade barriers will reduce domestic prices; and 3) Doha Round has no significant effect on PPI. Many countries have committed to implementing agricultural fair trade during the Doha Round so that this phase does not impact the PPI. This means that Asian countries should prioritize increasing agricultural product competitiveness over trade barriers and support price policies.

The PPI will rise as the domestic economy grows, as will inflation, exchange rates, and value-added. The same effect occurs when the last two explanatory variables in this study are increased: human capital and land area equipped for irrigation. Meanwhile, credit has negative effect on PPI.

Several recommendations are made to increase PPI in Asian countries in the era of economic globalization. First, developed and developing countries must increase their commitment to reducing support prices and trade barriers. The role of developed countries is also expected to be greater in assisting agricultural development in developing countries through investment schemes and technology transfer. On the other hand, the WTO must also conduct strict, impartial, and transparent supervision of agricultural trade transactions.

Second, agricultural business players need to increase agricultural value-added by improving farming, distribution, and marketing efficiency. This is technically possible with modern technology. This step ensures that agricultural activities produce low-cost and high-quality agricultural outputs. Consumers will be willing to buy it and producers will be able to get a good income. In addition, Asian countries must improve their agricultural marketing systems. So far, the marketing system has been concentrated on traders, resulting in farmers receiving the lowest profit.

Third, the government must improve agricultural business players' educational quality. Agricultural business players continue to require assistance and training in carrying out agricultural activities from the government, the private sector, and non-governmental organizations (NGOs). They must also learn about advancements in information and communication technologies (ICTs) to convey agricultural and non-agricultural information more easily and quickly.

Fourth, the government must prioritize agricultural infrastructure investment. This is to increase Asian agricultural products' quantity, quality, and efficiency to boost producer prices. These infrastructures include agricultural machinery, irrigation, transportation, and road infrastructure.

As researchers, we believe that this study has a limitation. Several studies can be conducted in the future, such as understanding the impact of WTO accession on agricultural product price transmission from consumers to producers, and agricultural marketing efficiency. The hope is that producers will receive the biggest share of the price paid by consumers. At the same time, this could be a step toward improving Asian countries' agricultural trade systems. Furthermore, we do not include agricultural subsidies in each country. Therefore, we suggest further studies to include this component considering the significant influence on Asian agricultural producer

prices.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data will be made available on request.

Additional information

No additional information is available for this paper.

CRediT authorship contribution statement

Agus Dwi Nugroho: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Muhammad Imam Ma'ruf:** Writing – original draft. **Muh Amat Nasir:** Writing – original draft. **Maria Fekete-Farkas:** Supervision, Conceptualization. **Zoltan Lakner:** Supervision, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank the reviewers who gave us suggestions on how to develop this article.

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