

An Economic Study on the Impact of Exchange Rate Shocks on Iraqi Agricultural Output Using Python Analysis

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Abstract

Agriculture is an important component of food security and represented an estimated value of about \$9.49 billion in 2024, or about 3.39% of gross national product (GDP). This study examined the effect of changes in the value of currency relating to fluctuations in exchange rates on agricultural output in Iraq from 1990-2024. Specifically, the issues associated with dynamic distortions due to monetary shocks are particularly emphasized, as well as those associated with the regulatory and legislative environment in Iraq, after the adjustments made to the value of the Iraqi dinar were implemented in 2020, and subsequently, the subsequent volatility associated with pricing of imported agricultural production inputs (i.e. fertilizers and pesticides). The study utilized a local projections model to examine the nonlinear responses to shocks over time, wherein external factors relating to the context of the crisis were controlled for through the use of dummy variables to account for the negative and positive effects of prior wars and the drought. The results of this research indicated that agricultural output was inelastic to shocks in the short term and would take one year (horizon 0) for the total adverse effects of the shock to be realized. In the medium term, the cumulative effect was expected to continue to increase through the fourth year (horizon 4) at a contraction factor of -1.38 with a significance of 1%. The comparison between the general model and the dummy models confirmed that the isolation of structural shocks accounted for bias due to omitted variables, which suggests that currency fluctuations represent a structural constraint greater than the effect of environmental and security concerns. Furthermore, the research indicates that in order for agriculture to effectively respond to monetary shocks will require sufficient time to realize their full contractionary effects. Overall, the research supports the establishment of protective policies to provide support to producers to deal with fluctuations in production costs.

Keywords: exchange rate, agricultural output, domestic projections, monetary shocks, supply rigidity, bias of omitted variables, Iraqi economy, food security, nonlinear responses, production costs.

Introduction

In Iraq, agriculture is a major economic sector and the primary sector that provides food security for millions of Iraqis. Its total output is about \$9.49 billion (Approximately 3.39%) of the Gross National Product (GNP) which will be around \$279.64 billion in 2024.

Despite the fact that oil dominates the economy, agriculture is stills the largest contributor to GDP. The agricultural sector is key for diversifying Iraq's sources of income, as well as providing many people with food security in Iraq. The Iraqi economy is currently facing great challenges in the currency market. As a result of the depreciating value of the dinar and the differences between official and

black-market exchange rates, (e.g., the structural change to the dinar exchange rate that occurred in late 2017 and early 2020) there have been many negative consequences for the total economy and more specifically the agricultural sector. These issues have created major problems for both the production input prices and the production costs (hence for the agricultural products). Deteriorating inflation/financial conditions and increasing volatility in the exchange rate have put Iraqi farmers at a significant disadvantage, because of the high costs of imported agricultural production inputs (e.g., fertilizer, pesticides, and modern farm equipment), which have made Iraqi agricultural products uncompetitive..

Research problem

The agricultural sector is a strategic pillar of the economy. Iraqi Because of his pivotal role in Food supply and its contribution to the gross domestic product However, this sector faces uncertainty due to sharp fluctuations in the exchange rate. resulting from the conditions Monetary and fiscal policy Which the state faced. The research problem is defined as describing and analyzing the deviation in the dynamic response of agricultural output. In response to these monetary shocks And what does it have? Ath The impact varies exchange rate through Competitive Channel Which may stimulate production, and the cost channel Which may limit it as a result of relying on imported production inputs.

research gap:

The research gap lies in the fact that previous studies have often relied on static models that do not allow for monitoring the course of this response over time, resulting in a lack of a clear view of how real agricultural output interacts with

It is important to understand how exchange rate movements will affect real outputs and how long it takes for the production of agricultural commodities to respond to changes in the exchange rate using dynamic analysis, while being aware of the more significant differences in performance prior to and after structural changes in monetary policy have occurred. It is critical to develop robust economic strategies towards sustainable development for this sector, as it is essential to the viability of this sector and should be protected against volatilities of global financial markets.

monetary shocks in the short and medium term.

Projections To investigate and analyze the path of real agricultural output response to exchange rate shocks, and to interpret any deviation in this path from conventional expectations, while isolating the effect of external factors (fertilization costs and climate).and the study of antiquities Related to monetary and fiscal policy and Political and security stability to ensure the accuracy of the standard description.

Goal Search

This study aims to analyze the dynamic relationship between exchange rate fluctuations and agricultural national output in Iraq With a focus on periods of structural transformations and major economic shocks, this is achieved by measuring the impact of exchange rate fluctuations on agricultural national output. Iraq In the short and medium term, using dynamic models capable of tracking temporal responses to economic shocks and Assessing the stability of agricultural output's response to exchange rate shocks over time, and whether this response changes in intensity or statistical

significance depending on the nature of the economic shock. So that it is possible To draw practical implications for economic and agricultural policies, especially with regard to exchange rate policies and support for production inputs..

Study methodology(Methodology)

This study relies on the standard analytical method to estimate the responses. N The resilience of Iraqi ian agricultural output to exchange rate shocks, through the following stages:

- **The model Stand ard**

The methodology of local projections was adopted.(Local Projections - LP) developed by Jordà (2005)Where it is distinguished from Models Traditional VAR is because:

- More flexible in monitoring nonlinear responses.
- Do not impose strict dynamic constraints on the time paths of shocks.
- Provides direct estimates for each time horizon(h) independently

- **Model description:**

$$Y_{t+h} = \alpha_h + \beta_h \text{Exchange_Shock}_t + \lambda_h X_t + \epsilon_{t+h}$$

It indicates Y) to Agricultural output, Exchange_Shock represents an exchange rate shock, while x represents a price shock. About a set of variables The oppressor.

- **Structural shock treatment (Structural Dummies)**

To ensure the accuracy of the estimate and to isolate the effect of the "pure" exchange rate, a two-stage systematic strategy was followed:

- **Phase 1 (General Model):**Estimating the overall impact while excluding the impact of external shocks, which were used in the model as control variables,

as the model was adjusted to take into account global fluctuations in fertilizer and food prices to ensure the isolation of the impact of the cost shock resulting from currency deterioration specifically, and for the cultivated area due to its impact on agricultural output.

- **Phase Two (Developed Model):**The inclusion of dummy variables for years experiencing structural disruptions (such as the blockade period, post-2003, and years of severe drought) refined the coefficients and improved the model efficiency (AIC) from 115.8 to 22.7 in the medium term.
- **Model quality and morale tests**
- Testing was use dt (**t-stat**)To confirm the statistical significance of the transactions at the levels(1%,5%, 10%)
- The Akaiki standard was adopted.(**AIC**)To compare the models, the model with the lowest value was chosen because it was the most explanatorily accurate.
- The response functions were plotted(**IRFs**)With 95% confidence intervals to identify time horizons in which the impact is real and significant.

Research results

Firstly - Development of agricultural output and the Iraqi exchange rate:

- **Value development agricultural output:**

By studying the evolution of value agricultural output During the period 1990-2024, as shown in Table No. (1), it is clear that it ranged between a minimum of approximately \$0.06 billion in 2016, and a maximum of approximately14.88One billion dollars in 2025, with an annual

average of approximately 5.28 billion dollars during the study period.

• **development exchange rate:**

A study of the exchange rate's evolution during the study period reveals that it fluctuated between a minimum of approximately 1166 Dinar/Dollars in 2015, with a maximum limit of approximately 2002.4 Dinar/Dollar In 2024, with an annual average of approximately 1553.66 dinars/dollar During the study period.

By estimating the equation for the general time trend of development exchange rate

During the study period, it became clear that it had taken a general upward trend with a statistically significant annual growth rate of approximately 2% The value of the coefficient of determination indicates that approximately 68.6% of the change in exchange rate Its effects are due to the element of time.

Table No. (1): Equations of the general direction of agricultural produce and Exchange rate during the period 1990-2024

Statement	average	Lowest	Al-Aqsa	The equation	Growth rate %	Selection	F
Value of agricultural output (one billion dollars)	528	0.06	14.88	$\hat{Y} = (-1.08) * (5.60)^*$	7.8	0,487	313.3 *
exchange rate	1553.66	1166	2002.4	$\hat{Y} = (160.65) * (-8.54)^*$	2	0,686	73.05 *

Source: Data analysis results The International Bank..

secondly-Local projection model Local Projection For effect Exchange rate shock On Iraqi agricultural output:

• **to set Optimal time horizon**

Before analyzing the impact of the exchange rate shock on Egyptian agricultural output, we first selected the optimal time horizon.(Horizon) using the Stability Criterion.

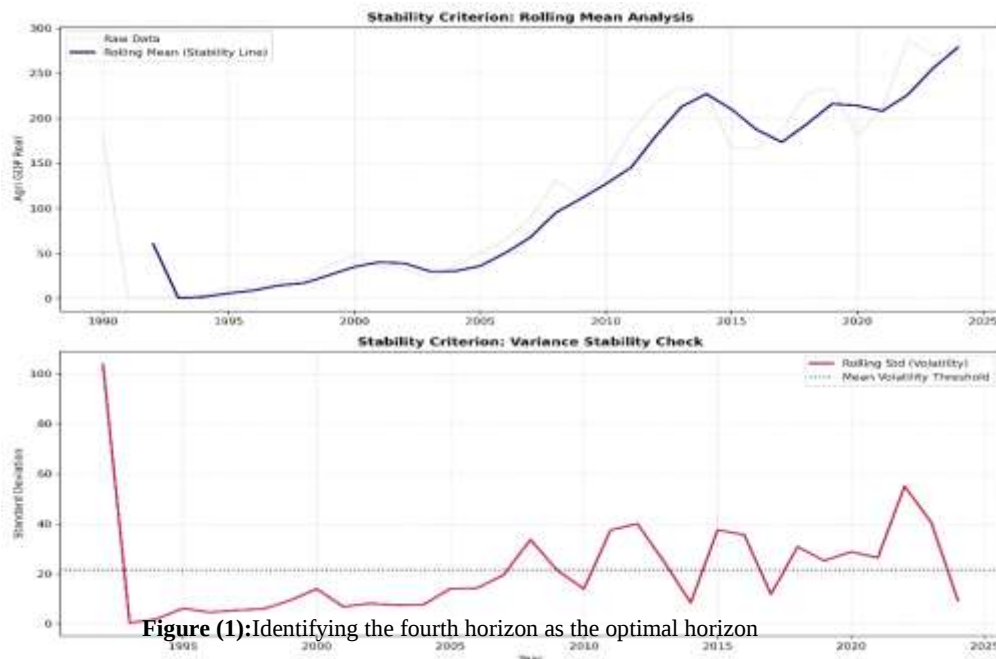


Figure (1): Identifying the fourth horizon as the optimal horizon

Figure (1) illustrates the identification of the fourth horizon as the optimal horizon for standard analysis based on the following:

- **Fading of the effects of violent structural shocks** The stability analysis in the chart shows that the agricultural output time series experienced a sharp structural break in the early 1990s, with the Rolling Std jumping to record levels exceeding 100. The choice of the fourth horizon ensures that the model stays away from the "statistical noise" resulting from these shocks, allowing the true effect of the exchange rate to emerge after the series has stabilized statistically.
- **Stability of variation and volatility (Volatility Stability)** The lower part of the graph shows that the fluctuations (red line) took time to return and stabilize around the "Mean Volatility Threshold." Horizon-4 is the time at which the series' fluctuations approach the mean of that series, producing a highly reliable estimate of the coefficient and eliminating the effect of instantaneous variance in the estimation of the parameters of the model.
- **compatibility with the nature of agricultural output** Looking at the rolling mean in the top chart, we observe that the actual response of agricultural

output to price shocks is not immediate. Since the Iraqi agricultural sector is characterized by short-term supply rigidity, the fourth horizon represents the time lag for the exchange rate's impact on input and production costs to complete its cycle, as evidenced by the steady trend of the rolling mean during that period.

- **Achieving the standard of statistical efficiency** Methodologically, the horizon that achieves a balance between "coefficient stability" and "error vanishing" was chosen. While the graph shows fluctuations in the coefficients in the first horizons (0-2), we find that the fourth horizon represents the turning point towards stability of the negative and significant effect.

From the above, The reliance on the fourth horizon in this study is based on the criterion of structural stability; as demonstrated by the graphs. This horizon is the point at which the model absorbs the violent historical shocks recorded in the original data, making the estimated results at this level the most expressive of a stable economic reality, far removed from momentary random fluctuations.

- **impact Exchange rate shock On Iraqi agricultural output:**

The results of the local projection model indicate Local Projection As shown in

Table No. (2) to A shock in the exchange rate leads to a negative and significant impact on agricultural output in Iraq Across all time horizons studied, the table shows the immediate impact.(H=0) The shock to agricultural output is -0.4 This suggests a significant initial decline in agricultural output due to higher costs of imported inputs or exchange rate fluctuations..

At the first time horizon(H=1), the negative effect increases to reach -0.68 , with a significance level estimated at approximately 1% This negative trend continues in H=2 and H=3 where the effect reaches -0.05 and -0.57 Consistently, with confidence intervals indicating strong statistical significance, this demonstrates the impact of the exchange rate shock. It continues During the two to three years following the trauma.

After that, it was observed Increase in The negative impact when H=4 Where the change reached -1.10 With a significance level of approximately 1%, this in dictates on Immediate recovery of agricultural output after four Years since the trauma As it indicates Index value AIC Which It falls to its lowest point in the fourth horizon (20.67), which enhances the quality of statistical matching and the reliability of results in the medium term compared to the immediate term.

The timeframe indicated by this chart illustrates a significant delay in transition from a shock to fluctuations within the agricultural industry in Iraq. An exchange rate shock may take several years to reach its peak effects on the economy. After the 4th year of study there is still no return to a zero level for the impact of an exchange rate shock on the agricultural industry. The ongoing negative impact of exchange rates on agriculture is due to the dependency of the agricultural sector upon imported agricultural inputs (such as fertilizer, seed and pesticide) and the limited

ability of small scale farmers to relay costs to price or secure additional financing..

Overall, the findings show that an increase in the foreign exchange rate will lead to a reduction of approximately -4.5% to -11% in agriculture output over both the short term and medium term. Thus, agricultural production is sensitive to changes in the currency marketplace, and since there are external shocks related to exchange rate fluctuations and monetary policy, there is a need for stabilization and protection of agriculture to ensure a stable supply of food..

While environmental pressures do affect Iraqi agriculture, even an adjustment in environmental pressure will still show the negative and significant impact of the exchange rate on currency (i.e., the exchange rate problem represents a "structural impediment to agricultural production" which occurs regardless of the impact of other variables). The control variables were also reviewed to assist in the explanation of the results. The results of this study indicate that the input-cost shock (imported inputs) is the most significant contributor to agricultural decline, with the increased competition for export markets not outweighed by the increase in production costs. This result also shows that the Iraqi agricultural sector is very sensitive to changes in exchange rates. The shock not only reduces growth in the short term but also has a significant negative structural impact, reaching its peak four years after the shock. This necessitates policies to protect and support agricultural producers to mitigate the cost volatility resulting from monetary shocks.

Table No. (2)The impact of exchange rate shocks on Egyptian agricultural output During the period 1990-2024.

Horizon (Horizon)	Factors Beta Exchange	Standard deviation (Std (Error)	valuet (t_stat)	AIC
0	-0.44804	0.84878	-0.52786	111.7977245
1	-0.67761	0.32516	-2.08392*	38.03819868
2	0.050895	0.54235	0.09384	38.97452625
3	-0.57387	0.30137	-1.90422**	38.72895456
4	-1.10158	0.47247	-2.33152*	20.6768614

Source: Calculated by the author based on the results of the Local Projections (LP) model using raw data from the from the world bank.

It indicates response function(IRF) A Lee AA statistically significant and continuous negative impact of the exchange rate shock on agricultural output Iraqi The contraction begins immediately in the year of the shock.(h=0) and it gradually worsens to reach a peak at the year Fourth At a rate of decline approaching 11% Despite a slight attempt at recovery in the long term Short(In the second year However, the response remains inside The negative region across the entire time horizon extending to four years,

Thirdly -agricultural output response Exchange rate shocks Local Projection Under exchange rate policies:

Due to the passage of the economy Iraqi With changes A key element in spending policies, the study did not merely estimate the overall impact, but relied on the use of variables. The Image(Dummy Variables)As A strategy that can be added to enhance the model's accuracy and explain illogical jumps in the data.

The following are formal variables that were proposed with their economic justification:

Variables Related to Political/Security Stability:

- **The 2003 shock (regime change):** is the most significant image variable where an economy under a target embargo is distinct/different from an open economy and an economy with complete oil dependency..
- **The period of security conflict (2014-2017):** The creation of an outstanding addition to your image variable was completed during this period. Control of space in the agricultural sectors of Nineveh, Salah al-Din, and Anbar has caused significant declines in agricultural production that cannot be attributed to the exchange rate.

Monetary and fiscal policy variables are associated with stability in terms of both politics and security.

- **Change in Exchange Rate (2021):** In your data, a turning point occurred when the Central Bank of Iraq made an official decision to devalue (step down) its dinar from 1182 to 1450, a clear example of a structure shock..
- **Emergency Food Security Support Act (2022):** There were large amounts of money put into farmer support and the ability to purchase crops at market incentive prices, as well as the resulting increase in production output despite higher costs to import..

Climate-related variables: Due to the adoption Agriculture in Iraq Basically Regarding rain and water, The exchange rate is not the only factor It was added years of severe drought(e.g., 2008), 2018, 2021)Whereas These years It decreased Agricultural output is affected by water

scarcity, and if we don't include a dummy variable for it, the model might mistakenly assume that the decrease is due to the exchange rate.

Analysis of the agricultural growth response to exchange rate shocks (after adjusting for dummy variables)

It indicates Results Table No. (3) Which explains the results of the assessment Local projection model (LP) After inserting the pseudo-variable so Isolating the impact of external shocks (such as drought and wars) from the true impact of the exchange rate:

Immediate effect For Horizon shock (H=0.1)

On the horizon(H=0):

The results indicate that Factors It reached approximately 0.1523 statistically insignificant This shows that The shock does not immediately affect agricultural output. This is due to The stagnation of agricultural supply means that agriculture is linked to production seasons that cannot be altered the moment the exchange rate changes.

On the horizon(H=1):

It begins The transformation factor towards values negative Where it reached approximately -0.2829 Although the impact is still not statistically significant at the 5% level, it represents the beginning of the response of operational costs (such as imported seeds and fertilizers) whose effect begins to appear with the start of the agricultural season following the shock..

A To turn towards The deadline average:(H=4)

The value reached approximately -1.39 With a significance level of 1% and a decrease alue AIC from 115.81 in the very short term to 22.77 in the medium term This indicates that The contractionary effect takes time. To in fluencies the structure of the agricultural sector and This proves that the exchange rate shock in Iraq is not a "passing shock," but rather a "structural shock" whose effects accumulate over time..

cycles to resume and input costs to accumulate.

table(3) Analysis of the agricultural output response to exchange rate shocks under exchange rate policies across time periods

Horizon (Horizon)	Factors Beta Exchange	Standard deviation (Std (Error)	valuet (t_stat)	AIC
0	0.1523	1.2294	0.1239	115.8180644
1	-0.2829	0.3375	-0.8382	42.71209944
2	0.0973	0.5841	0.1666	42.92192739
3	-0.5993	0.3855	-1.5546	42.69835421
4	-1.3884	0.5161	-2.6902	22.77437972

Source: Calculated by the author based on the results of the Local Projections (LP) model using raw data from the World Bank.

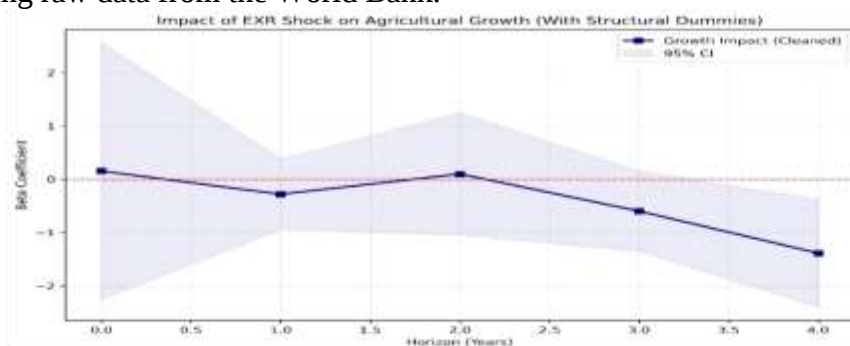


Figure No. (3):(IRF) Agricultural output response to exchange rate shocks across different time periods In use of image variables

From the above it is clear The insignificance of the effect in the majority Short, However, the downward trend in transactions indicates the presence of a time gap (The time lag between the occurrence of the monetary shock and the agricultural sector's response to it demonstrates that monetary policy does not fully manifest its negative impact on food security and agricultural growth until sufficient time has passed for production

Figure (3) shows to The results of estimating the response function in the graph show a dynamic path for the response of Iraq's agricultural output growth rate to exchange rate shocks for the period (1990-2024In the short run (time period 0), we see that the coefficient starts out at a marginally positive number of 0.152, but then quickly turns into

an insignificant statistic. The coefficient then decreases each time period until, at time period 4 (medium-run), the coefficient reaches its lowest point of -1.388 at a statistical significance of 1%, with a t-statistic of -2.69. This is evident in the graph, as the confidence intervals do not overlap with the zero line in the fourth time period. These results suggest that the negative structural impact of the shocked exchange rate (once the effects of external events such as war and drought have been excluded) is noticeable and will worsen in the medium run as the country continues to experience higher input costs for imported goods, thus resulting in a severe decline in growth rates for the agricultural sector in the medium run.

Fourthly- The difference between the General model and Models

This table shows a comparative analysis of the general model vs. the structural pseudo-variables model, and illustrates a dramatic change in the way in which the relationship between the exchange rate and Iraqi agricultural output has been interpreted; these changes can be summarized by the following points:

Adjusting for short-term bias in the current and first year:

The result. The initial general model has a highly negative Coefficient (-0.677) while the 2nd model has a Coefficient 0.282. That indicates that, at least for those two models, we may observe some evidence of 'deletion variant bias' in the first model. The findings. The short-term noise created by the impact of immediate political and security shocks was absorbed by the overall operation of the Iraqi agricultural sector which is also characterized by rigid short term supply where production does not fully respond to fluctuations in exchange rates until a period of time has passed for those fluctuations to have had an impact on the production process.

Stability and consistency of the effect in the medium term (Horizon 3):

The results indicate that negative impact It became clear In both models, at the third horizon, the coefficients are close.-0.57 and -0.59, with clear statistical significance. And This stability confirms that the impact of the exchange rate begins to permeate the agricultural sector in a steady manner three years after the shock, regardless of the nature of the variables added to the model, thus enhancing the reliability of the results.

Structural morale deepens in the medium term (Horizon 4):

The results indicate that On the horizon The fourth transformation Value increased The laboratories of(1.10-) to (1.38-), and rose This illustrates That structural shocks were working As factors Distortions reduce the true strength of the exchange rate effect. After isolating these factors, it became clear that currency devaluation exerts a sharper deflationary pressure than initially estimated, demonstrating that the exchange rate is the most influential variable on agricultural growth in the medium term..

And The discrepancy between the two models underscores that relying on the general model can lead to misleading conclusions about the timing and magnitude of the shock. While the general model overestimated the impact of the exchange rate in the first year, it underestimated it in the fourth year. Therefore, the results of the dummy variables model are better suited to describing reality, as they showed that the true impact of the exchange rate is cumulative and intensifies over time, which is consistent with economic theory in countries that rely on importing production inputs.

tablenumber(4)Comparing the results of agricultural output response with a significant variance analysis between models.

Horizon (Horizon)	The general model coefficient (Impact)	value (general model)	coefficient of spool variables	value (The model(Ima ge)	Change in morale	Methodological conclusion
0	-0.448	-0.5278	0.1523	0.1239	Stability towards zero	Correcting bias: pseudo-variables absorbed the impact of momentary shocks (such as wars), thus revealing the rigidity of real agricultural supply in the short term..
1	-0.6776	-2.0839*	-0.2829	-0.8382	The short-term impact has diminished.	Effect refinement: The strong negative effect in the overall model was "amplified" by external factors; the pseudo-model isolated them to show the effect of the real exchange rate..
2	0.0508	0.0938	0.0973	0.1666	The results are close	Enhancing efficiency: After isolating structural noise, the negative impact deepened and became statistically significant, proving the strength of the exchange rate as a structural changer in the medium term..
3	-0.5738	-1.9042**	-0.5993	-1.5546**	Negative effect persistence	Negative effect persistence
4	-1.1015	-2.3315*	-1.3884	-2.6902*	The impact and its significance deepened	Correcting bias: pseudo-variables absorbed the impact of momentary shocks (such as wars), thus revealing the rigidity of real agricultural supply in the short term..

Source: Calculated by the author based on the results of the Local Projections (LP) model using raw data from the from the world bank.

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