Research on the impact of trade uncertainty on national grain supply and risk cost control

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ABSTRACT

In order to explore the impact of trade uncertainty on the national grain supply, based on the BP neural network algorithm, this paper combines the characteristics of grain supply and trade data to construct an intelligent analysis model. Moreover, this paper uses historical data as the basic data to study the trade uncertainty and the relevant characteristics of grain supply, and combine the actual demand to construct the structure of the BP neural network model. After constructing the model, this paper analyzes the function of the model, combines the comparative analysis method to classify the data and studies the influence mechanism of trade uncertainty on the national grain supply. In addition, this paper combines the actual data to analyze the performance of the algorithm model of this paper, and the analysis results are consistent with historical data. Finally, this paper analyzes the cost control of national grain supply based on the results of the model analysis, and proposes several countermeasures.

Introduction

In people’s lives, uncertainty is the norm. When people cannot accurately determine the result of a certain event or decision in advance, the psychological state of unknowability of the result is uncertainty. In economics, uncertainty refers to the fact that economic participants cannot accurately understand or know the situation of future gains or losses due to the existence of risks. The economic policy uncertainty involved in this paper refers to the long-term, unobservable and inaccurately quantifiable, normalised uncertainty in the operation of the economic environment, rather than just the uncertainty caused by a certain agricultural ‘policy’ change in the narrow sense. It includes two aspects: ‘economic uncertainty’ and ‘policy uncertainty’, such as the uncertainty caused by changes in production costs to the micro-system of agricultural products, and the uncertainty in the macroeconomic environment caused by changes in macroeconomic policies, the uncertainty caused by the decision-making changes of the trading entities in the international trade activities and the unknown circumstances in the trade process, and the uncertainty caused by the changes in the monetary policy to the economic environment (Amershi et al. 2014). The upcoming viewpoint for the economy is erratic which is implied in economic uncertainty. At that point the individual discusses economic susceptibility, they normally advised that there is a huge possibility of negative financial cases. It could comprise expectations of a higher as well as more unpredictable expansion rate. While, a group of financial hazards wherever the upcoming path of government strategy is questionable, levitation hazard payments as well as powerful administrations, then individuals to delay spending in addition to venture till the above-specified vulnerability has been resolved is said to be as policy uncertainty. It may refer to limitations about currency connected else financial planning, the expense otherwise managerial system, else susceptibility over appointive results that will impact political initiative. The policy uncertainty affects investment based on floods in economic agreement uncertainty which enhances the precise danger. In addition to, the specified manner, the expenditure of wealth in the economy. Accordingly, advanced financial strategy susceptibility brings miserable venture, specifically owing to the irreversibility of assumption. How the macroeconomic limitations in which an association else region works influences its performance is alluded as macroeconomic environment. It manages the price level in an economy instead of singular enterprises as well as markets, total creation, & spending. The theoretical as well as practical importance
of macroeconomics are understanding as well as controlling economic fluctuations, functioning of an economy, inflation as well as deflation, formulation of economic policies, study of national income, etc.

A hypothesis that explains the coordinated effort among the vendors of a resource just as the buyers for that resource is named as law of supply in addition to demand. Overall, as cost grows, people will supply more & solicitation less in addition to, the reverse way around at the time of the worth falls. The theory of total supply and total demand is used to explain the relationship between national income and price levels, to examine the reasons for price changes and the way for the social economy to achieve a balance between total demand and total supply. The correlation between the long-term aggregate supply curve, the short-term aggregate supply curve and the aggregate demand curve can be used to explain macroeconomic fluctuations accordingly. When the short-term aggregate supply curve remains unchanged and the aggregate demand curve changes, the level of aggregate demand determines the equilibrium level of a country’s economic depression and prosperity. Moreover, when the short-term aggregate demand curve remains unchanged and the aggregate supply curve changes, the market price and national income move in the opposite direction. If the level of aggregate demand drops, market prices will rise, and national income will fall, which will result in a ‘stagflation’ symbiosis of stagnant economic development and inflation. In the long run, the economy has a tendency to achieve full employment. At this time, the output of products remains unchanged, and changes in aggregate demand can only change the price level of products. Therefore, when studying price issues from a macroeconomic perspective, total supply and total demand are the research basis that cannot be bypassed (Anderson et al. 2021; Gao et al. 2020).

Agriculture is an important basic industry sector of the national economy. Only by creating a stable rural economic environment can the healthy and stable development of agriculture be ensured (Antle and Stöckle 2017).

The macroeconomic uncertainty and the fluctuation trend of the agricultural product price curve also have obvious consistency, but there is a certain degree of hysteresis in some short-term cycles, which also shows that the agricultural product price changes are affected by the macroeconomic uncertainty. Through the above analysis of the relationship between cost uncertainty, international trade uncertainty, monetary policy uncertainty, consumption uncertainty, financial uncertainty, macroeconomic uncertainty and agricultural product prices, it can be seen that these uncertainties are closely related to changes in agricultural product prices. Therefore, further research on the dynamic relationship between uncertainty and changes in agricultural product prices will help to understand the formation mechanism of agricultural product prices. Moreover, it helps to improve the price formation mechanism of agricultural products, stabilise the uncertainty of economic policies and stabilise the price fluctuations of agricultural products is of great significance.

Based on the above analysis, this paper analyzes the impact of trade uncertainty on national grain supply and risk cost control, and analyzes the effectiveness of the method proposed in this paper through experimental research.

Related work

(Aydoğan and Vardar 2020) believed that the international grain market is not an effective channel to ensure grain security. Numerous long-term challenges are faced by grain security in China like restricted water assets, like loss of developed land from corruption as well as urbanisation, weak biological systems, a small-scale farming economy, successive cataclysmic events, expanded interest from populace development as well as worked on way of life, effects of environmental change, in addition to obsolete maturing agrarian framework, between others. The extent of planting region, creation or creation increment of a specific grain harvest to the absolute planting region, complete creation else creation increment of grain is alluded as theory of grain security. It mirrors the significance of different yields to provincial grain creation in a period. Since grain is a special kind of commodity with a political nature, the government should base itself on the adequate supply of domestic grain in order to achieve its own grain security. Production is the only effective way to ensure grain security, and it is not a desirable way to transfer grain through the international grain market. (Cai et al. 2018; Gao et al. 2020) pointed out that a high grain self-sufficiency rate is the basis for ensuring grain security, and the grain self-sufficiency rate depends on the comprehensive grain production capacity. Therefore, China must focus its policy on improving the country’s comprehensive grain production capacity. (Darabi et al. 2019) believed that in order to ensure grain security, farmers must first protect and mobilise the enthusiasm of grain production, so as to ensure the self-sufficiency rate of grain. Many scholars pointed out that the international grain market should be fully utilised and comparative advantages should be exerted to ensure grain security.
(Feng et al. 2019) believed that engaging in foreign trade in grain through the international grain market can give play to comparative advantages, thereby increasing the economic efficiency of agriculture and grain production, and ultimately improving the level of security. As indicated by the Foreign Trade Law, China's primary exchange strategy destinations are to speed up its opening to the rest of the world, foster unfamiliar exchange, in addition to advance sound financial turn of events. Exchange advancement system is the arrangement to animate creation as well as exchange of convinced regions through modifying the overall cost of exportable & importable items. The progression of China's trade improvement procedure could be parcelled into 2 critical stages through the recorded increment to WTO in 2001. (Goetz et al. 2015) pointed out that although grain security has the attributes of a public product, it must be emphasised to provide its required cost and efficiency, and the use of the international grain market is an effective way to improve the efficiency of grain security. (Hedlund et al. 2020) analyzed in detail the role of the use of international grain market in ensuring grain security. The first is to smooth out the inter-annual fluctuations in domestic grain production by making use of the international grain market. The second is to discover the comparative advantages of grain production in the global market through international trade, so as to obtain comparative benefits through grain trade. (Khan and Ansari 2018) emphasised that grain security is being pressured by population growth and resource constraints. To ensure grain security, it is necessary to make full use of both international and domestic resources and two markets. Therefore, the opening of the international grain market is an inevitable way to achieve grain security. (Kourou et al. 2015; Mi et al. 2010) pointed out that to ensure grain security, effective means should be used to ensure a reasonable level of security, and the use of the international grain market is precisely an effective means.

(Lanz et al. 2018) used the PVAR panel data model analysis to conclude that economic policy uncertainty has a short-term negative impact on prices expressed in CPI. Moreover, through comparative analysis, it proved that the price level in developed regions is more impacted by economic policy uncertainty than in the eastern and central regions. (Meredig et al. 2014) used the SVAR model of standard macroeconomic theory to identify structural shocks such as supply and demand shocks, monetary policy shocks and economic policy uncertainty shocks. (Mocanu et al. 2018) analyzed the impulse response of the impact of economic policy uncertainty on the price of livestock products. Moreover, it believed that economic policy uncertainty has a continuous and huge impact on the price of livestock products, and economic policy uncertainty is an important reason for the cyclical fluctuations of livestock product prices. However, this paper only analyzes the impact of economic policy uncertainty on the price of livestock products.

(Paramati et al. 2018) believed that the increase in oil prices can directly promote the increase in agricultural production costs, thereby indirectly promoting the increase in agricultural product prices. (Pattnaik et al. 2018; Nguyen et al. 2020) believed that low-frequency fluctuations in domestic grain prices can be largely explained by changes in production costs and international grain prices. (Paul 2019) believed that the price of crude oil has a significant spill-over effect on the price of agricultural products. (Rajkomar et al. 2019) proved the conclusion that international crude oil prices have a significant impact on agricultural product prices. (Rodriguez-Galiano et al. 2015) used the variance causality method to test and prove that crude oil prices have a significant spill-over effect on agricultural product price fluctuations. (Ruane et al. 2018; Bechikh et al. 2015) believed that the direct impact of international crude oil prices on agricultural product prices is not significant, but the indirect impact is more significant. The LSTAR nonlinear model constructed in (Salmoral et al. 2019) decomposes and proves that the international oil price can affect the price of agricultural products through indirect channels such as domestic inflation, currency issuance policy and international agricultural product prices. (Ward et al. 2016) also proved that there is a significant long-term positive correlation between the prices of major international grains and energy prices.

**Risk cost analysis model**

This paper uses BP neural network to construct the risk cost control model. A multi-facet feedforward network prepared through error back propagation algorithm is termed as back propagation (BP) in neural network. It is one among the most broadly applied neural organisation techniques. It is the substance of neural organisation preparing and strategy for calibrating the loads of a neural organisation reliant on the error rate got in the previous age like emphasis. To decrease error rates as well as make the model solid through expanding its speculation, you will be permitted through legitimate tuning of the loads. The role of standard back propagation algorithm in neural organisation is a short structure for ‘in reverse propagation of errors’. The standard technique for preparing counterfeit neural organisations. The specified strategy figures the inclination of
a misfortune work concerning every one of the loads in
the organisation. BP neural network is one of the most
widely used neural networks, and it is a complex, non-
linear, parallel dynamic system that can represent extre-
remely complex nonlinear model systems. As shown in
Figure 1, the BP neural network is divided into three
layers: input layer, hidden layer and output layer. Each
layer is composed of one or more neural nodes, and
each layer of neural nodes only accepts the input of
the neurons in the previous layer. Moreover, the infor-
mation input by the input layer must be processed by
each layer of neurons before it becomes the output of
the output layer, and the output is continuous data
between 0 and 1. Fully connected, recurrent layer, con-
volution as well as deconvolution are the 4 most
general types of layers in neural network.

The information layer of a neural organisation is made
out of counterfeit info neurons, in addition to conveys
the hidden data into the structure proposed for extra
dealing with through following layers of phony
neurons. The info layer is unquestionably the beginning
stage of the work cycle for the fake neural association.
The yield layer is answerable for creating the eventual
outcome. There must consistently be one yield layer in
a neural organisation. The yield layer takes in the
sources of info which are passed in from the layers
before it, plays out the estimations through its neurons
and afterward the yield is processed. Hidden layers, basi-
cally, are layers of numerical capacities every intended to
deliver a yield explicit to a proposed result. It considers
the capacity of a neural organisation to be separated
into explicit changes of the information. Each secret
layer work is specific to create a characterised yield.

The principle of BP neural network includes forward
propagation of signal and back propagation of error.
The forward propagation of the signal means that the
sample is input in the input layer, processed in the
hidden layer and output in the input layer. The back
propagation of the error is the result of the non-confor-
mity obtained after the forward propagation, and then
enters the hidden layer through the opposite direction,
and then propagates back to the input layer. In the
process, the error of the output result is allocated to
each unit of each layer. After continuous forward propa-
gation and error back propagation, the weight of each
layer is continuously adjusted to obtain the best value.

The estimation as well as capacity of halfway factors
(counting yields) intended for a neural organisation all
together from the information layer towards the yield
layer is alluded as forward propagation also known as
forward pass. The technique for ascertaining the angle
of neural organisation boundaries is termed as
backpropagation. To put it plainly, the technique navigates the organisation in turn around request, from the yield to the info layer, as per the chain rule from math.

**Forward propagation calculation process**

For the output layer, it is as follows (Xin et al. 2018):

\[
net_k = \sum_{j=0}^{m} w_{jk} y_j, \quad k = 1, 2, \ldots, l
\]  

(1)

For the hidden layer, it is as follows:

\[
y_j = f(net_j), \quad j = 1, 2, \ldots, m
\]  

(2)

\[
net_j = \sum_{i=0}^{n} v_{ij} x_i, \quad j = 1, 2, \ldots, m
\]  

(3)

The activation functions of formula (1) and formula (2) are both Sigmoid functions, an S-formed function is alluded as ‘sigmoid function’. It is otherwise called as a crushing function, as it maps the entire genuine scope of \(z\) into \([0, 1]\) in the \(g(z)\). It has two basic helpful properties such as it very well may be utilised to display a restrictive likelihood appropriation besides its subsidiary has a basic structure, as follows:

\[
f(x) = \frac{1}{1 + e^{-x}}
\]  

(4)

\(f(x)\) is continuous and differentiable, as follows:

\[
f'(x) = f(x)(1 - f(x))
\]  

(5)

When the expected output value does not match the network output value, there is an error \(E\), which is defined as follows:

\[
E = \frac{1}{2} (d - O)^2 = \frac{1}{2} \sum_{k=1}^{l} (d_k - O_k)^2
\]  

(6)

The hidden layer is referred as think about the mistake going back along the loads of the yield layer towards the neurons. Things are somewhat more convoluted in the hidden layer. The error signal is determined in the hidden layer as the weighted mistake of every neuron in the yield layer. The error definition of the above formula expands to the hidden layer, as follows:

\[
E = \frac{1}{2} \sum_{k=1}^{l} [d_k - f(net_k)]^2
\]

(7)

It is further extended to the input layer as follows:

\[
E = \frac{1}{2} \sum_{k=1}^{l} \left[ d_k - f \left( \sum_{j=0}^{m} w_{jk} f(net_j) \right) \right]^2
\]  

(8)

It can be known from the above formula that the error of network training is a function of the weights \(w_{jk}\) and \(v_{ij}\) of each layer. Therefore, adjusting the weight can adjust the size of the error. When the output error is less than or equal to the expected error or the set number of learning times is reached, the calculation ends, otherwise, the backward propagation calculation is performed.

**Back propagation calculation process**

The principle of weight adjustment is to keep the error smaller, so it needs to be adjusted along the negative gradient of the weight, that is, the adjustment of the weight is proportional to the gradient of the error. The ‘-’ negative sign fundamentally refutes the angle in addition to, consistently moves towards the nearby minima is included in the update rule of gradient descent. Angle is positive in the first quadrant, yet in the event that you utilise the specified gradient as it is you move away from beginning else minima. Along these lines, the negative sign aides hither.

\[
w_{jk} = -\eta \frac{\partial E}{\partial w_{jk}}, \quad j = 0, 1, 2, \ldots, m; \quad k = 1, 2, \ldots, l
\]  

(9)

\[
v_{ij} = -\eta \frac{\partial E}{\partial v_{ij}}, \quad i = 1, 2, \ldots, n; \quad j = 1, 2, \ldots, m
\]  

(10)

Among them, \(\eta\) is the learning rate, which is generally \((0, 1)\). The above two formulas are mathematical expressions for weight adjustment ideas rather than specific weight adjustment calculation formulas. We assume that in the entire derivation process, there is \(j = 0, 1, 2, \ldots, m; \quad k = 1, 2, \ldots, l\) for the output layer and \(i = 1, 2, \ldots, n; \quad j = 1, 2, \ldots, m\) for the hidden layer.

For the output layer, it can be written as:

\[
w_{jk} = -\frac{\partial E}{\partial w_{jk}} = -\frac{\partial E}{\partial O_k} \cdot \frac{\partial O_k}{\partial net_k} \cdot \frac{\partial net_k}{\partial y_j} \cdot \frac{\partial y_j}{\partial w_{jk}}
\]  

(11)

and

\[
\delta_k^0 = -\frac{\partial E}{\partial net_k} = -\frac{\partial E}{\partial O_k} \cdot \frac{\partial O_k}{\partial net_k} = -\frac{\partial E}{\partial net_k} f'(net_k)
\]

(12)
Therefore, there are:
\[ w_{jk} = \eta \frac{\partial}{\partial v_{ij}} y_j = \eta (d_k - o_k)(1 - o_k)y_j \]  
(13)

For the input layer, it can be written as follows:
\[ v_{ij} = -\frac{\partial E}{\partial x_i} = -\frac{\partial E}{\partial y_j} \cdot \frac{\partial y_j}{\partial y_i} \cdot \frac{\partial y_i}{\partial x_i} \]  
(14)

and
\[ \delta_j = -\frac{\partial E}{\partial net_j} = -\frac{\partial E}{\partial y_j} \cdot \frac{\partial y_j}{\partial net_j} \cdot \frac{\partial net_j}{\partial y_j} \]  
(15)

because
\[ \frac{\partial E}{\partial o_k} = -(d_k - o_k) \]  
(16)
\[ \frac{\partial E}{\partial y_j} = -\sum_{k=1}^{l} (d_k - o_k)f'(net_k)w_{jk} \]  
(17)

Therefore, there is:
\[ \delta_j = \left( \sum_{k=1}^{l} \delta_k w_{jk} \right) y_j(1 - y_j) \]  
(18)
\[ v_{ij} = \eta \delta_j x_i = \eta \left( \sum_{k=1}^{l} \delta_k w_{jk} \right) y_j(1 - y_j)x_i \]  
(19)

According to the weights and threshold changes of each layer of neuron connections obtained above, iterative update is performed for the next round of learning and training. The following is the update formula for weights and thresholds:
\[ w_{jk}(n + 1) = w_{jk}(n) + w_{jk} \]  
(20)
\[ v_{ij}(n + 1) = v_{ij}(n) + v_{ij} \]  
(21)

When the new weights and thresholds of each layer are calculated, then it turns to forward propagation. It can be known from the above deduction process that the BP algorithm is obtained by calculating the derivative of the error function to the weight and the threshold. The boundary inside a neural organisation that changes input information inside the organisation’s secret layers is termed as weight iteration. A neural organisation is a progression of hubs, else neurons. Inside every hub is a bunch of information sources, weight, in addition to a predisposition esteem. Regularly the loads of a neural organisation are contained inside the secret layers of the organisation. Association loads are changed to assist with accommodating the contrasts between the real as well as anticipated results for ensuing forward passes in neural organisations. At times to evaluate the yield of a neuron in the yield layer is said to be as threshold transfer function. Between neurons, the entire expected relationship is permitted. Meanwhile circles are accessible in the above-specified kind of organisation, it transforms into a non-straight powerful framework which modifies continually till it shows up at a state of concordance. Therefore, when calculating the increment of the weight and the threshold, the reciprocal of the activation function of the hidden layer and the output layer must be calculated. This requires that the activation function of each neuron in the hidden layer and the output layer must be continuous and derivable. The derivation of the above-mentioned BP neural network algorithm is based on a three-layer network structure. For the network structure with more layers, the derivation idea is similar to the three-layer network structure. The calculated changes in the weights and thresholds of the last layer are followed by analogy until the input layer, the derivative of the neuron activation function in the output layer is calculated, and the neural network output error is used to return the calculation. An initiation work in a neural organisation characterises how the weighted amount of the info is changed into a yield from a hub or hubs in a layer of the organisation. Here and there the enactment work is known as a ‘move work’. If the yield scope of the initiation work is restricted, then, at that point it could be known as a ‘crushing capacity’.

The BP neural network used in this paper is based on the above forward and backward propagation principles. On this basis, the input data can be further verified and predicted to achieve the final purpose of the trade financing risk prediction and evaluation needed in this paper.

Price transmission refers to the process in which when commodity prices in one place fluctuate, such fluctuations will some other related products else industries by anomaly channels causing related product price fluctuations or the process of product price fluctuations in other regions, causing related product price fluctuations or the process of product price fluctuations in other regions. Price fluctuation transmission can be divided into spatial price transmission and vertical price transmission. The degree of business sectors at topographically isolated areas shares normal since quite a while ago run cost or exchange data on a homogeneous ware is termed as spatial price transmission, also known as market integration (MI). While, two fundamental sorts are included in vertical asymmetric price transmission (APT) such as based on velocity as well as magnitude. In any case, the size of APT is suggesting diverse since quite a while ago run reactions among positive as well as negative shocks. (For instance, a non-linear since quite a while ago run value balance). Spatial
price transmission mainly refers to the price transmission between different regions or different markets caused by the correlation between products. Vertical price transmission mainly refers to the price transmission between product industrial chains, that is, the transmission of price fluctuations between commodity prices in the same industrial chain, including cost-driven price transmission and demand-driven price transmission. In addition, cost-driven transmission refers to the transmission of price fluctuations of upstream products in the industry chain to downstream products through costs. Demand-driven transmission means that the price fluctuations of downstream products cause price fluctuations of midstream products, which in turn leads to fluctuations in the prices of upstream products.

International grain prices affect China’s grain supply through market mechanisms. Moreover, it mainly affects China’s grain production through the transmission of futures market, market information and import trade, and it affects China’s grain imports through the price comparison mechanism and import demand mechanism (Figure 2). A section of a market system, which includes dissimilar techniques to coordinate purchasers as well as merchants is the main role of price comparison mechanism. The value system is a monetary model wherever cost undertakes a critical part in coordinative the movements of makers, purchasers, as well as asset providers. An illustration of a value system utilises declared offer & ask costs.

The law of commodity value shows that commodity value determines price, price is based on value, and price fluctuations always fluctuate around commodity value. Price transmission, that is, price transmission, refers to the transmission of price fluctuations to other related industries or related products through different paths, thereby causing the prices of related industrial products to fluctuate, or causing commodity prices in other spatial regions to fluctuate. Price transmission can generally be divided into inter-industry or inter-regional price level transmission and inter-industry chain price vertical transmission. Horizontal transmission mainly refers to the price transmission between different regions or different markets caused by the horizontal correlation between industries; vertical transmission refers to the vertical transmission of prices between different levels and links in the product supply chain. International food price fluctuations are transmitted from the international market to the domestic market through price level transmission, and the fluctuations affect domestic food prices, which in turn affect food supply. Under the current background of economic globalisation, the rise or fall of food prices in the international market will be imported into China through channels such as international trade, futures markets and market information, which will affect China’s food prices. In the process of market competition, changes in commodity market prices reflect market supply and demand. Participants in market activities allocate resources for economic benefits, and adjust production through market price information.

In the international trade market, fluctuations in international food prices mainly affect food imports through the price comparison mechanism, and the domestic demand for international food through the import demand mechanism, which in turn affects food imports. In a perfectly competitive market, assuming other conditions remain unchanged, price is an important factor influencing the competitiveness of commodities. The lower the price, the stronger the competitiveness. The fluctuation of international food prices is a weather vane for a country’s food imports, and the level of foreign food imports will be affected by the price difference between the two markets at home and abroad. When the price of the international food variety rises and the domestic price of the food variety remains unchanged, the international competitiveness of the domestic food variety will increase, and the amount of grain exports will increase, but the import volume will decrease; when the international price of the food variety falls and the domestic price of the food variety remains unchanged, the domestic grain The international competitiveness of varieties has weakened, and grain companies prefer to import for profit-seeking purposes, and the volume of grain imports has increased. Therefore, fluctuations in international food prices will change the comparative advantage of a country’s food prices, which in turn will affect the country’s food imports.

Out of the demand for imported grain varieties, international grain prices affect China’s grain imports through the import demand mechanism. When the price of international food varieties rises, the disposable income of domestic farmers, the consumption expenditure of urban residents, the production cost of food enterprises, and domestic inflation expectations are relatively reduced, which in turn leads to a decline in domestic demand for international food imports and a reduction in imports; international food prices fall At that time, the disposable income of domestic farmers, the consumption expenditure of urban residents, the production cost of grain enterprises, and the expectation of domestic inflation have all increased relatively, which has led to an increase in domestic demand for international food imports and an increase in imports.

International grain prices affect China’s grain supply through policy-driven mechanisms. It mainly affects
domestic grain prices through the market access policies and export subsidy policies of the WTO Agriculture Agreement, which in turn affects domestic grain imports and production. The non-trade concerns are considered through the agreement which contains food security just as the need to guarantee the environment, then, at that point gives exceptional other than differential treatment towards non-mechanical countries, recollecting an improvement for the odds also terms of access for country consequences of explicit charge interest to the individuals. A structure to the drawn-out change of rural exchange as well as home-grown approaches, fully intent on prompting more attractive rivalry besides a less mutilated area is given through WTO Agricultural agreement. The WTO Agreement on Agriculture went into power at the time of the World Trade Organization (WTO) appeared on 1 January 1995. Its fundamental goal is to change horticultural exchange along with the goal that it is nearer to cutthroat economic situations – yet additionally to serve different destinations. In addition, it affects domestic grain prices by driving domestic agricultural support policies, which in turn affects grain production and reserves (Figure 3).

The purpose of the governments of various countries in formulating agricultural support policies is to maintain the stability of domestic grain prices, so that the income of farmers is not damaged, and domestic grain production and stocks can also be in a stable state. The frequent fluctuations of grain prices in the international market will interfere with domestic agricultural support policies and affect the effects of the policies. This will in turn cause the government to adjust policies, and farmers and grain companies will therefore change production decisions and purchase strategies, thereby affecting domestic grain production and reserves.
Meanwhile, due to the large population of China, the supply and demand of grain cannot be separated from the international market. The various problems that have emerged after the implementation of the domestic agricultural support policy are also related to the long-term fluctuations of the international grain market prices. Since joining the WTO, China has encountered strong pressure from the international grain market, and its agricultural support policies have undergone tremendous changes and adjustments as a result. The government first abolished the agricultural production tax that lasted for thousands of years, and successively implemented grain crop seed subsidies, direct grain subsidies, agricultural machinery purchase subsidies, comprehensive agricultural materials subsidies, minimum purchase price policies, temporary purchase and storage policies, and target price support policies.

**Figure 3.** Schematic diagram of trade uncertainty affecting grain supply through policy-driven mechanisms.

**Analysis of the impact of trade uncertainty on national grain supply**

According to the above analysis, the impact of trade uncertainty on the country's grain supply is analyzed on the basis of the intelligent model constructed in this paper. Grain security is always a major issue related to the national economy and people's livelihood. In recent years, with the gradual increase in the degree of opening up of China’s grain market, the international and domestic markets have gradually become closer. Table 1 shows the basic changes in the nominal grain price index on the international market from 1964 to 2020. It can be seen that the volatility characteristics of the grain price index on the international market during this period are very obvious, and the overall trend of volatility is increasing.
However, in different periods, the characteristics, frequency and causes of fluctuations are different. The corresponding statistical diagram is shown in Figure 4.

International soybean prices showed a fluctuating growth trend as a whole from 1994 to 2017. Compared with the other three grain varieties, soybean prices fluctuated the most, as shown in Figure 5 and Table 2.

**Analysis and discussion**

The balance of grain supply and demand is an important guarantee for achieving China’s grain security. Under the background of the new era, China’s grain supply cannot be separated from the international grain market, and fluctuations in international grain prices have become an important factor restricting China’s grain supply. This article first combs the current research on the characteristics of international grain price fluctuations, the factors affecting fluctuations and the transmission effects of fluctuations. Moreover, based on the current problems on China’s grain supply side, this paper uses comparative advantage theory, price transmission theory and farmer behaviour theory to construct a research framework for the influence of international grain price fluctuations on China’s grain supply. In addition, this paper regards international grain prices, China’s grain production and grain imports as an organic whole, and theoretically analyzes the impact mechanism of international grain price fluctuations on China’s grain supply.

**Table 1. Table of International Grain Price Index Fluctuations.**

| Year | Price Index | Year | Price Index | Year | Price Index |
|------|-------------|------|-------------|------|-------------|
| 1964 | 32.82       | 1983 | 104.72      | 2002 | 91.89       |
| 1965 | 31.79       | 1984 | 101.63      | 2003 | 89.42       |
| 1966 | 35.12       | 1985 | 93.08       | 2004 | 96.35       |
| 1967 | 35.96       | 1986 | 89.39       | 2005 | 91.13       |
| 1968 | 37.55       | 1987 | 88.22       | 2006 | 98.25       |
| 1969 | 35.16       | 1988 | 86.11       | 2007 | 114.83      |
| 1970 | 38.22       | 1989 | 85.90       | 2008 | 115.99      |
| 1971 | 34.50       | 1990 | 86.57       | 2009 | 123.15      |
| 1972 | 34.82       | 1991 | 98.25       | 2010 | 155.94      |
| 1973 | 39.43       | 1992 | 102.66      | 2011 | 194.44      |
| 1974 | 41.76       | 1993 | 106.37      | 2012 | 161.54      |
| 1975 | 45.72       | 1994 | 101.95      | 2013 | 194.44      |
| 1976 | 57.30       | 1995 | 104.83      | 2014 | 220.15      |
| 1977 | 86.10       | 1996 | 107.12      | 2015 | 220.32      |
| 1978 | 96.36       | 1997 | 114.02      | 2016 | 215.07      |
| 1979 | 80.68       | 1998 | 129.51      | 2017 | 199.43      |
| 1980 | 77.81       | 1999 | 124.70      | 2018 | 170.14      |
| 1981 | 88.41       | 2000 | 117.28      | 2019 | 165.90      |
| 1982 | 94.54       | 2001 | 112.28      | 2020 | 177.99      |

**Figure 4. Diagram of International Grain Price Index Fluctuations.**

**Figure 5. Statistical diagram of international prices of rice, wheat, corn and soybeans (unit: USD/ton).**

**Table 2. Statistical table of international prices of rice, wheat, corn and soybeans (unit: USD/ton).**

| Year | Rice | Wheat | Corn | Soybean |
|------|------|-------|------|---------|
| 1997 | 147.50 | 126.13 | 287.92 | 270.31 |
| 1998 | 167.61 | 177.86 | 152.28 | 252.77 |
| 1999 | 574.31 | 233.73 | 160.92 | 276.21 |
| 2000 | 492.96 | 202.74 | 515.76 | 285.37 |
| 2001 | 378.03 | 178.77 | 123.04 | 263.57 |
| 2002 | 202.52 | 199.26 | 120.32 | 196.87 |
| 2003 | 363.57 | 176.60 | 125.13 | 217.40 |
| 2004 | 556.88 | 167.36 | 126.19 | 194.74 |
| 2005 | 539.95 | 172.40 | 267.26 | 213.45 |
| 2006 | 386.00 | 182.56 | 300.18 | 259.68 |
| 2007 | 435.41 | 216.32 | 364.17 | 345.70 |
| 2008 | 169.87 | 226.19 | 356.58 | 282.17 |
| 2009 | 159.89 | 185.69 | 186.40 | 270.86 |
| 2010 | 176.69 | 239.86 | 188.70 | 374.46 |
| 2011 | 237.43 | 226.53 | 260.14 | 605.74 |
| 2012 | 270.09 | 233.46 | 252.31 | 431.60 |
| 2013 | 272.82 | 265.30 | 242.62 | 437.67 |
| 2014 | 334.80 | 318.81 | 314.78 | 576.61 |
| 2015 | 286.80 | 294.68 | 315.44 | 627.22 |
| 2016 | 295.86 | 348.69 | 315.44 | 591.76 |
| 2017 | 342.77 | 308.10 | 277.46 | 579.19 |
| 2018 | 336.41 | 308.10 | 223.15 | 422.90 |
| 2019 | 278.96 | 233.47 | 208.24 | 398.10 |
| 2020 | 299.86 | 296.09 | 233.91 | 407.70 |
On the basis of the above analysis, several risk cost control strategies for national grain supply under the background of trade uncertainty are proposed.

Stabilise grain production and optimise the supply-side structure of the grain industry. China has a large population and few land, and natural resources are inherently scarce. In some of China’s main grain producing areas, the ecological environment has been severely damaged due to the discharge of industrial waste water and exhaust gas, the cultivated land has been severely destroyed, and the quality of food varieties has been questioned. The area of arable land has always been the bottleneck for stable production. Therefore, strengthening the protection and management of arable land resources and creating a green and healthy arable land ecological environment are the prerequisites for stabilising China’s food production. The second is to strengthen the innovation of agricultural science and technology, and implement the ‘storage of grain in technology’. The traditional high-cost and low-efficiency production method based on the quantity of food has been difficult to adapt to the new situation of current international agricultural development. The way out of agricultural production must rely on scientific and technological progress. Persist in the implementation of ‘Hiding Grain in Technology’, increase the transformation rate of the grain industry’s achievements through agricultural scientific and technological innovation, enhance the level of grain storage, and promote the grain industry to achieve a virtuous circle of innovative development, transformation and upgrading, and improvement of quality and efficiency, thereby promoting a balance between China’s grain supply and demand. To ensure China’s food security. First of all, in the new economic era, the most important task for implementing ‘grain storage in technology’ is technological innovation in the grain seed industry. It can be said that the grain seed industry is the establishment of the improvement of the cutting-edge grain industry. The cultivation of high-quality, high-yield, high-efficiency, multi-resistant, and versatile grain varieties through technological innovation is an important guarantee for the strategy of ensuring China’s grain self-sufficiency and absolute safety of rations; Secondly, to enhance China’s food science and technology innovation capabilities, diversified investment in technological innovation is required. This not only requires the government’s leading role in financial investment, but also guides social capital to invest in technological innovation. China can learn from the United States’ efforts in agricultural scientific research and technological innovation. Pay attention to, vigorously carry out industry-university-research cooperation, increase the proportion of private agricultural innovation investment, encourage private individuals or enterprises to establish their own agricultural scientific research institutions and test stations, build channels for the transformation of scientific and technological achievements, and promote the development of an integrated model of scientific research, production, promotion and sales; Third, it is necessary to strengthen the integrated development of agricultural science and technology, establish a food science and technology development system, and focus on the development of food variety improvement, storage, deep processing, logistics, quality inspection and other technologies, and strengthen the collaborative innovation of food science and technology. At the same time, it is necessary to carry out the systematic promotion of agricultural technology, requiring the establishment of an agricultural technology extension system, and strengthening of agricultural production material equipment and food technology support, so that it can meet the multi-level and diversified requirements of clear division of labour and orderly competition; finally, the need for professional training of farmers’ quality, Chinese farmers’ educational level and technological literacy have been low for a long time, and they also lack the sensitivity to capture market information. This directly affects China’s grain supply capacity. Therefore, the government has continuously increased the government’s The investment in the construction of the scientific and technological literacy of the farmer team will strengthen the construction of the ‘three rural’ teams, encourage young labourers with better education to stay in the countryside to revitalise agricultural production, and promote the research and development of high-quality grain varieties through scientific and technological innovation, thereby increasing the potential for increasing grain production.

The first is to optimise the structure of the grain supply side. At present, China is in a stage of rapid economic development, and the consumption of grain products by urban and rural residents not only requires enough grain, but also good grain. When domestic grain products cannot meet the needs of domestic residents in terms of taste, quality, variety and price advantages, international grain products will take advantage of it. Taking wheat as an example, due to the low output of domestic high-quality wheat and the high-quality and high-priced imported international wheat, domestic wheat is facing the dilemma of destocking. Therefore, it is necessary to deepen the supply-side structural reform of the grain industry, fully integrate the changes in domestic market demand, and change the extensive development model that focused on increasing quantities in the past. At the same time, it is
necessary to shift to an intensive development model that pursues high-quality and green environmental protection to increase the effective supply of grain and the mid-to-high-end supply, and reduce the ineffective and low-end grain supply. This not only requires optimising the planting structure of grain varieties to increase consumers’ supply of green and safe mid-to-high-end grain products, but also strengthening the supervision of the quality of grain products, so as to comprehensively improve product quality and ensure that the structure of grain product supply and demand reaches a balance. The first is to follow the grain consumption side, optimise the structure of agricultural production and planting on the basis of ensuring that rations are fully self-sufficient, and focus on enhancing the production capacity of the weaker grain varieties on the supply side.

The second is to strengthen the market-oriented reform of grain prices and increase the international competitiveness of prices. The stable market price of grain is the basic feature that reflects the balance of supply and demand in the grain market. The current market is in the context of an era of open economy, and price is not only a weather vane that best reflects the balance of market supply and demand, but also a regulator to adjust the balance of market supply and demand. It is not only affected by the supply and demand in the domestic market, but also by the supply and demand in the international market. The reason is that price fluctuations in the international market will be transmitted to the domestic market through various channels, leading to price fluctuations in the domestic market. Therefore, in order to avoid the impact of violent price fluctuations in the international market on the Chinese market and effectively prevent and control the risk of price fluctuations, we need to continue to strengthen the market-oriented reform of grain prices and improve the international competitiveness of grain prices. Specifically, we should start from two aspects: stabilising prices, continuing to strengthen the market-oriented reform of grain prices, and improving the pricing position of the grain futures market.

The third is to improve agricultural control policies. It is necessary to accelerate the market-oriented reform of grain prices. The introduction of a market price competition mechanism does not mean that the government completely abandons its control and intervention in the market, but it is to avoid the impact of the international market on the Chinese grain market and ensure the balance of China’s grain supply. The system wherever the powers of interest as well as supply decide the costs of ware in addition to progression is termed as value component. Also, we can say that, it is the purchasers as well as merchants who really decide the cost of an item. In the new situation, in order to guarantee the income of farmers from growing grain, ensure the balance of production and import structure in grain supply, and ensure the high-quality and green development of the grain industry, the primary task is to establish and improve WTO rules, protect the interests of farmers, support agricultural development, and ensure the agricultural support subsidy system. Among them, one of the ways to improve agricultural support and protection policies is to increase agricultural ‘green box’ subsidies.

Conclusion

The balance of grain supply and demand is an important guarantee for China’s grain security. Under the background of the new era, China’s grain supply cannot be separated from the international grain market. The fluctuation of international grain prices has become an important factor restricting China’s grain supply. This article combines the current problems of China’s grain supply side, uses comparative advantage theory, price transmission theory and farmer behaviour theory to construct a research framework for the impact of international grain price fluctuations on China’s grain supply, and theoretically analyzes the impact mechanism of international grain price fluctuations on China’s grain supply. Subsequently, this paper establishes a BP neural network model of China’s grain supply structure imbalance to estimate whether China’s grain supply is currently unbalanced, and explores the correlation between international grain prices and the fluctuation of China’s grain supply. Finally, this paper analyzes the effectiveness of the method proposed in this paper through empirical analysis. The research results show that the method proposed in this paper has a certain effect.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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