Patterns of Domestic Grain Flows and Regional Comparative Advantage in Grain Production in China

Chen Chunlai

(Department of Economics, Adelaide University)

Christopher Findlay

(Asia Pacific School of Economics and Management,

Australian National University

and

Research Institute of Economics and Business

Kobe University)

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1. Introduction

Grain marketing reform has gradually changed China's domestic regional grain trading regime from government controlled planned regional grain transfers to a more market-oriented regional grain trading system based primarily on the demand and supply of regional grain markets. Since the late 1990s, China's regional grain flows have expanded rapidly, due to the acceleration of domestic grain marketing reform and the growth of grain production.

With the much faster economic growth in the south-east coastal region since the economic reform, grain production not only has lost comparative advantage compared to other economic sectors in this region but also has lost comparative advantage compared to other regions in grain production in China. Therefore, since the mid-1980s the pattern of China's domestic regional grain flows has gradually changed from "transferring grains from the South to the North" to "transporting grains from the North to the South". As a result, in the late 1990s grain exporting regions were mainly in the north-eastern, the central and the north-China regions. Their shares in total regional grain outflows were approximately 45 percent, 27 percent and 14 percent respectively. In the same period, the grain importing regions were mainly in the south-east coastal region and the three municipalities. The former accounted for approximately 60 percent and the latter accounted for 32 percent of the total regional grain inflows.

Is the pattern of China's domestic regional grain flows consistent with its regional comparative advantage in grain production? This topic is especially interesting given the fact that even though China as a whole appears to have a comparative disadvantage in grain production, at least in maize and wheat (see below), some of its regions and provinces may still have a comparative advantage in producing some grain crops. This implies that there exists great potential for China to improve regional resource allocation and, therefore, to increase grain production, through market-oriented domestic grain marketing reform and the promotion of domestic regional grain flows based on the principle of regional comparative advantage in grain production. The findings of this study may also have important policy implications for China's international grain trade, as China is nearer to becoming a member of the World Trade Organisation (WTO) and to opening its domestic grain market to global competition.

The paper is organised as follows. The next section examines China's domestic regional grain trading regime and the pattern of regional grain flows in the late 1990s. Section 3 discusses the regional comparative advantage in grain production in China. Section 4 conducts the empirical test using the binomial logit model on the relationship between the pattern of China's regional grain flows and its regional comparative advantage in grain production. Empirical results are then presented and discussed, followed by some concluding remarks in the final section.

2. The pattern of domestic grain flows in China

China's domestic grain trade regime during the last nearly 50 years can be divided into three distinct phases. From 1953 to 1978, grain transfers among regions and provinces were under the state control, subject to unified planned transfer. From 1979 to 1992, with the implementation of economic reform, the domestic grain trade regime was also changed. During this period, domestic grain transfers were arranged in a combination of planned transfers and market adjustments. With the deepening of economic reform, in 1993 the planned domestic grain transfers were abolished. Since 1993, the domestic grain trade was mainly based on market operations supplemented by a two-tier grain reserve system that was managed by the central and the provincial governments.

During the period from the 1950s to the mid-1980s, food shortage was a long lasting issue in China. Because the grain production conditions in the South are generally better than in the North, the government, under the planned grain transfer scheme, transferred grains from the South to meet food shortages in the North. After the economic reform, with the fast growth of grain production nationwide, especially in the North, grain consumption has shifted from food grains to feed grains. More feed grains, mainly maize, are produced in the North and that grain has been transported to the

South. Thus, since the mid-1980s as we noted earlier, the pattern of domestic grain flows has changed.

In the 1990s, with the development of regional grain markets and the domestic grain trade policy changes, regional grain flows have expanded. According to the calculation of Grain Research Project Group (Liu Jiang, 2000), in 1998 the quantity of regional grain flows accounted for 5.8 percent of China's total grain production, an increasing 1.2 percentage points compared to the early 1990s. For the 15 grain deficit provinces, in 1998 grain inflows reached 29.8 million tonnes (including international imports), 43.6 percent more than in the early 1990s, and accounting for 19.2 percent of their total grain consumption.

According to State Grain Bureau (Wang Zhonghai, et al, 2000), during the period from 1995 to 1999, grain exporting regions were mainly in the north-eastern region, the central region and the north-China region. Their shares in total grain outflows were 45.5 percent, 27.4 percent and 13.7 percent respectively. In the same period, grain importing regions were mainly in the south-east coastal region and the three municipalities. The former accounted for 60.3 percent and the latter accounted for 32.1 percent of the total regional grain inflows.

Among the grains traded in regional markets, maize takes the largest share, followed by wheat and rice. In the late 1990s, the shares of maize, wheat and rice in regional grain flows were approximately 35 percent, 30 percent and 25 percent respectively.

According to the information available, in the late 1990s China's domestic grain flows in terms of the three main crops of maize, wheat and rice were basically presented the following pattern, which is presented in Table 1.

As the table shows, the main exporting provinces were

- maize: Hebei, Liaoning, Jilin, Heilongjiang, Shandong and Henan
- wheat: Hebei, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shandong, Henan and Xinjiang

- rice: Hebei, Liaoning, Jilin, Heilongjiang, Jiangsu, Anhui, Jiangxi, Henan, Hubei, Hunan, Sichuan and Ningxia

In contrast, the main net grain importing provinces were the three municipalities, the south-east coastal provinces, the south-west provinces and the north-west provinces.

Is this pattern of domestic regional grain flows consistent with the regional comparative advantage in grain production in China? The following sections will analyse and answer this question.

Table 1 Net grain flow position of provinces in the late 1990s in China

Province	Maize	Wheat	Rice
Beijing	-	-	-
Tianjin	-	-	-
Hebei	+	+	+
Shanxi	-	-	-
Inner Mongolia	-	+	-
Liaoning	+	+	+
Jilin	+	+	+
Heilongjiang	+	+	+
Shanghai	-	-	-
Jiangsu	-	-	+
Zhejiang	-	-	-
Anhui	-	-	+
Fujian	-	-	-
Jiangxi	-	-	+
Shandong	+	+	-
Henan	+	+	+
Hubei	-	-	+
Hunan	-	-	+
Guangdong	-	-	-
Guangxi	-	-	-
Hainan	-	-	-
Sichuan	-	-	+
Guizhou	-	-	-
Yunnan	-	-	-
Tibet	-	-	-
Shaanxi	-	-	-
Gansu	-	-	-
Qinghai	-	-	-
Ningxia	-	-	+
Xinjiang	-	+	-

Notes: “ + ” refers to net grain outflow,
“ - ” refers to net grain inflow,
Source: Summarised from Wang Zhonghai, et al (2000).

3. Regional comparative advantage in grain production in China

A region's pattern of trade is a reflection of its comparative advantage which is determined by its resource endowments. In a free market economy, a region's comparative advantage is evident in its trade with other regions. In the case of regional grain flows, a region's comparative advantage in grain production is revealed by the volumes in grain trade with other regions. However, a test of this framework is difficult in China because of the lack of accurate data on the volumes in grain trade among regions. Therefore, to assess the influence of regional comparative advantage in grain production on trading patterns in China, we have to look for an alternative.

Zhong Funing and others (2000) used a series of direct production indicators, instead of the trade flow data, to assess regional comparative advantage in grain production in China. In their study, two sets of indicators to measure regional comparative advantage in China's main grain crop production were calculated.

The first set of indicators includes Net Social Profitability (NSP) and Domestic Resource Costs (DRC), both measuring the net social welfare gained from one production activity against its opportunity costs at border prices.[1]

The second set of indicators includes Efficiency Advantage Indices (EAI), Scale Advantage Indices (SAI) and Aggregate Advantage Indices (AAI), which measure relative yield and scale advantages in a region.[2]

The NSP measures the net social gain produced from an economic activity defined as the difference between values of the products and associated opportunity costs plus possible externality. Measured at border prices, the value of the NSP indicates the potential net social gain from one activity based on an international comparison. Therefore, it can be taken as an indicator of the implied comparative advantage (or

[1] See Pearson (1973).
[2] See Li (1997).

disadvantage) for that activity. If $NSP_j > 0$, the region has a comparative advantage in the jth activity and if $NSP_j < 0$, it does not.

The DRC measures the necessary total costs of domestic resources required in one activity in order to earn (or save) one unit of foreign currency. A Domestic Resource Costs Coefficient (DRCC) is defined as the DRC divided by the shadow price of foreign exchange. Therefore, the following conclusions hold: if $DRCC_j < 1$, then the region has a comparative advantage in the jth activity and if $DRCC_j > 1$, it does not.

The EAI is an indicator of the relative yield of one crop in relation to the average yield of all crops in the region, and to the national average. If EAI > 1, then the yield of that crop, relative to all other crops, is higher than that of the national average, and vice versa. Assuming no significant difference in techniques in grain production, or, at least no significant barriers to technology diffusion and adoption among regions, the EAI can be taken as an indicator of relative efficiency in grain production due to natural resource endowments. Therefore, it could be used as an indicator of comparative advantage.

The SAI shows the extent of concentration of one crop in a region, relative to that at the national average. If SAI >1, then the degree of concentration of that crop in the region is higher than that in the whole country, implying that farmers in the region prefer to grow more of that crop, in relative terms, and vice versa. If the concentration level is determined by economic factors, then the SAI could be taken as an indicator of comparative advantage. In this case, a low value of SAI means that producers do not want to increase the share of that production, either as it is less profitable or restricted by natural (or other) conditions. This implicitly assumes that producers are able to respond to market situation with adjustment in their crop mix in order to maximise profits in grain production. However, this assumption seems to contradict to the actual situation because the Chinese farmers are not able to fully realise their comparative advantage as the government intervention prevents them from fully adjusting their grain production mix. Therefore, SAI may not fully reflect the real regional comparative advantage in grain production in the present situation in China.

The AAI is simply the geometric average of the EAI and SAI. If AAI >1, then that crop in the region is considered to have a comparative advantage over the national average, and vice versa. As EAI indicates yield differentials and SAI indicates relative production shares, their geometric average could be taken as a kind of aggregate indicator of comparative advantage.

Zhong Funing and others (2000) calculated the regional comparative advantage indicators as mentioned above for main grain crops, maize, wheat, rice and soybeans. The 1998 cost-benefit data for farm products and other relevant data are used in the calculation of DRCC and NSP in each of the selected provinces. In order to reduce the impact of weather and other random disturbances, 3-year moving averages of yields and sown areas were used in the calculation of EAI, SAI and AAI.

The calculated results show that at the national level China has no comparative advantages in maize and wheat production, but has comparative advantages in *Japonica* rice and middle season *Indica* rice production. At the regional level, the comparative advantage in grain production varies not only across provinces but also across crops.

In general, Tianjin, Hebei, Liaoning, Jilin, Heilongjiang and Henan have a comparative advantage in maize production. Hebei, Shanxi, Inner Mongolia, Heilongjiang, Shandong, Henan, Shaanxi, Gansu and Xinjiang have a comparative advantage in wheat production. Tianjin, Hebei, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Yunnan and Ningxia have a comparative advantage in *Japonica* rice production. And finally, Jiangsu, Anhui, Hubei, Sichuan, Guizhou and Yunnan have a comparative advantage in middle season *Indica* rice production.

4. Empirical test

4.1 Model and variable specification

Based on the above discussion, we are now in a position to analyse and answer the question of whether the pattern of China's domestic regional grain flows is consistent with its regional comparative advantage in grain production. Because the actual data on regional grain flows are not available, therefore, to conduct the empirical test we apply the logit model approach in the study. For this approach only two kinds of provinces are identified: they are the net grain exporters and the net grain importers, which we have already identified and discussed in Section 2.

The logit model has been applied in many areas of economic study, such as analyses of the travel mode of urban commuters (McFadden, 1974; Hensher, 1968), of occupational choice among multiple possibilities (Schmidt and Strauss, 1975a; 1975b) and of enterprise performance (Huang and Duncan, 1997). For a detailed general discussion of the binomial model see Green (1970) and Maddala (1983).

For this study, the logit model takes the form

$$P(Y_i = j) = \frac{\exp(\alpha_j^{'} X_i)}{\Sigma_k \exp(\alpha_j^{'} X_i)} \qquad (1)$$

where Y_i is the province's net grain flow position, with j = 1 if it is a net grain exporter and j = 0 if it is a net grain importer. $P(Y_i = j)$ is the probability of province i with certain set of comparative advantage indicators and other factors (X_i) being a net grain exporter (j = 1) or being a net grain importer (j = 0), with α_j a vector of coefficient estimates for outcome j.

The probability for j = 0 for each observation is

$$P(Y_i = 0) = \frac{1}{1 + \exp(\alpha_1^{'} X_1)} \qquad (2)$$

and the probability for j = 1 for each observation is

$$P(Y_i = 1) = \frac{\exp(\alpha_1^{'} X_1)}{1 + \exp(\alpha_1^{'} X_1)} \qquad (3)$$

The above two probabilities always sum to one for each observation.

The data used in this study have already been discussed in the previous two sections. The dependent variable is the net grain flow position of provinces being a net grain exporter or net grain importer in the late 1990s. There are 45 observations in the data set, of which 21 were net grain exporters (either maize, wheat or rice) and 24 were net grain importers. Because the sample size for each of the three grain crops, maize, wheat and rice, is too small, therefore, no attempt is made to test the relationship between the comparative advantage indicators and the pattern of regional grain flows for each of the individual crops. Instead, the trading position for all crops is tested in the one model. However, we acknowledge that such tests are very desirable if the sample size permits.

The independent variables (X_i) include the comparative advantage indicators of DRCC, NSP, EAI and SAI. Because AAI is simply the geometric average of EAI and SAI, the effect of AAI on the dependent variable is already captured by EAI and SAI. Therefore, AAI is excluded from the model.[3] It is expected that the impact of DRCC on the dependent variable will be negative, while the impact of NSP, EAI and SAI will be positive. Of course, there is likely to be some problems of multicollinearity among these variables and we discuss our approach to this problem in more detail below.

Apart from the above comparative advantage indicators, we also include provincial per capita grain output, provincial per capita income, and the share of urban population of

[3] In addition, the correlation coefficient between AAI and EAI and SAI is very high, which will cause the problem of collinearity in the regression, therefore, AAI is excluded from the test.

province as independent variables to capture the effect of other grain supply and demand variables on the pattern of regional grain flows.

Provincial per capita grain output, denoted as PQ, is the average output of 1996-98 for maize, wheat and rice respectively. Given the current per capita grain consumption level, the probability of a province being an exporter of a particular grain is expected to increase with the increase of per capita output of that grain in that province.

Provincial per capita income, denoted as PI, is approximated by the average per capita provincial GDP of 1996-98. An increase of per capita income will increase the total consumption of grains, including both direct and indirect grain consumption. Therefore, higher provincial per capita income is assumed to have a negative impact on the probability of a province being a net grain exporter.

It should also be noted that other empirical work indicates that after a certain income level, a further increase in per capita income will lead to a decline in the direct consumption of grains while the indirect consumption of grains, like meats, eggs, dairy products and high valued processed grain products, will increase. If these products are produced locally, the total quantity of grains demanded locally will increase, thus increasing the probability of importing grains from other regions. In this case, the increase of per capita income will tend to increase the probability of a province being a net grain importer. However, if a considerable portion of the local consumed meats, eggs, dairy products and high valued processed grain products are imported from other regions, the total quantity of grains demanded locally might not increase. In this case, the increase of per capita income would not have significant impact on grain flows. In this case, the actual impact of per capita income on regional grain flows is inconclusive.

The share of urban population of province, denoted as SUP, is the average share of urban population in the province from 1996 to 1998. It is assumed that the higher the share of urban population, the larger the grain demand will be. Therefore, a higher value of SUP is expected to have a negative impact on the probability of a province being a net grain exporter.

One qualification is that, in general, urban people have a higher per capita income and tend to consume more animal products and more high value and processed grain products than their rural counterparts. The impact of the share of urban population on regional grain flows is also partially affected by the situation of whether these products are sourced locally or are imported from other regions.

Finally, in order to test whether there is a significant difference in the impact of the comparative advantage indicators, and of other grain supply and demand variables, on the pattern of regional trade flows of the three crops, three dummy variables, W for wheat, M for maize and R for rice, are also used in the estimation. The test is that, for example, if the estimated differential coefficient of the particular dummy variable, for example DRCC, for wheat (W) is significantly different from 0, it indicates that the impact of DRCC on the pattern of regional trade flows for wheat differs significantly from that of maize and rice.

4.2 Regression results and explanations

The regression results for the relationship between the pattern of regional grain flows and the comparative advantage indicators and other grain supply and demand variables in China in the late 1990s are reported in Table 2. Because the correlation coefficient between DRCC and NSP is very high which is -0.91, to eliminate the potential problem of collinearity, the variables of DRCC and NSP are entered into the regression equation separately. Therefore, we have two regression models. Both models are performed relatively well. The likelihood ratio test is 30.34 (with 6 degree of freedom) for Model I and 31.02 (with 6 degree of freedom) for Model II, both are statistically significant at the 1% significance level, which suggests the statistical soundness of the estimated results. Furthermore, the Cragg-Uhler R^2 is 0.65 and the Mcfadden R^2 is 0.49 for Model I, and the Cragg-Uhler R^2 is 0.67 and the Mcfadden R^2 is 0.50 for Model II, both of which indicate the relatively high explanatory power of the estimated equation.

Table 2 Estimation results of the pattern of regional grain flows in China (late 1990s)

Variables	Model I	Model II
Constant	3.9964	-6.8568
	(0.8789)	(-1.7877)
DRCC	-10.604	
	(-2.4484)**	
NSP		0.01631
		(2.7176)**
EAI	2.5909	2.6112
	(0.9934)	(0.9709)
SAI	0.04999	0.1564
	(0.07328)	(0.2083)
PQ	22.304	25.482
	(2.7567)**	(2.9231)**
PI	-0.000055	-0.000136
	(-0.2849)	(-0.6685)
SUP	-0.01494	-0.00962
	(-0.3338)	(-0.2089)
Likelihood Ratio test	30.34 (with 6 D.F.)	31.02 (with 6 D.F.)
Cragg-Uhler R^2	0.65	0.67
McFadden R^2	0.49	0.50

Note: Asymptotic t-ratios are in parentheses; estimates with ** are significant at the 5% significance level.

The estimation results reveal interesting information about the relationship between the pattern of regional grain flows and the regional comparative advantage in grain production in China.

First, the coefficient estimates for the first set of comparative advantage indicators of DRCC and NSP are both significant at the 5% significance level. The sign is negative on the coefficient for DRCC and positive on the coefficient for NSP. This conforms to the expectation that the smaller the value of DRCC and the larger the value of NSP in a province, the stronger the comparative advantage of that province will have in that particular grain and, therefore, the more likely it is that that province is a net grain exporter (either in maize, wheat or rice). This result also reveals that the pattern of China's regional grain flows is consistent with its regional comparative advantages in grain production, as measured by Domestic Resource Costs and Net Social Profitability.

Second, the coefficient estimates for the second set of comparative advantage indicators of EAI and SAI are not significant. The possible explanation for EAI may be that, first, a higher crop yield in a province might not necessarily lead to a higher total output of that crop in that province compared to other provinces because the expansion of that crop production might be constrained by the availability of land and other resources in that province, especially when the province is a minor producer of that crop. Second, a higher crop yield sometimes is associated with higher production input costs. In that case, the economic efficiency and competitiveness of that crop production is actually low, which will tend to reduce the incentives in that crop production, thus reducing the possibility of outflows of that crop.

As for the lack of significant of SAI, the first explanation is similar with that for EAI. For example, the three municipalities, Beijing, Tianjin and Shanghai, have very high relative shares of sown areas in either maize, wheat or rice in their total grain sown areas, but because of their small size with very limited arable land, their total production of either maize, wheat or rice is very low compared to other provinces. Therefore, even though they have relatively higher share in grain sown areas of these crops, their ability to export grains is low. Second, the use of SAI implies that farmers are able to respond to changes in the market situation with an adjustment in their crop mix in order to maximise profits in grain production. However, as we already discussed in Section 3, this assumption may not hold in China because of government intervention in grain production. Chinese farmers are not able to fully adjust their grain production mix, thus preventing them from realising their comparative advantage.

Third, the coefficient estimate for the provincial per capita grain output is positive and significant at the 5% significance level. This confirms our expectation that the higher the per capita grain output in a province, the higher the probability of that province will be a net grain exporter.

Fourth, the coefficient estimates for provincial per capita income (PI) and the share of urban population of province (SUP) are not statistically significant. The impact of per capita income and the share of urban population on regional grain flows is partially affected by the situation of the regional flows of animal products and high-value processed grain products. The estimation results might actually imply that there exists a large quantity of regional flows of animal products and high-value processed grain products among China’s provinces.

Finally, the test results for the difference in the impact of comparative advantage indicators and other grain supply and demand variables on the pattern of regional trade flows of wheat, maize and rice are reported in Tables 3 and Table 4. Based on the estimation results in Table 2, the variables of DRCC, NSP and PQ are included in the test. The test results show that there is no statistically significant difference in the impact of DRCC, NSP and PQ on the pattern of regional trade flows for each individual grain crops of wheat, maize and rice.

Table 3 Test results for differences in the pattern of regional trade flows of Wheat, Maize and Rice in China (late 1990s)

Variables	Model I	Model II	Model III	Model IV
Constant	5.9442	5.8143	7.4307	4.9607
	(1.9907)**	(1.9018)*	(1.8632)*	(1.3667)
DRCC	-10.254	-9.7244	-12.194	-11.942
	(-2.5267)**	(-2.3381)**	(-2.0581)**	(-2.4317)**
PQ	20.816	18.994	19.986	39.654
	(3.0391)***	(2.6587)**	(2.2392)**	(2.1424)**
DRCCW		-4.8839		
		(-0.94627)		
PQW		24.665		
		(0.89598)		
DRCCM			-4.8560	
			(-0.85515)	
PQM			43.196	
			(1.1027)	
DRCCR				3.7981
				(1.0712)
PQR				-25.934
				(-1.2773)
Likelihood Ratio test	27.64	28.77	30.74	30.27
	(with 2 D.F.)	(with 4 D.F.)	(with 4 D.F.)	(with 4 D.F.)
Cragg-Uhler R^2	0.61	0.63	0.66	0.65
McFadden R^2	0.44	0.46	0.49	0.49

Note: Asymptotic t-ratios are in parentheses; estimates with ***, ** and * are significant at the 1%, 5% and 10% significance level respectively.

Table 4 Test results for differences in the pattern of regional trade flows of Wheat, Maize and Rice in China (late 1990s)

Variables	**Model V**	**Model VI**	**Model VII**	**Model VIII**
Constant	-4.4760	-4.5702	-5.6180	-6.1845
	(-3.2430)***	(-3.2509)***	(-2.9754)**	(-3.1025)***
NSP	0.014506	0.014934	0.018907	0.013205
	(2.7968)**	(2.7643)**	(2.6613)**	(2.0392)**
PQ	22.779	22.510	25.041	37.233
	(3.2304)***	(3.1702)***	(3.0463)**	(2.7573)**
NSPW		-0.0033559		
		(-0.21061)		
PQW		3.2928		
		(0.41728)		
NSPM			0.0023079	
			(0.10718)	
PQM			10.306	
			(1.2107)	
NSPR				0.0081622
				(0.57099)
PQR				-13.148
				(-1.5598)
Likelihood Ratio test	27.11	27.30	29.02	30.17
	(with 2 D.F.)	(with 4 D.F.)	(with 4 D.F.)	(with 4 D.F.)
Cragg-Uhler R^2	0.60	0.61	0.63	0.65
McFadden R^2	0.44	0.44	0.47	0.49

Note: Asymptotic t-ratios are in parentheses; estimates with ***, ** and * are significant at the 1%, 5% and 10% significance level respectively.

5. Conclusion

Regional grain flows in China have been expanding with the growth of grain production and the development of grain markets, especially in the 1990s. Promoting regional grain flows based on the principle of comparative advantage can improve China's aggregate economic efficiency through better use of agricultural resources. It can also add to the gains from China's participation in the international grain markets. The question is whether the current pattern of regional grain flows is consistent with the distribution of regional comparative advantage in grain production in China? This study has attempted to answer this question.

A binomial logit model is employed which adopts a discrete variable for each observation, with the value of one if the province is a net grain exporter (either maize, wheat or rice) in the late 1990s, and zero otherwise. The study uses the data sets of net grain (either maize, wheat or rice) flow position of provinces in the late 1990s, summarised from Wang Zhonghai, et al (2000), regional comparative advantage indicators of maize, wheat and rice in the late 1990s, calculated by Zhong Funing, et al (2000), and other variables affecting the supply and demand in grain markets.

The study revealed that the current pattern of China's regional grain flows was consistent with the structure of regional comparative advantage in grain production, measured by the comparative advantage indicators of Domestic Resource Costs Coefficient (DRCC) or Net Social Profitability (NSP). This suggests that the regional and structural readjustment in agricultural production in the 1990s has achieved positive results in improving regional resource allocation in grain production in China.

The study also found that the Efficiency Advantage Indices (EAI), measured by relative grain yield, and the Scale Advantage Indices (SAI), measured by relative grain sown area, were not statistically significant determinants of the observed pattern of regional grain flows in China. The explanation may be that government intervention in grain production is still an obstacle for the Chinese farmers as they try to optimise their grain production mix.

The results found that the per capita grain output contributed positively to a province's probability of being a net grain exporter.

The study also found that per capita income and the share of urban population of province were not statistically significant explanators of the patterns of trade flows. One complication in identifying the effects of these variables on grain trade flows arises from the impact of trade in animal products and processed grain products. The lack of significance of these variables could be an indicator of the extent of the regional trade in these items.

Finally, the study found that there is no statistically significant difference in the contribution of these variables to the pattern of regional trade flows of wheat, maize and rice.

The results of this study have important policy implications for domestic grain marketing reform in China. Impediments to regional trade continue to exist in China. Reform measures should be designed to accelerate domestic grain market development and promote regional grain flows based on the principle of regional comparative advantage. Moreover, reform measures should also be designed to reduce government intervention in grain production and to allow farmers to have more freedom to adjust their grain production mix in order to achieve a more efficient resource allocation and realise their comparative advantage in grain production.

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