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Spatial Market Integration and the Dynamics of Transaction Costs in the Chinese Soy Bean Market

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Abstract: The development over time of market integration between Chinese provinces is analyzed by estimating threshold vector error correction models for rolling windows during 1998-2003. Transaction costs clearly decrease during this period characterized by liberalization of external trade and domestic markets.

JEL classification Number: C32, F15, F16, N55, Q13, Q17.

Keywords: Threshold Cointegration, Spatial Market Integration, China, Transaction Costs.

1. Introduction

There is a growing literature on spatial integration of markets in the presence of transaction costs. Balke and Fomby (1997) pioneered threshold cointegration methodology, which can be applied for retrieving information on transaction costs from data on prices in spatially separated markets. Adjustment towards the long run equilibrium of prices is triggered only if arbitrage across markets is profitable; hence if deviations from the equilibrium exceed a threshold which represents the level of transaction costs. Hansen and Seo (2002) extend the univariate setup of Balke and Fomby to a multivariate cointegration framework of the Johansen type. The introduction of threshold cointegration methodology has spawned a

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large stream of empirical applications for testing market integration in various economic fields, including purchasing power parity (e.g., Lo and Zivot, 2001) financial markets (e.g., Siklos and Granger, 1997), and markets for gasoline (e.g., Chen et al., 2005) and agricultural commodities (e.g., Goodwin and Piggott, 2001, Meyer, 2004, and recently Ben-Kaabia and Gil, 2007).

We complement previous research by focusing on the dynamics of spatial market integration. We aim to measure the development of transaction costs over time, defined as the sum of all costs associated with a transaction including transportation costs. To allow for time-varying transaction costs seems appropriate when market institutions, infrastructure and the political environment change over time. We demonstrate error correction modeling in a rolling window analysis using soybean prices in four Chinese provinces for a period when commodity markets were liberalized. The emergence of markets for several agricultural commodities in China has been analyzed by Huang and Rozelle (2005).

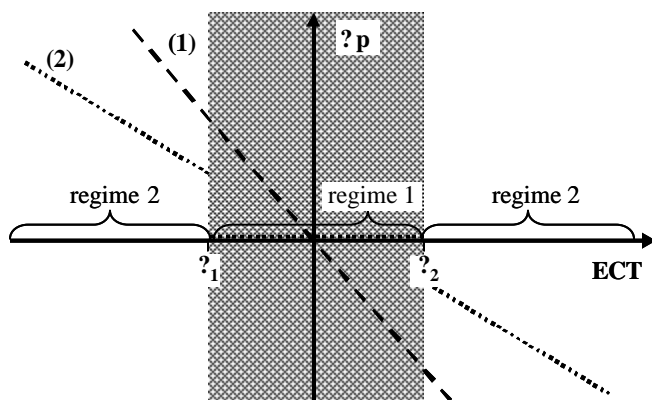
China is the world's fourth largest producer of soybeans and a large portion of the produce from the main production regions as well as imported quantities are shipped domestically to processors and users throughout the country. Towards the end of the 1990s the Chinese government has successively reduced its involvement in domestic grain and soybean markets. State control on inter-province shipments ended, State Grain Enterprises were encouraged to operate independently and profit oriented, and numerous private traders entered the market (OECD 2005). However, the (re)organization of the newly liberalized interregional trade between import harbors, surplus- and deficit regions was an ongoing process during the first half of the current decade. We analyze to what extent these developments are reflected in the dynamics of transaction costs estimated for rolling windows of fixed length covering the 1998-2003 period.

2. Method and Data

Previous threshold error correction models imply that the width of a non-adjustment band around price equilibrium is constant over time. Thus, they do not capture variability of transaction costs and are not suitable for evaluating (policy induced) changes of market integration over time. In our approach we identify thresholds for a rolling window of time spans, which involves breaking down the total sample into a number of consecutive sub

samples of fixed length. The procedure to identify transaction costs is based on the threshold vector error correction model (TVECM) proposed by Hansen and Seo (2002) and modified by Meyer (2004). Figure 1 shows the price change in one location (Δp) as a function of the (previous period's) deviation from the spatial price equilibrium (ECT). The symmetric thresholds τ_1 and τ_2 dividing the price adjustment process into two regimes are set within the range of this ECT. In contrast to the linear relation (line (1)) the path depicted as line (2) is flat within the interval $[\tau_1, \tau_2]$. This feature allows accounting for non-linearities due to transaction costs that prevent adjustments to small deviations in regime 1 (hatched area).

Figure 1: Error Correction Paths



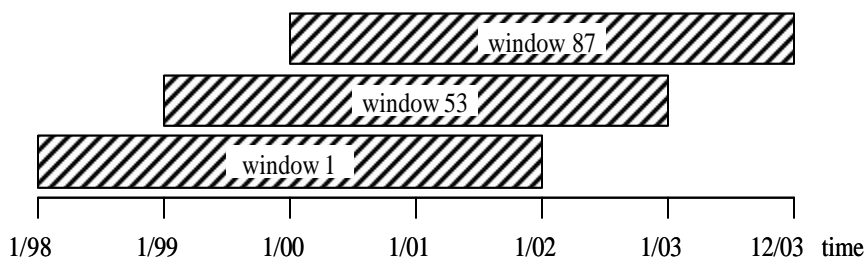
Presentation based on Meyer, 2004.

Our procedure consists of three steps for each time window: First, we test for cointegration among province pairs using the Johansen method. As a second step, we test for market integration, i.e. long run co-movement of the prices. Market integration is accepted if the cointegration coefficients are not significantly different from unity. Third, we utilize the TVECM to test for linear vs. threshold cointegration deciding upon the difference between the adjustment parameters of regime 1 and regime 2. Given the lack of a stringent distribution theory for the estimates (Hansen and Seo) we interpret the thresholds as indicating the level of transaction costs (Goodwin and Piggot, Meyer). This implies that in regime 1 no equilibrating price adjustment takes place. Comparing the results across windows provides insights into the development of transaction costs and market integration over time.

We analyze series of wholesale prices for soybeans in four provinces for the period from January 1998 to December 2003. The provinces Heilongjiang and Jilin in the north east are the biggest production (and surplus) areas while Beijing and Henan in east-central China are net-importing regions. Together they represent half of total domestic production in 2003, emphasizing the importance of the north eastern region for soybean production. The data were collected by the Jilin Province Grain and Oil Information Center (JGOIC) at trading spots which are considered representative for the respective province: grain storage bureaus, traders or processing firms. Our original data set contains weekly prices except for 14 gaps (of one or two missing weeks) so that we finally use 294 observations.

We set the window width to 208 weeks (4 years) to have a sufficient number of observations for each estimation and thus, allow the model to find a meaningful long run equilibrium. Hence, we ‘move’ a window of four years width within a sample covering six years, which produces 87 windows, as displayed in Figure 2.

Figure 2: Rolling Windows



We capture the dynamics of market integration and transaction costs during two years.¹

3. Empirical application and results

Based on the Johansen trace statistic, 57% of all possible combinations of provinces and windows are cointegrated.² The relative occurrence of market integration, indicated by cointegration coefficients not different from unity, is somewhat lower at 41%. However, market integration differs across provinces. As indicated in Table 1, markets in the two surplus regions Heilongjiang and Jilin show integration with the other provinces in 54% and 49% of all windows respectively, whereas for Beijing this figure is only 16%.

¹ The number of windows is less than the number of weeks in two years because of the mentioned gaps in the weekly data.

² Detailed information is available from the authors.

Table 1: Results of Market Integration

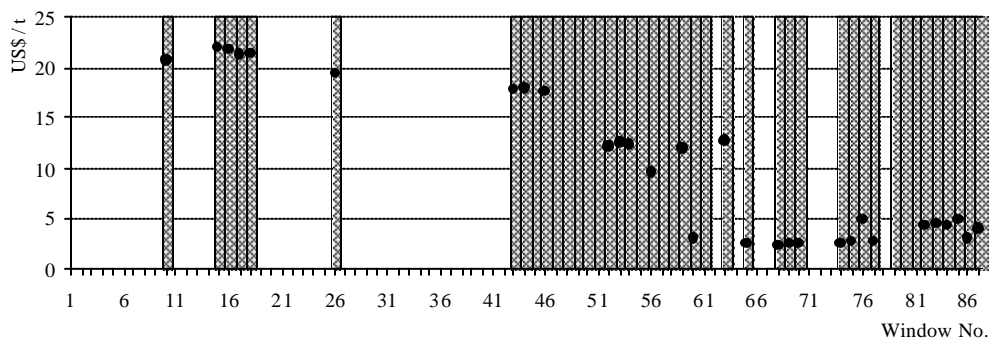
	Heilongjiang	Jilin	Beijing	Henan	Average
Heilongjiang		63%	19%	59%	54%
Jilin	53%		48%	28%	49%
Beijing	12%	16%		14%	16%
Henan	53%	42%	17%		42%
Total average					41%

Note: *Percent of windows with integrated markets based on all possible windows

For a more detailed presentation of our further results we focus on Jilin, due to its outstanding market integration pattern.

Figure 3 presents results for the relation Jilin-Henan with the windows from 1 to 87 on the x-axis. The hatched areas mark windows with integrated markets. There are only few windows with market integration in the first half of the total range. This means that sufficiently long periods of price co-movement within a window cannot be found unless the time towards its end (from mid of 2002 onwards) is included. The time from 1998 to mid 2002 has obviously seen major changes in the price equilibrium so that common cointegration vectors could not be established for most of these windows. This may reflect the emerging of a vivid trading sector in this period, consisting of more self reliant State Trading Enterprises as well as new private traders.

Figure 3: Dynamics of Market Integration and the Estimated Thresholds: Henan-Jilin



Among those 43 windows with integrated markets we find 30 windows with significant thresholds indicated by dots. The estimated thresholds are interpreted as transaction costs,

measured in US\$ per ton. If prices in Jilin differed in the preceding week from the equilibrium with Henan by less than the threshold value no adjustment in Jilin occurs.

The application of a rolling window analysis captures the effects of continuous adjustment to a changing economic environment with decreasing transaction costs: For the windows representing periods of market integration in the first half of the total range the level was above 20 USD/t, i.e. almost 10% of the price. After that period, i.e. from window 43 onwards we observe transaction costs decreasing to around 18 and then 13 USD/t. This may be attributed to the transformation process in the Chinese economy, the emergence of internal markets as mentioned above, and indirectly related to China's accession to the WTO. Although the soybean market started opening up already in 1998, the WTO accession in 2001 had an impact on the economy at large, i.e. also on transport and communication and other trade facilities. For the periods represented by windows 60 and higher we can no longer establish a decreasing trend. This suggests that the adjustment to the opened internal markets and the shock of the WTO accession was completed. The average level of transaction costs was around 3-5 USD/t, less than 2-3% of the price, which is substantially lower than in all the other periods. The relation Henan-Jilin represents a very clear case of decreasing transaction costs. This general pattern is found in all the other relations too.

The relatively low level of transaction costs, particularly at the end of the period conforms with findings of Park et al. (2002) and Huang and Rozelle (2005) who show for several commodities that regional markets are similarly well integrated in China as in the United States.

4. Conclusions

Application of threshold error correction models in a rolling window mechanism is suitable to assess continuous development of transaction costs over time. Although the available data are limited to four Chinese provinces and only one province is found to have its soybean markets well integrated with other provinces, we gain a plausible picture of transaction costs, market integration and the development of trade opportunities during the 1998-2003 period.

China's internal commodity market reforms and its accession to the WTO combined with the ability of the market to adjust quickly to new situations provide the basis to gain welfare by efficient reallocation of scarce factors, resources, and products. Transaction

costs in soy bean trade fell from 10% to 2% in our example, and evidence suggests that Chinese soy bean markets are well integrated.

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