Domestic Market Fragmentation and Economic Growth in China

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Protectionism and industry localization in Chinese provinces

Abstract

This paper analyses the relationship between domestic market integration and economic performance at the sub-national level within China.

It follows a two step procedure. First, it estimates a province-level indicator of market fragmentation based on the methodology pioneered by Engel and Rogers (1996) and recently expanded by Parsley and Wei (2001). Specifically we focus on price dispersion rather than trade flows that are typically examined in the literature. We argue that inter-regional price volatility in integrated economies should not depend on the relative position of markets. We use a three-dimensional data set of monthly prices on 7 agricultural goods, between 1987 and 1997 across 170 cities of 28 provinces. We deem a province to be poorly integrated when inter-market price dispersion is greater for markets that lie on different side of its border than for markets that locate within the province, after distance and market specificities are controlled for.

Second, it then embeds this measure of market fragmentation into a cross-province growth framework, estimated with the GMM method.

We find that provincial borders matter in China, in the sense that they imply great discontinuities in the price arbitrage process. Chinese domestic market integration does not appear to have much improved between 1987 and the middle of the 1990s.

Our analysis of provincial growth dynamics underline the favorable impact of market integration on economic performance and agricultural value-added. It confirms the beneficial role of the fight against provincial protectionism.

JEL Codes: F02, F14, F15, O52, R58.

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Introduction

This paper studies whether market segmentation retards economic growth in the context of China. Market segmentation means that goods, services and factors of production -capital and labor- are not easily mobile across different regions. China's political and economic structure is described as de facto federalism. It is traditionally based on a decentralized regional planning where provinces[1] can be considered as autonomous economic actors that govern most economic activities and have huge regulatory, economic and financial powers in hands[2].

Figure 1 presents a map of China that highlights Chinese administrative divisions.

Empirical works often recognize the existence of local protectionism along the reform course and treat Chinese provinces as distinct due to their autonomy and the presumed limited economic integration among them[3].

However, authors do not agree on the evolution of market performance in China and specifically on whether or not the deepening of market economic reforms in the 1990s has led to greater domestic integration. Assessments of market performance and most importantly of its development have been mixed.

On the one hand, observers acknowledge the active promotion of transport infrastructure building by Chinese central authorities. Naughton (1995) furthermore underlines the efforts made in creating a unified competitive marketplace notably through the development of private and collective sectors and price liberalization. On the other hand, not only most studies do conclude that there is a general lack of integration between regional markets (Zhou et al. (2000), Cheng and Wu (1995)) but also recent articles by Young (2000) and Poncet (2002 and 2003) argue that China's domestic markets became more fragmented over the 1990s.

The issue of regional economic integration in China takes on particular importance since the country joined the World Trade Organization. It fuels a growing number of studies of China's market integration. Unfortunately, these analyses suffer from four major shortcomings. First, studies are so far mainly focused on single products and/or specific regions so that their findings can hardly be generalized. Second, there are often problems with the data related to averaging and aggregation of the information over various locations or over several products[4]. Third, they test whether or not markets are integrated on average at a specific time but seldom estimate changes over time and how integration varies across provinces. And yet, the real issue deals with the impact of the reforms on province-level market integration. Fourth, they fall short of examining the implications of the degree of measured market integration, notably on economic growth.

This study aims at overcoming these deficiencies by relying on a very disaggregated data set. We focus on price dispersion rather than trade flows that are typically examined in the literature through gravity models to compute time varying provincial all-inclusive indicators of market integration. We use a three-dimensional panel of monthly prices on 7 homogeneous agricultural products (rice, corn, egg, peanut, hog, beef and mutton) from 170 individual market sites across 28 Chinese provinces between January 1987 and December 1997.

As put forward by Parsley and Wei (2002), the study of cross sectional dispersion of common currency price differentials is a very useful way to study goods market integration. It has a theoretical background and does not suffer from the classical limitations of trade flows-based approach. Indeed, the connection between market integration and trade flows can be rather loose. The volume of trade depends not only on gravitational factors (size, distance etc.) but also on the degree of substitutability of each partner's output. All else equal, two countries each producing low substitutable output may trade more

had they produced high substitutable output. This may hold even if trade barriers are lower in the latter case. Engel and Rogers (2000) further argue that in the traditional trade theory, the absence of trading costs does not imply a necessary large volume of trade since it also depends on such things as factor endowments or market size. The volume of flows could be use as an efficient measure of openness only if the evolution of these other factors beside integration were accurately controlled for.

Prices reflect changes in market integration whether trade occurs or not and whatever the degree of substitutability of output, market size and factor dotations. It is the potential for arbitrage that dictates the range of prices fluctuations.

We adopt a price-based approach and measure market integration within China focusing on observed deviations from the Law of One Price for a set of homogeneous agricultural products. This procedure draws from the original argument of Heckscher (1916) that the existence of costs of arbitrage imposes an inequality constraint between prices in two locations. Greater market integration (lower tariffs, reduced transport cost and other costs of arbitrage) unambiguously translates into a lower dispersion of prices of identical goods.

We argue that the primary culprit behind China's apparent lack of market integration is the presence of provincial borders that divide Chinese domestic market. We borrow from the border effect literature pioneered by Engel and Rogers (1996) and investigate how provincial border-related trade barriers prevent price arbitrage. In integrated economies, all else equal, the relative position of markets, especially the existence of a border separating them should not affect their relative price. It should therefore have no impact on the no-arbitrage band. Our regression approach uses the study of provincial border effects in the price divergence across market-pairs and over time to infer the degree of integration of the Chinese economy.

We compare the price dispersion for intra-provincial market-pairs with that for cross-border market-pairs and deem provinces to be integrated when their borders have no impact on observed deviations of the Law of One Price once transport costs (proxied by distance) and market specificities are controlled for.

Time-varying provincial border effects are computed to assess how market performance evolves over time in China. They are then introduced in the traditional growth regression framework, using the GMM estimator, to show how market fragmentation affects GDP and agricultural value-added growth.

As far as we know, this paper is the first that uses this methodology on this topic.

The results underline the economic importance of the Chinese provincial borders to be substantial as they are significant explanatory variables in accounting for observed deviations of the Law of One Price.

We find the impact of borders on price dispersion to vary greatly between provinces. The overall hierarchy of the computed provincial indicators of market integration is very much coherent with the entire literature on market development in China. The impact of Chinese provinces' borders on the width of no-arbitrage zone does not appear to vanish over time, putting into question the capacity of the reforms to enhance market integration within China.

The empirical analysis of the impact of market integration on economic performance confirms the detrimental feature of spatial discontinuities.

We find strong and robust evidence of a negative effect of provincial market fragmentation on both per capita agricultural value-added growth and global per capita GDP growth.

This paper proceeds as follows: section I develops the method used to measure provincial market integration and proceeds to the empirical

estimation. Section II presents a formal analysis of the impact of market integration on the economic performance of Chinese provinces. Section III concludes.

1 Empirical methodology and estimation

1.1 Empirical methodology

Measuring market integration based on the study of deviations from the Law of One Price has been the focus of a dense literature.

As Engel and Rogers (1996) argue, "the failure of prices of similar goods to equalize between sites is a sign that the markets are not completely integrated". Indeed, a fundamental proposition of economic theory is that in absence of transaction costs, taxes and other barriers to cross-city trade, identical goods must sell for the same price[5]. Prices will fail to equalize when there are barriers to the free flow of goods. As such, a comprehensive measure of how well two markets are integrated is how closely prices adjust to each other in those markets.

A first simple explanation for deviations from the Law of One Price (LOOP) focuses on costs of arbitrage. As recognized first by Heckscher (1916), prices for a similar good may differ between cities due to costs of arbitrage, most importantly due to transportation costs that place a lower bound on the differentials before arbitrage takes place. The presence of costs of transporting the tradable good imposes two inequality constraints on the prices of an identical good, k, in two differnt locations i and j:

$lnP(i,k,t) + lnC(ij,k,t) \geq lnP(j,k,t)$

and

$lnP(j,k,t) + lnC(ij,k,t) \geq lnP(i,k,t)$

We thus obtain a band of no-arbitrage equal to:

$-lnC(ij,k,t) \leq lnP(i,k,t) - lnP(j,k,t) \leq lnC(ij,k,t)$

Intuitively, as argued by Parsley and Wei (2001), any particular realization of the price differential $Q(ij,k,t) = lnP(i,k,t) - lnP(j,k,t)$

may not be zero and can either be positive or negative without triggering arbitrage as long as $|Q(ij,k,t)|$ is less that the cost of arbitrage. The existence of arbitrage costs does not imply any particular realization of relative prices but defines a range within which $Q(ij,k,t)$ must fall.

Our strategy in this paper is to investigate the importance of border effects as impediments to arbitrage through the study of a measure of the dispersion of $Q(ij,k,t)$ through time.

We follow the litterature in studying the feasible range of deviations of the Law of One Price based on measures of volatility such as the standard deviation or the inter-quartile range of the empirical distribution of the price dispersion.

The implicit assumption here is that the volatility measure is proportional to the true range of no-arbitrage across time and across different pairs of locations.

The difference between $Max[Q(ij,k,t)]$ and $Min[Q(ij,k,t)]$ is not chosen as a measure of the no-arbitrage band since it would certainly be driven by a few outliers.

Our application to Chinese market development specifically aims at studying the spatial discontinuities implied by provincial borders. As such in addition to considering transportation costs, we examine border-related impediments to price arbitrage. Our empirical method relates to the border effect literature. This literature was established by Engel and Rogers (1996) who analyze price dispersion between US and Canadian cities and find that price variation is much higher for two cities located in different countries than for two equidistant cities in the same country[6]. The border effect measures the extent that border-related trade barriers prevent price arbitrage since, in integrated markets, borders should not have any impact on relative price dispersion.

The basic hypothesis is that in absence of market segmentation, the

dispersion of the relative price of a similar product between markets should not be influenced by their respective regional location once transportation costs between them is controlled for.

However various studies on price patterns underlined that the border matters[7]. Main contributions include studies of Engel and Rogers (1996) on the US and Canadian border, Engel and Rogers (2001) on European market integration,O'Connell and Wei (2002) on price differences across US cities, Parsley and Wei (2001) on the border effect between US and Japan. They all find large border effects, however declining over time.

To the extent that prices of comparable goods differ within China, these differences should be explained by transportation costs that eliminate arbitrage opportunities and should in no way be related to the regional position of the markets. The variation of the price should be the same for two markets located in different provinces than for two equidistant markets in the same province. At least the importance of regional borders in explaining price dispersion across China's locations should diminish over time, in relation to the reform progress.

1.2 Data source

This research relies on a unique very disaggregated price dataset compiled by the survey centre of Research Center for the Rural Economy (unpublished) that spans January 1987 through December 1997.

Exactly 170 sites from 28 of China's provinces report prices of different agricultural commodities every 10 days. The prices are the average price of transactions that day in the local periodic market. We compute monthly price as the average of the three prices over a given month.

Appendix 2 lists the various markets by province covered by the dataset. As the dataset only covers 2 cities in the province of Qinghai, we decide not to compute the border effect for Qinghai, but keep the

data of Qinghai cities in the sample.

We study all bilateral price comparisons allowed in our dataset. Thus, we go beyond most studies that compute relative price after picking one location as the reference. There are 14,365 market pairs [=(170*169)/2] - each with monthly time periods between January 1987 and December 1997. Therefore, for each of the agricultural goods, the vector of relative price contains potential 1,896,180 observations (=14,365*11*12).

As our focus in this study is on the arbitrage of prices over time we need to concentrate on homogeneous and non-seasonal goods. We therefore disqualify exotic fruits, highly perishable products as well as heterogeneous products. Additionally, not all goods are available in each time period and the spatial coverage varies hugely between products. Since we are interested in both cross-sectional and time series variation, we decide to concentrate on the seven goods where data is the most available, namely rice, corn, peanut, egg, hog, beef and mutton[8].

Our dataset is exceptional in the sense that it covers several markets in each province. The above-mentioned research on Chinese price integration in China always looks at price integration between provinces on the basis of prices for one single market per province.

We argue that the border of a given economic entity should on the opposite be calculated based on the direct comparison of price dispersion of cross-border market pairs with that of domestic markets pairs.

The counterfactual used as the norm to compute the border effect existing in cross-border price arbitrage for a specific Chinese province should be the average price dispersion within its borders. It should therefore not include markets pairs for which none of the markets is located in the province.

In this paper, intra-provincial price dispersion is matched against

cross-border price dispersion for each specific border to compute provincial border effect.

1.3 Empirical estimation

We denote as $P(i,k,t)$, the yuan price of good k in market i at time t. Let t=1, 2, ..., M denote a particular month and year in which the price is computed. For a given city pair (i, j) and a given good k at a time t, we define the price difference as:

$Q(ij,k,t) = lnP(i,k,t) - lnP(j,k,t)$

We compute first difference of $Q(ij,k,t)$, denoted $q(ij,k,t)$, in order to take into account potential non-stationarity. Engel and Rogers (1996, 2000, 2001) show that qualitatively the same results are obtained whether using the standard deviation of the 12-month ahead forecast error[9] and using the standard deviation of the first difference of $Q(ij,k,t)$[10]. As noted by Engel and Rogers (2000), relative price is theoretically not expected to have a unit root. In practice, however, even if it is stationary, it is so persistent that there is very little evidence that price series converge. The authors consider the volatility of the first difference of relative price as the measure that enhances the reproducibility of their findings.

Let $DLOP(q(ij,k,s))$ denote the Deviation from the Law of One Price of $q(ij,k,t)$ over the year s. We gauge this deviation by the most widely used measure of dispersion that is the standard deviation of the empirical distribution of $q(ij,k,t)$. It corresponds to the width of the no-arbitrage zone and thus proxies the degree of market fragmentation.

Our regression attempts to explain $DLOP(q(ij,k,s))$, the dispersion of price changes for a given market-pair (i,j) and good k over year s. It further aims at investigating whether dispersion is greater when the two markets i and j lie on the opposite sides of the provincial border than when they are both located in the same province.

We estimate the equation:

$$
\begin{aligned}
DLOP\left(q(ij,k,s)\right) &= \sum_{k}\sum_{s}\beta_s^k + \sum_{s}\sum_{x=1}^{z}\lambda_s^x D_s^x \\
&+ \sum_{k}\sum_{s}\phi_s^k distance_{ij} + \sum_{k}\sum_{s}\psi_s^k distance_{ij}^2 \\
&+ \rho border_{ij} + \epsilon_{ij} \qquad (1)
\end{aligned}
$$

We allow the relative price dispersion to vary from market to market considering that prices in some markets could be more volatile than the average due to idiosyncratic measurement error or seasonalities there. D_x is a dummy variable for each market in our sample. For each market pair (i,j) the dummy variables for market i and market j take on values on 1. We introduce yearly market dummies.

Because the different goods may have different degrees of price volatility every year, we include yearly dummy variables β_s^k for each product k.

Let $distance_{ij}$ be the real road distance in kilometers between city i and j and $distance_{ij}^2$, its squared value. We hypothesize that the variability of relative price will be larger the greater the distance between locations. As in gravity model of trade, we postulate following Engel and Rogers (2001) a concave relationship between $distance_{ij}$ and $DLOP(q_{ij,k,s})$ and thus expect $\psi > 0$ and $\phi < 0$. We consider a concave relationship between the volatility of $q_{ij,k,s}$ and distance because shipping costs do not rise linearly with distance: at shorter distances shippers might employ truck that would not be economical over longer distances. As different transport costs apply to the our agricultural products and as transport costs may evolve over time, we allow yearly specific coefficients on $distance$ and $distance^2$ for each good.

A huge effort was put in the measure of the real distance between cities. Distances are computed following the shortest itinerary and the most rapid roads based on very detailed maps. This method helps to control for the fact that communication and transportation conve-

nience varies enormously across and within provinces.

The dummy variable $Border_{ij}$ is equal to 1 if markets i and j are located in different provinces. The literature on border effect traditionally studies a single border (i.e US-Canada border in Engel and Rogers (1996), US-Japan Border in Parsley and Wei (2001)). Here the innovation lies in that we study the impact of the individual borders for each one of different provincial economic entities in China. The border effect is intended to capture the additional deviation from the Law of One Price due to the crossing of a provincial border. It is therefore computed as the difference between the average price deviation for intra-provincial market-pairs and cross-border market pairs for a given province. It implies that equation 1 needs to be run for each province separately, that is considering only market pairs in which at least one market lies in the province.

Table 1 in Appendix reports the results of equation 1 on separate years. The size and the evolution over time of the overall border effect estimates are coherent with the evolution of the market reforms and market performance over the period in China as described in Park et al (2002). Greater border effects are found in 1988-89 and 1994-95. Our results stress that border related costs of arbitrage persist over the 1990s[11].

Table 2 displays the average border effect for each province. The border effect for province P is obtained from the regression of equation 1 on the sub-sample of observations for which either market i or market j belong to province P[12]. We compare the no arbitrage band width when the two markets are located on different sides of the border with that when both markets lie inside the province. The border dummy captures the additional costs of arbitrage implied by crossing the specific provincial limits, once distance is controlled for.

The coefficient estimates obtained for border effects are in line with the results obtained when running regressions on the entire dataset.

We find the impact of borders on price dispersion to vary greatly between provinces. The results shed light on the spatial disparities of market integration. All coefficients are positive and almost all are significant at the 5% confidence level. A positive coefficient corresponds to a higher relative dispersion associated to the crossing of the provincial border effect over the period 1987-1997. Findings of non-significant average border effects over the entire period 1987-97 do not imply that there are no border-related trade costs for each year of the period. The border effects can indeed be significantly positive in some years.

The hierarchy of average provincial border effects appears consistent with provinces features and profiles stated in various studies such as Goodman and Segal (1994), Yang (1997) and Cheung, Chung and Lin (1998) and in stories on trade tensions. Lowest border effects and thus higher economic integration with the rest of the territory are found for coastal provinces of Guangdong, Liaoning and Hebei province and for three coastal municipalities (Shanghai, Beijing and Tianjin).

On the opposite, landlocked and depressed western provinces are characterized by greater impact of their borders on price dispersion: Inner Mongolia, Guizhou, Sichuan, Ningxia and Xinjiang provinces have border effects that are far higher than the other provinces. Western provinces tend to have larger border effects. The findings of greater discontinuities in the Western part of China and the hierarchy of the provincial indicators of market integration are very much coherent with the entire literature on Chinese market development.

The low border effects for Henan, Hubei and Hunan are in line with the central position of these provinces. They are located in the core of China, at the cross-roads of the country's two main transport axes: North-South and East-West.

We need to ensure the quality and the significance of our esti-

mates. We can legitimately doubt that the model based exclusively on prices of agricultural products can provide us with reliable indicators of overall market integration. We test if our indicator is representative of trade impediments applied by a province. We compute its correlation coefficients with other measures of trade barriers available in the literature. Poncet (2002) studies the trade-diminishing impact of provincial borders in 1992 and 1997. She relies on inter-provincial trade flows to compute provincial border effects. We find a significant correlation coefficient of 45% between the two measures.

Our interest is in studying the evolution of the border effect over time and its impact on economic activity. As a final step, we decompose each provincial border effect over time to assess the evolution of the economic integration of each specific province. We compute yearly border effects. Regressions are made separately for each province. Our results help to conclude about the market development in China and to highlight provincial specificities.

The border effects by province and time periods can be considered as all-inclusive indicators of impediments to price arbitrage and thus of lack of market integration.

All border effects are not always significant at the 10%. As already underlined in the general regression, our measure of the discontinuities in the price arbitrage process induced by the border is higher at the end of the 1980s and mid 1990s for most provinces.

The vector of these coefficients by province and years constitutes our indicator of fragmentation that will be used in the next section. We only consider significant coefficient at the level of 10%. Table 3 reports the twenty highest border effects obtained in our regressions.

2 Market integration and Growth

We turn now to the effect of market integration on growth. We introduce our indicators of provincial economic fragmentation estimated in

previous section in the traditional cross-country empirical framework.

Several studies analyze China's provincial growth dynamics. Most of them focus on trade openness, foreign direct investment, fiscal decentralization or infrastructure (Zhang and Zou (1996), Wang and Yao (2003) and Young (2000)). None of them focuses on the impact of domestic market development. As far as we know this is the first empirical study of the role of the market integration within China on economic performance[13].

2.1 The model

We use a dataset of 28 provinces and 6 sub-periods between 1987 and 1997 to study the impact of market integration of economic performance. We single out the year 1987 and then look at two-year subperiods between 1988-1997, respectively 1988-1989, 1990-1991, 1992-1993, 1994-1995 and 1996-1997. We estimate the following growth equation:

$$y_{i,t} = \alpha_0 y_{i,t-T} + \alpha_1 X_{it} + \alpha_2 MF_{it} + \eta_i + \gamma_t + \epsilon_{it} \tag{2}$$

where y_{it} is log-level of real per capita GDP in province i at time t, $y_{i,t-T}$ is its lag $T = 2$ years ago, X_{it} is a set of control variables in logarithm which are measured as averages over the two year period between t and and $t-T$ and MF_{it} is the provincial Market Fragmentation indicator estimated in the previous section. The disturbance term consists if an unobservable province fixed effect that is constant over time η_i, an unobserved period effect that is common across provinces γ_t and a component that varies across both provinces and periods which we assume to be uncorrelated over time ϵ_{it}.

This equation confronts us to four econometric problems. First, MF_{it} is the coefficient on the border effect that has been estimated in the previous section for province i and time period t. It is therefore measured with error as it is fitted with a standard deviation. Second,

the introduction of the lagged dependent variable together with fixed provincial effects renders the OLS estimator biased and inconsistent as the lagged dependent variable is correlated with the error term even in absence of serial correlation between ϵ_{it}. The third difficulty is that of omitted variables. Differences in economic growth across China reflect a variety of factors other than market lack of integration. To the extent that these factors are correlated with the border effect, the significance of MF_{ij} in the growth regression that omits these factors may simply reflect market fragmentation serving as a proxy for other policies and institutions that are conducive to growth. Finally, most of the explanatory variables (MF_{ij} as well as traditional control variables) may be endogenous with respect to economic growth. Notably, provinces may choose to liberalize, reduce impediments to price arbitrage and promote inter-provincial trade when growth performance is good.

Next section presents the Generalized Method of Moments that controls for these four empirical problems.

2.2 The Methodology

Generalized Method of Moments is the prominent way to address the problems of estimating growth regressions.

The first difference GMM estimator was originally developed by Arellano and Bond (1991) and was first introduced in the growth literature by Caselli, Esquivel and Lefort (1996).

The basic idea is to estimate the equation (2) in differences, using appropriate lags of the right-hand side variables as instruments.

The first difference procedure removes unobserved individual specific effects η_i so that estimates are no longer biased by time-invariant omitted variables[14].

The use of instrumental variables allows consistent estimation of the parameters even in the presence of measurement error and endogenous right-hand side variables (such as investment and schooling rates

and the indicator of market integration in our context of economic growth). The critical identifying assumption is that the time-varying error terms ϵ_{it} in the original level equation are serially independent. In that case, lagged levels of right-hand variables may be used as instruments of the subsequent first differenced variables.

2.3 Empirical Estimation

Our measure of market integration relies on a 3-dimensional panel of prices of only agricultural prices. As a first step, it is therefore interesting to investigate the impact of our indicator of border-related trade costs on real growth of agricultural GDP per capita.

The vector of control variables X_{it} is defined according to the augmented Solow model as proposed by Mankiw, Romer and Weil (1992). We introduce the increase in total power of machinery as a proxy for physical capital and the share of the population with more than primary schooling as a proxy for human capital.

Our basic equation includes four explanatory variables: the initial GDP of the primary sector per capita, the rate of investment in machinery power, the schooling variable and our indicator of market fragmentation computed previously in this study based on the deviation from the Law of One Price. We use the contemporary values of these last three variables as well as of other control variables introduced later to test the robustness of the model.

Appendix 2 reports the variable definitions and their statistical definitions.

The consistency of the GMM estimator depends on whether lagged values of the explanatory variables are valid instruments in the growth regression. We address this issue in considering two specification tests suggested by Arellano and Bond (1991).

The overall validity of the instruments can be tested using standard Sargan test of over-identifying restrictions[15]. It analyzes the sample analog of the moment conditions used in the estimation process. The

figures reported in the table for the Sargan test are the Chi^2 values for the null hypothesis, valid specification.

We also report tests for the absence of first-order and second-order serial correlation in the first-differenced residuals. If the disturbances ϵ_{it} are not serially correlated, there should be evidence of significant negative first-order serial correlation in differences residuals and no evidence of second-order serial correlation in the differenced residuals. Second-order serial correlation of the differenced residual indicates that the original error term is serially correlated and thus that the instruments are misspecified. On the other side, if the test fails to reject the null hypothesis of no second order serial correlation, we conclude that ϵ_{it} is serially uncorrelated and the moment conditions are well specified.

The Sargan test of overidentifying restrictions does not indicate a serious problem with the validity of the instrumental variables.

Failure to reject this null hypothesis of no second order serial correlation shown by the insignificance of test statistics gives further support to the model.

Results appear in Table 4.

The first regression (column 1) relies on the provincial fixed effect (within) estimator with standard errors that are robust to heteroskedasticity.

The remaining columns presents the regression results using on the one-step GMM estimators, with standard errors that are not only asymptotically robust to heteroskedasticity but have also been found to be more reliable for finite sample inference (Blundell and Bond (1998))[16].

Our indicator of market fragmentation enters as a significant and robust negative determinant of agricultural GDP per capita. Its impact on agricultural GDP growth appears to be quite high. The two indicators of advancements in reforms (Openness to Foreign Direct

Investment (FDI) and importance of the private sector) however fail to enter significantly in the regression. These results may be due to the lack of indicator that are specific to the agriculture.

It is interesting to ensure that the positive impact found of market integration on growth of agricultural GDP per capita also applies when looking at the real growth of GDP per capita.

We conduct exactly the same estimations than for agricultural GDP using this time the real GDP per capita as the explained variable.

Table 5 presents the results of the regression on provincial income per capita. We introduce the investment rate as a proxy for physical capital and the same variable as in the previous case: the investment rate, the schooling variable and our indicator of market fragmentation.

Our indicator of market fragmentation enters significantly with a negative sign in all regressions. Its impact on per capita GDP growth appears to be quite smaller than on agricultural GDP growth. This result appears coherent with the fact that our indicator is computed exclusively on information from the primary sector. It is however interesting to see that our indicator is also a significant determinant of global income growth. It also proves very robust to the inclusion of control variables such as financial openness and the importance of the non-public sector.

Our results underline that the larger a province's border effect (thus the lower its economic integration with the rest of the country) the lower its economic growth. These findings prove the detrimental impact of market segmentation on growth in China. By extension, it underlines the counter-productive effect of protectionist policies adopted by provincial authorities along the reform course.

As detailed in Kumar (1994) and Chinese Economic Studies (1993), provincial governments used their newly and increased powers acquired with the decentralization to protect their local markets from outside competition. The ultimate objectives were to promote the de-

velopment of infant industries and to limit the undesired social and economic effects of the reform such as increased unemployment, falling profits, and widespread bankruptcies. In some way, local protection measures were put in place to protect the economic performance of the local economy.

Our results indicate that resorting to protections had exactly the opposite results. They prove the failure of local governments to promote growth through trade barriers. On the opposite, they make the case for greater trade and price liberalization in order to strengthen per capita income.

Physical capital accumulation variable enters significantly and with the expected positive sign in the regression. The proxy for human capital accumulation also appear with a significantly positive.

We find a strong evidence of conditional (or beta-) convergence. The coefficient estimates of the lagged dependent variable are always significant and smaller than unity. The convergence rate is computed as $-ln(\alpha_0)/T$ where $T = 2$ is the time spell and α_0 is the coefficient of the initial real GDP per capita.

We introduce several variables to test the robustness of our relation between market integration and economic growth. They all enter with the expected sign. Column 3 reports the results when the share of FDI to GDP is added as an explanatory variable. A proxy of the importance of the non-state sector is introduced in column 4. They both enter with a positive and significant coefficient. These results are coherent with the recognition that more advanced provinces in the transition process achieve higher economic growth.

Our results stress the counter-productive impact of discontinuities in the Chinese domestic market. They confirm the beneficial impact of the liberalization process and the necessary fight against provincial protectionism.

3 Conclusion

This paper empirically examines the effect of market integration on economic performance in China. We use a traditional growth regression framework, estimated with the GMM method.

We rely on a new approach in that we focus on price dispersion rather than trade flows that are typically examined in the literature in order to measure provincial market integration.

We compute provincial indicators of domestic market fragmentation based on the distribution of price deviations from the LOP. We rely on a very detailed price dataset covering 7 individual agricultural goods, between 1987 and 1997 across 170 cities of 28 provinces.

We find the economic importance of the Chinese provincial borders to be substantial as they are significant explanatory variables in accounting for observed deviations of the Law of One Price. Moreover their impact on the width of no-arbitrage zone did not decrease over time between 1987 and 1997, putting into question the capacity of the reforms to enhance market integration within China.

Our results stress the counter-productive impact of discontinuities in the Chinese domestic market in terms of both per capita agricultural GDP and global economic growth. They confirm the beneficial impact of the liberalization process and the necessary fight against provincial protectionism.

Appendix 1: Map of Chinese provinces

Appendix 2: List of markets

Province	Markets
East:	
Beijing	Bei Wanzhuang, Pinggu, Daxing, Fangshan
Tianjin	Zishuidao, Jinghai, Nanjiaoqu, Jixian
Hebei	Shi Jiazhuang, Baoding, Cangzhou, Baxian, Linzhang, Dingxian, Zhunhua
Shanghai	Shiliupu, Nanhui, Jinshan, Songjiang
Jiangsu	Nanjing, Suzhou, Huaiyin, Suixian, Taixing, Wuxian
Zhejiang	Hangzhou, Ningbo, Wenzhou, Xiaoshan, Putuo, Huangyan, Yiwu
Fujian	Xiamen, Xiamen, Quanzhou, Longhai, Fu'an, Changting, Putian
Shandong	Jinan, Zibo, Yantai, Laiyang, Liaocheng, Yidu, Tai'an, Mengyin
Guangdong	Guangzhou, Zhanjiang, Huizhong, Shunde, Dianbai, Puning
Guangxi	Nanning, Liuzhou, Guilin, Linshan, Guixian, Zhongshan, Yishan, Pingguo
Liaoning	Shenyang, Anshan, Jinzhou, Gaixian, Jinxian, Chantu
Center:	
Shanxi	Taiyuan, Changzhi, Houma, Wenxi, Taigu, Gaoping, Hongtong
Jilin	Changchun, Jilin, Siping, Gongzhuling, Jiaohe, Jiutai, Heihekou
Anhui	Hefei, Benbu, Ma'anshan, Changfeng, Liu'an, Suxian, Xuancheng
Jiangxi	Nanchang, Jingdezeng, Jiujiang, Nankang, Yugang, Taihe, Guangfeng
Henan	Zhengzhou, Kaifeng, Luohe, Linbao, Minquan, Miyang, Linxian
Hubei	Wuhan, Huangshi, Shashi, Yingshan, Xianning, Zhaoyang, Tianmen
Hunan	Changsha, Hengyang, Xiantang, Youxian, Dongkou, Jiahe, Nanxian, Huayuan
I. Mongolia	Huhehaote, Baotou huancheng, Jining, Tongliao, Ningcheng
West:	
Heilongjiang	Ha'erbing, Mudanjiang, Qitaihe, Wuchang, Ning'an, Zhaodong, Baiquan
Sichuan	Chengdu (Dongchenggenxia & longtanshiJianyang), Chongqin (Xuetianwan) Chongqin (Huaiyuan), Jianyang, Mianyang
Guizhou	Guiyang, Bijie, Huangping, Liuzhi
Yunnan	Kunming, Gejiu, Baoshan, Xuanwei, Dali, Yuxi
Shaanxi	Xi'an, Baoji, Xianyang, Zhouzhi, Suide, Pucheng, Chenggu
Gansu	Lanzhou, Tianshui, Qinyang, Wuwei, Wenxian, Longxi
Qinghai	Xining, Ledu
Ningxia	Yinchuan, Wuzhong, Zhongwei, Pingluo
Xinjiang	Wulumuqi, Shihezi, Hami, Akesu, Qitai

Table 1: Regressions relating price volatility to distance and the border over time

	87	88	89	90	91	92	93	94	95	96	97
	Standard Deviation										
Distance	By product										
$Distance^2$	By product										
Border	2.62***	4.23***	7.76***	0.04	7.99***	4.30**	5.32***	5.72**	4.45***	1.13	3.68**
	(0.88)	(1.12)	(1.23)	(1.24)	(1.45)	(1.44)	(1.61)	(1.63)	(1.44)	(1.46)	(1.43)
R-Squared	79.83	73.95	68.67	71.13	74.43	66.20	70.28	64.09	71.57	74.15	76.06
Nb of Observ.	63 484	55 871	49 160	43 448	47 616	43 522	34 548	26 184	30 689	28 055	32 183
	Inter-Quartile Range										
Distance	By product										
$Distance^2$	By product										
Border	3.31**	4.43***	10.12***	0.00	4.91**	4.25**	6.69***	5.56**	5.87***	2.33	5.42**
	(1.53)	(1.62)	(2.04)	(1.97)	(2.21)	(2.13)	(2.48)	(2.57)	(2.20)	(2.33)	(2.21)
R-Squared	70.88	76.16	67.04	67.51	70.22	70.65	66.56	72.32	69.61	74.79	68.17
Nb of Observ.	68 636	64 130	57 520	48 079	54 149	50 174	39 305	30 035	33 681	31 339	34 465

Notes: All regressions contain as explanatory variables dummies for each of the 170 individual cities and product dummies in addition to the variables listed in the cell.

Heteroscedasticity-consistent standard errors are reported in parentheses. Coefficients on border effects are multiplied by 10^3.

Appendix: Regression results by province

Table 2: Provincial border effects

Provincial border effects	
Province	Standard Deviation $q(ij,k,s))$
	border effect
Beijing	0.07
Tianjin	2.24
Hebei	2.85***
Shanxi	4.05***
I. Mongolia	10.86***
Liaoning	2.10
Jilin	3.05***
Heilongjiang	2.20
Shanghai	0.67
Jiangsu	6.06***
Zhejiang	4.75***
Anhui	3.06***
Fujian	7.63***
Jiangxi	4.77***
Shandong	6.46***
Henan	0.60
Hubei	4.04***
Hunan	3.86***
Guangdong	3.05**
Guangxi	3.46***
Sichuan	6.91***
Guizhou	7.49***
Yunnan	3.68***
Shaanxi	3.51***
Gansu	3.74***
Ningxia	8.09***
Xinjiang	9.47**

***, ** and *denote significance at 1, 5 and 10% level.
Coefficients are multiplied by 10^3.

Table 3: Highest Provincial border effects

Provincial border effects		
Province	Year	Standard Deviation $q(ij,k,s))$
		border effect
Beijing	95	55.13***
Beijing	94	37.43***
Xinjiang	88	35.34***
Xinjiang	89	33.59***
Guizhou	95	31.44***
Inner Mongolia	92	31.05***
Ningxia	95	29.56***
Shanxi	95	28.80***
Inner Mongolia	89	23.91***
Fujian	93	22.45***
Jiangsu	91	22.45***
Xinjiang	93	21.24***
Xinjiang	94	21.24***
Shaanxi	95	20.67***
Zhejiang	97	20.16***
Fujian	91	19.92***
Liaoning	97	19.43***
Ningxia	89	18.63***
Fujian	89	17.86***
Ningxia	96	17.55***
Zhejiang	93	17.50***
Shanxi	89	17.49***

*** denote significance at 1% level.

Coefficients are multiplied by 10^3.

Appendix : Variables definition

Income per capita: real GDP per capita. Provincial GDP is deflated using provincial CPI.

Investment rate: ratio of fixed investment to GDP.

Schooling: share of population with at least primary education computed based on a permanent inventory procedure by Démurger (2001).

Importance of private sector: share of non-state investment in total investment.

Foreign Direct Investment: ratio of FDI to GDP.

Market Fragmentation: estimated coefficient on border effect based on Deviations from the Law of One Price.

Agricultural GDP per capita: GDP of primary sector divided by population.

Investment in agriculture: Total Power of Agricultural Machinery in KW divided by total sown area in ha.

Statistical sources

State Statistical Bureau, various years, China Statistical Yearbook, Beijing. Comprehensive statistical data and materials on 50 years of new China (1999).

Appendix : Growth Regression results

Table 4: Fragmentation and Agricultural GDP

	Eq. 1	Eq. 2	Eq. 3	Eq. 4
	Within	GMM	GMM	GMM
Initial Income	0.29***	0.29*	0.27*	0.39***
	0.10	0.15	0.07	0.10
Investment rate	0.20**	0.13**	0.14**	0.19***
	0.08	0.06	0.07	0.07
Schooling	1.38***	1.30***	1.36***	1.21**
	0.49	0.47	0.49	0.49
Market Fragmentation	-0.39***	-0.32***	-0.33***	-0.37***
	0.10	0.09	0.08	0.10
Foreign Direct Investment			0.01	0.01
			0.03	0.02
Private Sector Importance				0.05
				0.05
R^2	0.98			
Time dummies	yes	yes	yes	yes
Sargan Test		22.2	16.4	15.7
AR(1) test		-2.74***	-2.39***	-2.81***
AR(2) test		0.85	0.76	0.65
Nb of Observ.	135	135	135	135
Nb of Provinces	27	27	27	27

Heteroskedastic consistent standard errors in parentheses
with ***, ** and * denoting the significance at 1, 5 and 10% level.

Table 5: Fragmentation and per capita GDP

	Eq. 1	Eq. 2	Eq. 3	Eq. 4
	Within	GMM	GMM	GMM
Initial Income	0.82***	0.64***	0.86***	0.88***
	0.05	0.10	0.06	0.04
Investment rate	0.08**	0.27***	0.22***	0.16***
	0.04	0.03	0.04	0.04
Schooling	0.41*	0.61**	0.43	0.69**
	0.25	0.33	0.30	0.32
Market Fragmentation	-0.11*	-0.16**	-0.10*	-0.12*
	0.06	0.08	0.06	0.07
Foreign Direct Investment			0.03***	0.04***
			0.01	0.04
Private Sector Importance				0.08**
				0.04
R^2	0.98			
Time dummies	yes	yes	yes	yes
Sargan Test		19.25	21.59	18.47
AR(1) test		-1.78*	-2.75***	-2.38**
AR(2) test		-0.43	-1.25	-1.49
Nb of Observ.	135	135	135	135
Nb of Provinces	27	27	27	27

Heteroskedastic consistent standard errors in parentheses
with ***, ** and * denoting the significance at 1, 5 and 10% level.

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