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Whither China? Reform and Economic Integration among Chinese Regions

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Abstract

This paper investigates the changing nature of economic integration in China. Specifically, we consider business-cycle synchronization (correlation of demand and supply shocks) among Chinese provinces during the period 1955-2007. We find that the symmetry of supply shocks has declined after the liberalization initiated in 1978. In contrast, the correlation of demand shocks has increased during the same period. We then seek to explain these correlations by relating them to factors that proxy for interprovincial trade and vulnerability of regions to idiosyncratic shocks. Interprovincial trade and similarity in factor endowments tend to make shocks more symmetric. Surprisingly, foreign trade and inward FDI have little effect on the symmetry of shocks.

JEL Codes: E32, F15, H77.

Keywords: VAR model; business cycle synchronization; China; reform..

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1 Introduction

Since 1978, China has been undertaking a gradual and largely steady liberalization. The changes were especially profound in the economic sphere although, lately, they have extended also to the political domain. The three decades of economic liberalization have had far-reaching e¤ects on the Chinese economy and society. Most of the changes have been for the better: China has been able to maintain a high rate of growth, recently becoming the second largest economy in the world. Yet, the bene…ts of this expansion have not been universally shared. Most notably,oftcoa7i954(tl8(e)-391h)-390(un)-rgest economic zones in the early years of liberalization.[2] This e¤ectively introduced a two-speed system, allowing selected regions to charge ahead in economic liberalization while the rest of the Chinese economy proceeded more cautiously. This appears to have laid the foundations of the subsequent economic gaps between the coastal areas and the rest of the country.[3]

In this paper, we document the depth of economic integration among Chinese provinces and analyze the factors that foster such integration. Our analysis proceeds in two steps. First, we use a structural VAR model to identify province-speci…c shocks between 1955 and 2007.[4] Our methodology allows us to distinguish between shocks that have a temporary and permanent e¤ect on output, typically referred to as demand and supply shocks, respectively, in the relevant literature. We compute the correlations between these shocks for all possible pairs of provinces for four sub-periods: two before and two after the 1978 liberalization. These correlations capture the intensity of integration, and the changes therein, among China's provinces, over a period during which the country gradually abandoned central planning, state ownership as well as Maoism and embraced economic liberalization. Second, we analyze the determinants of these correlations using a stylized version of the gravity model (broadly in line with Artis and Okubo, 2008, although they use a di¤erent methodology for estimating the business-cycle correlations). In particular, we seek to explain the correlations of shocks by relating them to factors that proxy for the vulnerability of regions to idiosyncratic developments as well as factors that can facilitate inter-regional transmission of shocks. The latter include the endowments of physical and human capital, transport infrastructure, structure of the economic

[2] On the history of SEZs and the role they have played in Chinese economic development, see Chen et al. (2011), and the references therein.

[3] An especially poignant example of the fruits of this policy is Shenzhen, a city in Guandong, whose population exploded from around 300,000 to its current 14 million since it became the …rst special economic zone more than 30 years ago.

[4] The use of structural VARs to assess the nature of economic integration between countries or regions was pioneered by Bayoumi and Eichengreen (1993) whose work was in turn motivated by the Theory of Optimum Currency Areas (henceforth OCA; Mundell, 1961). Bayoumi and Eichengreen applied this methodology to assess the merits of adopen3(i)-7(t)17(y)-13(08(t)-10(h)-16(i))-7(o)-1453(i)-7-13(r)-10(i)-7(t)imssesshc intehssun(m, ashed y of tsda

Soviet-type economy, with the central government in Beijing retaining control over political appointments and decisions while devolving much of economic policy making to the provinces.

The decentralization accelerated further after Mao's death in 1976.[5] The objective was to

low level at the beginning of the 1990s to a level comparable to that of the US at the beginning of the 2000s. Furthermore, they argue that international trade and local economic policy foster synchronization. However, Carsten et al. (2010) argue that this finding may be attributable to the specific macroeconomic environment during the period analyzed and as such it cannot be generalized into the future.

Another popular method is to identify shocks using the structural vector auto-regressive (SVAR) model formulated by Blachard and Quah (1989). An SVAR model allows one to identify shocks and the economic responses to them. This method has became a popular tool for identifying asymmetric shocks since it was applied by Bayoumi and Eichengreen (1993) to assess the similarities of economic cycles in Europe in the run-up to the formation of the European Economic and Monetary Union (Babetskii, 2005). The SVAR methodology allows us to distinguish between shocks that affect both output and price level permanently (usually denoted as supply shocks) and those affecting output only temporarily while having a permanent price-level effect (demand shocks). The literature studying the business-cycle synchronization of the Chinese economy using the SVAR method remains very limited, however. Tang (1998) adopts an SVAR model to gauge the degree of economic integration within China using data on industrial output and the retail price index. He argues that a high degree of integration prevails in Eastern China only. This finding is also replicated by Poncet and Barthélemy (2008).

Gerlach-Kristen (2009) uses a different methodology: she identifies the common component in output gap fluctuations at the provincial level by using principal component analysis. She finds that the degree of synchronization varies over time: it is high during the 1960s, declines during the 1970s and 1980s and then rises again. Her results indicate, furthermore, that business cycles in the inland provinces in Northern and Northeastern China tend to be less influenced by the national business cycle.

In summary, the evidence so far, as limited as it is, suggest that the Chinese provincial business cycles have become more synchronized over time but this process has not been uniform. In particular, a gap may be emerging between the coastal and interior regions.

2.3 Determinants of Business-cycle Co-movements

There is no consensus as to which determinants of business-cycle co-movement are important. There are instead many potential candidate explanations of business-cycle synchronization or the lack thereof.

One leading candidate is trade. Frankel and Rose (1998) present empirical evidence that higher bilateral trade between two countries leads to greater correlation of business cycles between them. An opposite view is put forward by Krugman (1993) who argues that international trade increases specialization, making shocks more asymmetric. Frankel and Rose (1998) argue that inter-industry and intra-industry trade play different roles in this respect. The former reflects specialization and therefore may cause asymmetries. The latter implies that the country simultaneously exports and imports products of the same category. The total effect of trade intensity on business-cycle correlation is therefore theoretically ambiguous and the question can only be answered empirically. Fidrmuc (2004) adopts the specification of Frankel and Rose (1998) and applies it to a cross section of OECD countries over the last ten years with quarterly data, controlling for intra-industry trade in his analysis. His findings confirm the Frankel and Rose view. Baxter and Kouparitas (2005), similarly, argue that trade is the only factor with a robust effect on business cycle synchronization. In contrast, de Haan et al. (2008b) argue that the role of trade is less important than suggested by this literature.

Empirical evidence of the positive relationship between similarity in structure of output and business-cycle synchronization has been stressed in a series of papers by Imbs (1998, 2003, 2004) and is found also in analyses using regional data by Kalemi-Ozcan et al.(2001) and Clark and Wincoop (2001). Kalmemi-Ozcan et al. (2001), in particular, find that U.S. states that are more specialized in turn display a lower correlation of business cycles with the aggregate U.S. growth.

Another approach, related to the trade-based link discussed above, is motivated by the gravity model of trade. The gravity model relates bilateral trade flows to variables such as distance between regions, common language, common border, and so on. Therefore, gravity-model variables can be, in turn, used as proxies for trade and therefore can be used as determinants of business-cycle synchronization: see, among others, Clark and van Wincoop (2001), Calderon et al. (2007) and Fidrmuc (2004).

Fatás (1997) argues that the coordination of monetary and fiscal policies is also a key determinant of business-cycle synchronization. Meanwhile, he points out it has an ambiguous

East, Center and West; besides reflecting geography, this categorization also broadly captures the differences in the degree of economic development. During the early transition period, the coastal areas in the East were the main beneficiaries of the open door policy, developing much more quickly than the interior areas in the Center and West. Furthermore, we divide the 53 years[9] covered by the data into four sub-periods: 1955-1965, 1966-1977, 1978-1991 and 1992-2007. This break-down reflects the main phases of China's economic and political development. The first two sub-periods correspond to the early and late Maoism. The early Maoist period includes the Great Leap Forward (1958-1961) while the late Maoist period overlaps with the Cultural Revolution (1966-1976). Chinese economic reform was initiated in 1978 and this lead

$$
\begin{aligned}
y_t &= b + \sum_k b_{k} y_{t-k} + \sum_k b_{k} p_{t-k} + e_t^y \\
p_t &= b + \sum_k b_{k} y_{t-k} + \sum_k b_{k} p_{t-k} + e_t^p
\end{aligned}
\qquad (1)
$$

Output and price-level are in log-differences: $y = \log GDP_t - \log GDP_{t-}$ and $p_t = \log P_t - \log P_{t-}$. b_{ijk} are coefficients, and k is the lag length. e_t^y and e_t^p are disturbances which are assumed to be serially uncorrelated and take the following form:

$$
\begin{aligned}
e_t^y &= c\ \varepsilon_t^D + c\ \varepsilon_t^S \\
e_t^p &= c\ \varepsilon_t^D + c\ \varepsilon_t^S
\end{aligned}
\qquad (2)
$$

where ε_t^D and ε_t^S are demand and supply disturbances, respectively. These equations state that the unexplainable components of output growth and inflation are linear combinations of supply and demand shocks. The vector of structural disturbances, ε_t, can be obtained under the following restrictions:

$$
\begin{aligned}
&1: \quad c + c = Var(e^y) = 1 \\
&2: \quad c + c = Var(e^p) = 1 \\
&3: \quad c\ c + c\ c = Cov(e^y; e^p) \\
&4: \quad \sum_k c\ \varepsilon_{t-k}^D = 0
\end{aligned}
$$

The first three restrictions on the coefficients of Equation (2) follow from the normalization conditions and from the assumption that temporary and permanent shocks are orthogonal ($Cov(\varepsilon^D; \varepsilon^S) = 0$). The fourth restriction on coefficients c_{ij} states that demand shocks have no long-term impact on the level of output.

3.3 Correlations of Supply and Demand Shocks

Having estimated the demand and supply shocks affecting the individual provinces, we calculate $^S_{ij}$ and $^D_{ij}$, the correlation of supply/demand shocks between any two provinces i and j during period . If the correlation of shocks is positive, the shocks are considered to be symmetric and if it is negative, they are considered asymmetric. Table 1 and Table 2 give the weighted-average (with GDP used as weights) correlations of supply and demand shocks for each province and for each sub-period, respectively. Figures 1-4 depict the distribution of

4 Determinants of Business Cycle Co-movement in China

4.1 Methodology

So far, we have explored the changing nature of business-cycle synchronization during the last

- coast and interior-coast dummies: equal to 1 when both provinces are located in the coastal region and when one province is on the coast while the other lies in the interior, respectively,[11]

- bilateral distance calculated as the shortest distance for freight transportation by railway in kilometers, and

- economic size, measured as the sum of the two provincial GDPs.

Regions specializing in producing similar products are likely to be exposed to similar shocks. There is, however, no standard measure of similarity in the production structure. Following Clark and van Wincoop (2001), Imb (2004) and Poncet and Barthélemy (2008), we compute Krugman's (1991) absolute value index. Let S_{ni} and S_{nj} denote the GDP shares for industry n in provinces i and j. Then, the dissimilarity of the two provinces' production structures is measured as

$$\frac{1}{N}\sum_{n}^{N} |S_{ni} - S_{nj}|$$

To compute the index, we consider 5 broad sectors of the Chinese economy: primary sector (comprising agriculture, hunting, forestry, fishing, and mining and quarrying); construction; manufacturing; infrastructure services (transportation, post and telecommunications); and trade services (wholesale, retail and catering).[12]

Another potential source of asymmetric shocks is represented by local policy making. Dissimilarity of local policies is measured by means of two indicators. One captures the provincial divergence of fiscal policy while the other investigates heterogeneity in terms of inflation. Similar to Clark and van Wincoop (2001) and Poncet and Barthélemy (2008), we use the standard deviation of provincial budget deficit differentials to measure the dissimilarity of fiscal policy (with annual budget deficits expressed as a percentages of GDP). We capture provincial

[11] These two dummies should reveal up whether business cycles are more closely synchronized among coast provinces (captured by the coast dummy), between coast and interior provinces (coast-interior dummy), or among interior provinces (omitted category).

[12] The data are taken from the Chinese national statistic year book.

divergence in inflation as

$$\frac{1}{T}\sum_{t}|GPI_{i;t} - GPI_{j;t}|$$

(see also Boyreau-Debray, 2000; and Poncet and Barthélemy, 2008), where $GPI_{i;t}$ is the general price index of the province i during the period t and T is the sub-period time span.

A major source of divergence of business cycles can be the exposure to foreign trade and foreign direct investment. We measure the foreign trade dissimilarity as

$$\frac{1}{T}\sum_{t}|Trade_{i;t} - Trade_{j;t}|$$

where $Trade_{i;t}$ correspond to the percentage share of foreign trade in GDP of province i during period t and T is the sub-period time span. An analogous formula is used for FDI dissimilarity.

Finally, differences in factor endowments can also play a role in explaining the degree of business-cycle synchronization. We consider two factors of production: investments in human capital and fixed-assets. Investment in human capital is measured as secondary and higher education enrolment rates (i.e. the ratio of the total secondary and higher education enrolment to the population). Investment in physical capital is expressed as a percentage of GDP. For the pre-1978 period, we only have public investment (private investment during this period is likely to be very low or zero). After 1978, the data distinguish between total investment in physical capital (including public investment) and public investment only. For the general regressions, we include only total investment, whereas we use both types of investment in the univariate regressions. Both investments (human and physical capital) are entered as dissimilarity indexes computed in the same way as those for production structures, inflation and trade discussed above.

Thus, we estimate the following regressions for correlation of supply or demand shocks between the regions

$$ {}^{k;f}_{ij} = X_{ij} \; {}^{k;f} + {}^{k;f}_{ij} \qquad (3)$$

The dependent variable is either the standard correlation of supply and demand shocks ($k = S; D$) or its Fisher-z transformation (superscript $f = c; z$, denoting the two alternative

The regressions results for the correlations of demand shocks are presented in Tables 6-7. Again, essentially none of the included variables explain the correlations of shocks during the early Maoist period (and again, the regressions for this period are not jointly significant). Dursignificant during the Maoist period again: for supply shocks during both sub-periods and limited explanatory power of economic factors should perhaps not be surprising, given that the Maoist period was dominated by politically-induced shocks of the Great Leap Forward and Cultural Revolution. During the reform period, factors typically associated with bilateral (interprovincial) trade matter, although their importance is not overwhelming. In particular,

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Table 1: Weighted average supply shocks's correlation by province

Region	Province name	1955-1965	1966-1977	1978-1991	1992-2007
EAST	Beijing	0.61	0.54	0.41	0.26
	Tianjin	0.77	0.37	0.48	0.34
	Shanghai	0.68	0.35	0.49	0.33
	Liaoning	0.78	0.27	0.38	-0.35
	Shandong	0.63	0.38	0.46	0.29
	Jiangsu	0.39	0.53	0.37	0.27
	Zhejiang	0.68	0.10	0.53	0.35
	Fujian	0.69	0.35	0.49	0.37
	Guangdong	0.65	0.35	0.38	0.41
CENTRAL	Hebei	0.71	0.42	0.50	0.25
	Shanxi	0.78	0.50	0.23	0.03
	Inner-Mongolia	0.65	0.46	0.18	0.10
	Jilin	0.73	0.49	0.35	0.33
	Heilongjian	0.78	0.40	0.37	0.09
	Anhui	0.48	-0.09	-0.21	0.09
	Jiangxi	0.43	0.45	0.39	0.36
	Henan	0.71	0.34	0.19	-0.12
	Hunan	0.78	0.52	0.36	0.38
	Hubei	0.72	0.48	0.37	0.16
WEST	Guangxi	0.76	0.24	0.42	0.43
	Sichuan	-	-	0.46	0.32
	Guizhou	0.82	0.35	0.29	0.08
	Yunnan	0.58	0.38	0.35	0.32
	Shaanxi	0.78	0.36	0.39	-0.04
	Gansu	0.61	0.19	0.33	0.20
	Ningxia	0.56	0.32	0.25	-0.26
	Qinghai	0.69	0.23	0.39	0.11
	Xinjiang	0.59	0.51	0.29	0.27

Table 2: Weighted average Demand shocks's correlation by province

Region	Province name	1955-1965	1966-1977	1978-1991	1992-2007
	Beijing	0.01	0.05	0.43	0.60
	Tianjin	0.20	0.23	0.47	0.66
EAST	Shanghai	0.18	0.16	0.34	0.73
	Liaoning	-0.18	0.17	0.17	0.50
	Shandong	0.21	0.07	0.19	0.51
	Jiangsu	-0.07	0.18	0.37	0.76
	Zhejiang	0.26	0.08	0.41	0.75
	Fujian	0.18	-0.13	0.48	0.74
	Guangdong	0.18	0.10	0.37	0.66
	Hebei	0.17	0.09	0.49	0.71
	Shanxi	0.05	0.20	0.38	0.66
CENTRAL	Inner-Mongolia	0.05	-0.02	0.44	0.79
	Jilin	0.19	0.03	0.10	0.60
	Heilongjian	0.11	0.30	0.20	0.75
	Anhui	-0.18	0.29	0.40	0.66
	Jiangxi	0.21	0.14	0.45	0.66
	Henan	-0.07	0.29	0.37	0.72
	Hunan	0.18	-0.17	0.38	0.78
	Hubei	0.08	0.10	0.39	0.75
	Guangxi	0.14	0.02	0.53	0.70
	Sichuan	-	-	0.32	0.68
	Guizhou	0.23	0.16	0.53	0.77
WEST	Yunnan	0.16	-0.18	0.28	0.58
	Shaanxi	0.14	0.22	0.26	0.67
	Gansu	0.14	-0.24	0.21	0.36
	Ningxia	0.16	-0.04	0.49	0.73
	Qinghai	0.12	-0.10	0.37	0.71
	Xinjiang	-0.08	-0.15	0.38	0.68

Table 3: Sub-groups

Sample	Observations
East	Beijing, Tianjin, Shanghai, Liaoning, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, Hainan
Central	Hebei, Shanxi, Inner-Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hunan, Hubei
West	Guangxi, Guizhou, Yunan, Sichuan, Shaanxi, Gansu, Ningxia, Qinghai, Xinjiang

Table 4: Determinants of interprovince correlation of supply shocks: 1955-65 and 1966-77

	1955-65		1966-77	
	ols	z	ols	z
common border dummy	0.045	0.082	0.014	0.021
	(0.043)	(0.084)	(0.061)	(0.077)
coast dummy	-0.107	-0.228	-0.053	-0.084
	(0.047)*	(0.092)*	(0.067)	(0.085)
same region dummy	0.041	0.068	0.063	0.102
	(0.032)	(0.062)	(0.049)	(0.061)
coast-interior dummy	-0.038	-0.109	0.042	0.047
	(0.067)	(0.132)	(0.096)	(0.121)
distance/1000	0.019	0.024	0.007	0.014
	(0.013)	(0.025)	(0.019)	(0.024)
$LogY_i + LogY_j$	0.011	0.021	-0.002	0.007
	(0.016)	(0.031)	(0.022)	(0.028)
dissimilarity of physical capital	-0.488	-0.945	-0.117	-0.023
	(0.237)*	(0.464)*	(0.336)	(0.421)
dissimilarity of human capital	0.024	0.038	0.017	0.014
	(0.017)	(0.034)	(0.048)	(0.060)
dissimilarity of in‡ation	-0.001	-0.002	-0.003	-0.003
	(0.002)	(0.003)	(0.002)	(0.003)
std dev of ...scal de...cit	0.482	1.069	-0.858	-1.395
	(0.210)*	(0.412)**	(0.563)	(0.706)*
constant	0.544	0.695	0.416	0.41
	(0.125)**	(0.246)**	(0.210)*	(0.263)
observations	325	325	324	324
R	0.05	0.06	0.02	0.03

Figures in ( ) are standard errors. Signi...cance levels: ** 1%, *5%.

o: results based on original data, z: results based on Fisher "z" tranformation and log(variables)

Table 5: Determinants of interprovince correlation of supply shocks: 1978-91 and 1992-07

	1978-91		1992-07	
	ols	z	ols	z
common border dummy	0.031 (0.048)	0.045 (0.057)	0.226 (0.068)**	0.276 (0.082)**
coast dummy	0.203 (0.060)**	0.26 (0.073)**	0.279 (0.089)**	0.356 (0.107)**
same region dummy	-0.026 (0.037)	-0.030 (0.045)	-0.019 (0.056)	-0.031 (0.067)

Table 6: Determinants of interprovince correlation of demand shocks: 1955-65 and 1966-77

	1955-65		1966-77	
	ols	z	ols	z
common border dummy	0.020	0.018	0.061	0.064
	(0.080)	(0.092)	(0.071)	(0.080)
coast dummy	0.116	0.140	-0.045	-0.061
	(0.087)	(0.100)	(0.078)	(0.089)
same region dummy	-0.047	-0.055	0.011	0.019
	(0.059)	(0.068)	(0.056)	(0.064)
coast-interior dummy	-0.021	-0.033	-0.159	-0.177
	(0.125)	(0.144)	(0.111)	(0.126)
distance/1000	0.005	0.006	-0.089	-0.096
	(0.024)	(0.028)	(0.022)**	(0.025)**
$LogY_i + LogY_j$	-0.053	-0.061	0.009	0.011
	(0.029)	(0.034)	(0.026)	(0.029)
dissimilarity of physical capital	-0.604	-0.729	-0.775	-0.859
	(0.440)	(0.509)	(0.387)*	(0.441)
dissimilarity of human capital	-0.004	-0.006	0.050	0.052
	(0.032)	(0.037)	(0.055)	(0.063)
dissimilarity of in‡ation	-0.004	-0.004	-0.003	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)
std dev of …scal de…cit	0.331	0.350	-0.029	-0.126
	(0.391)	(0.452)	(0.649)	(0.739)
constant	0.514	0.599	0.211	0.232
	(0.233)*	(0.269)*	(0.242)	(0.275)
observations	325	325	324	324
R	0.02	0.02	0.13	0.12

Robust standard errors in parentheses. Signi…cance levels: ** 1%, * 5%.

o: results based on original data, z: results based on Fisher "z" tranformation and log(variables)

Table 7: Determinants of interprovince correlation of demand shocks: 1978-91 and 1992-07

	1978-91		1992-07	
	ols	z	ols	z
common border	-0.032	-0.032	0.020	0.035
dummy	(0.047)	(0.059)	(0.031)	(0.056)

Table 8: Univariate determinants of interprovince correlation of supply shocks, 1955-77

Table 9: Univariate determinants of interprovince correlation of supply shocks, 1978-07

Table 10: Univariate determinants of interprovince correlation of demand shocks, 1955-77

variables	1955 − 1965		1966 − 1977	
	o	z	o	z
common border	0:016038	0:012693	0:167365***	0:179765***
	:	:	:	:
	:	:	:	:
distance/1000	0:00005	0:000539	−0:10486***	−0:113886***
	:	:	:	:
	:	:	:	:

Table 11: Univariate determinants of interprovince correlation of demand shocks, 1978-07

variables	1978 − 1991		1992 − 2007	
	o	z	o	z
common border	0:023834	0:046782	0:020040	0:037709
	:	:	:	:
	:	:	:	:
same region	−0:023149	−0:031228	0:011592	0:031778
	:	:	:	:
	:	:	:	:
coast_intra	−0:012962	−0:017831	−0:039961	−0:057588
	:	:	:	:
		:	:	:
coast_interior border				

Figure 1: Interprovince correlation of supply shocks 1955-1965

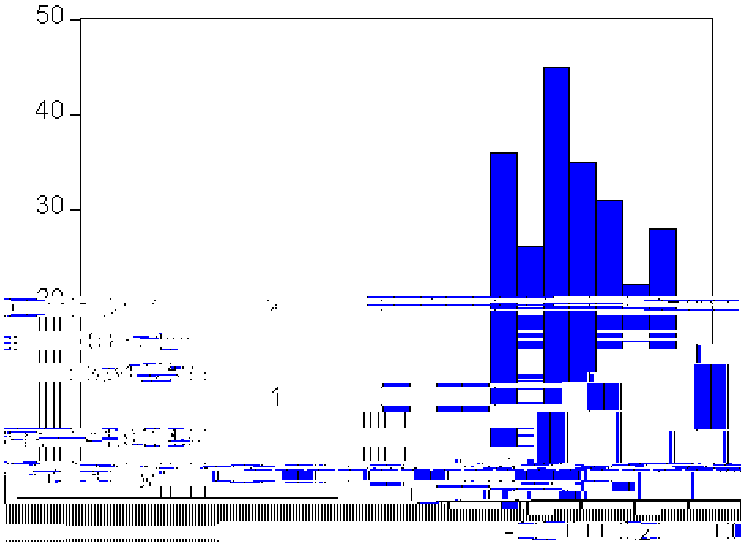

Figure 2: Interprovince correlation of supply shocks 1966-1977

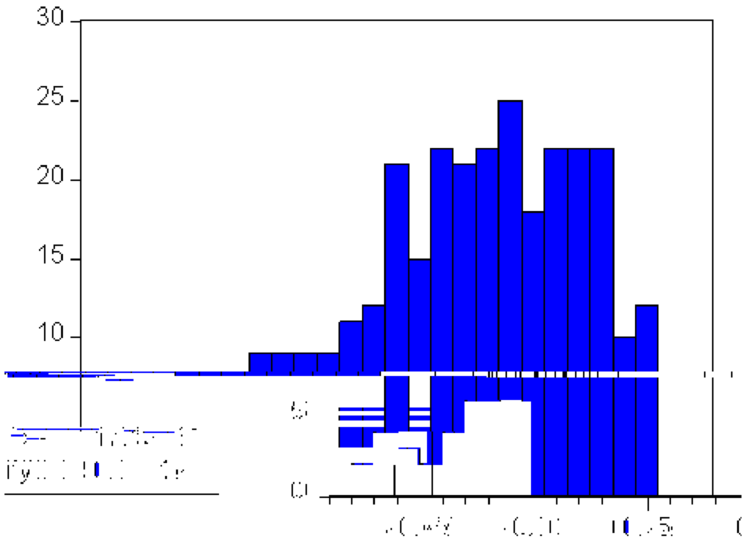

Figure 3: Interprovince correlation of supply shocks 1978-1991

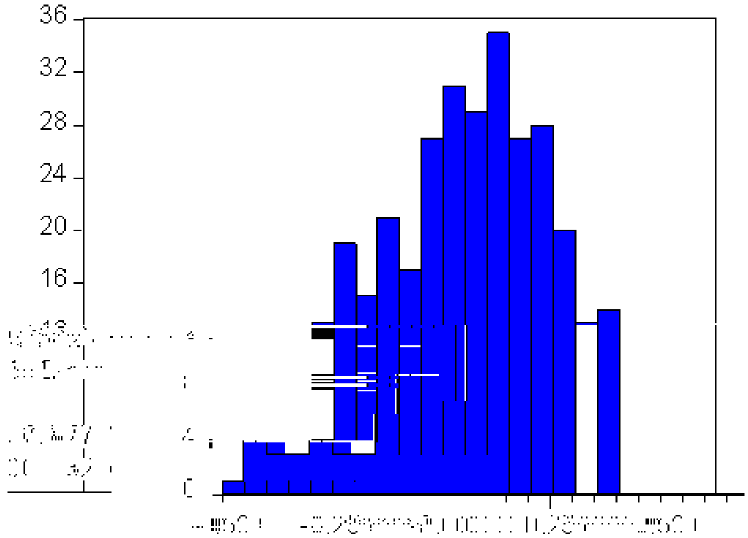

Figure 4: Interprovince correlation of supply shocks 1992-2007

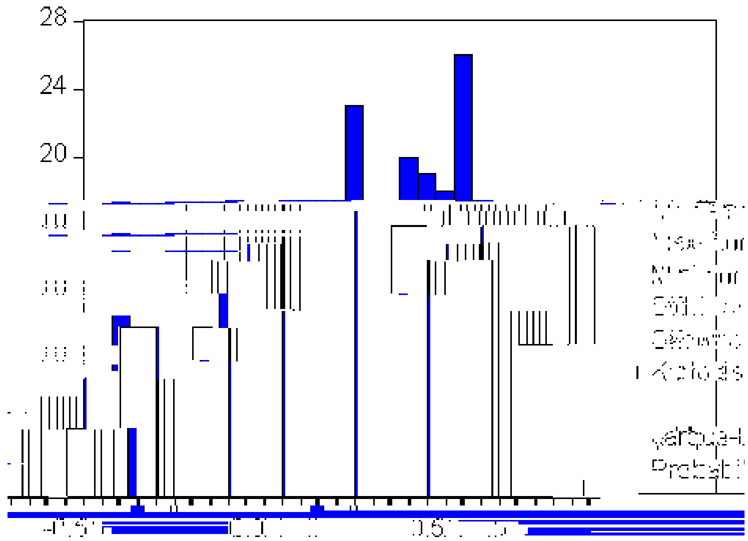

Figure 5: Interprovince correlation of demand shocks 1955-1965

Figure 6: Interprovince correlation of demand shocks 1966-1977

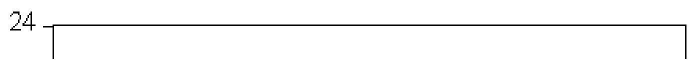

Figure 7: Interprovince correlation of demand shocks 1978-1991

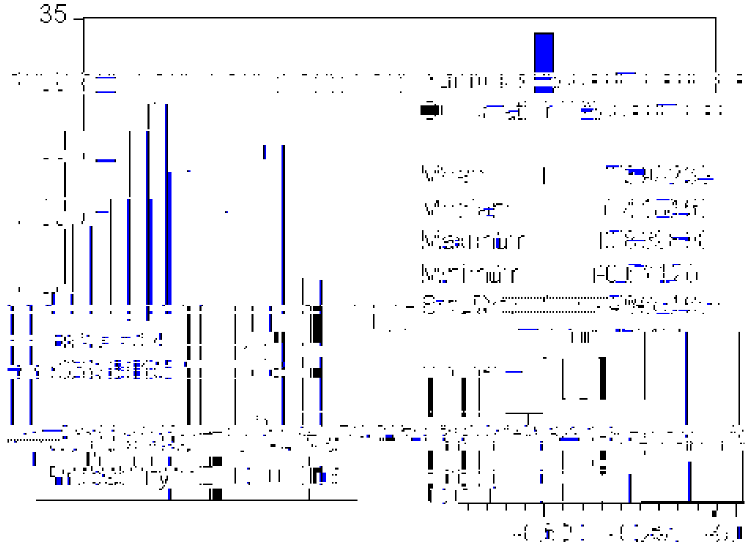

Figure 8: Interprovince correlation of demand shocks 1992-2007