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Inter-regional Variability of Inflation Rates

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Theoretical considerations suggest that as market institutions are developing in Russian regions, the divergence of regional consumer price levels, which has been caused by the price liberalization of 1992, should give way to price level convergence. Using price dynamics data (overall consumer price indices, food price indices, manufactured goods price indices, service price indices) across 7 regions of West Siberia over 1992–1998, the tendency of such convergence is studied. The speed in which regional price levels converge to the national price level and to the price levels of other regions is estimated. Besides that, the price differential thresholds, below which interregional arbitrage becomes unprofitable, are also estimated.

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Keywords: Russia, law of one price, price differential, inflation, market integration

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

NON-TECHNICAL SUMMARY

Theoretical considerations suggest that, as market institutions are developing, the divergence of price levels in Russian regions, which has been caused by the price liberalization of 1992, should give way to their convergence. Analyzing consumer price dynamics from January 1992 through June 1998 in 7 regions constituting West Siberia, the author attempts to determine whether such tendency actually exists and what is the extent of the influence held by factors blocking price equalization across regions.

Aggregated data are used for the analysis: overall consumer price level (cost of living) and its three components, namely, the price levels of food, manufactured goods and services. These levels are calculated from corresponding monthly consumer price indices provided by the Russian Goskomstat. Qualitative analysis of price dynamics in West Siberia gives evidence that the early price divergence stage could be limited to the time interval of 1992 – 1993. Nevertheless, the expected consequent price convergence is far from obvious, for the price level dispersion across regions still remains substantial.

Standard for the law of one price testing, an autoregressive model is used for the quantitative analysis. The speed of each region's price level convergence to the average Russian level as well as to price levels of other West-Siberian regions is estimated. It is found that the overall price level tends to converge to the average national level in about half of the regions during the whole 1992 – 1998 time span and during the segment without the price divergence stage, 1994 – 1998 (the tendency is augmented in the latter case). What is not entirely usual is that the behavior of service price levels that aggregate pure nontradables has similar pattern. Issuing from the tests, it can be confidently said that the tendency for food price levels to converge exists in a number of regions, and there are grounds to assume that the same convergence takes place in the rest of West Siberia. But, the behavior of manufactured goods price levels is quite different than that of food price levels.

The fact that differences between regional price levels still remain high, though the tendency of price convergence exists (in principle), indicates that there is considerable friction. To evaluate the integral effect of all factors preventing inter-regional equalization of food and manufactured goods prices, the non-linear model put forward by M. Obstfeld and A. Taylor is adopted. This model is based on the assumption that prices converge only to some threshold below which arbitrage becomes un-

profitable. The magnitude of the threshold is determined by the joint influence of all factors hindering the convergence of prices. Taking into account "the arbitrage inaction band" when using this model makes it possible to find much more cases of convergence to the law of one price. At the same time, there are a number of cases when the height of thresholds isolating West-Siberian regions from one another is abnormally great.

The results obtained suggest that on one hand there are market forces acting across the West-Siberian consumer market, but, on the other hand, opposing forces exist as well, and therefore this market still remains to be poorly integrated. The main factors causing market segmentation are price and inter-regional trade controls, organized crime, uneven costs and profit from trade in various regions, poor market infrastructure, and institutional immaturity of commodity arbitrage in Russia.

1. INTRODUCTION

At the close of the planned economy era in Russia, the centralized pricing system was no longer all-embracing. Nevertheless, market pricing acted on a very limited scale, and the bulk of the consumer market comprised goods with fixed prices that were in the main common for the whole country. Therefore, it is felt that consumer price levels[1] have been rather similar across Russian regions up to the end of 1991. Hand in hand with this, by the early 90s, high excess demand accumulated which varied widely across regions. As a result, its own potential (latent) equilibrium price levels formed in each region. And so, as soon as prices were freed in January 1992, they quickly changed from the common initial level to local equilibrium levels. This forced a divergence in inflation rates across regions: the rise in prices was more rapid *as a whole* where these levels were higher, and was slower in regions with lower levels. The divergence of price levels across regions went on almost unobstructedly because of the insignificant volume of arbitrage. (So long as there existed neither relevant infrastructure nor market agents in that period, the overwhelming share of both retail and wholesale trade still remained to be state-run, having neither the stimuli nor the possibilities for arbitrage).

But then, as wholesale and retail trade were being privatized and market institutions were developing, one might expect the interregional arbitrage to broaden. And this, as it seems, should cause the reverse process: convergence of regional price levels (through deceleration of inflation in regions with high levels and acceleration in regions with lower ones). If this is the case, cumulative inflation relative to December 1991 (when regional price levels are assumed to be roughly equal) should differ little across the regions from certain time on. The early stage of the market transformation, when there was almost nothing to oppose price divergence across regions, came to an end apparently by 1994 – 1995 (albeit a sharp break off point, obviously, could not be determined; besides, this is probably individual for each region). Nevertheless, price level differences still remain substantial up to now.

Paraphrasing Kenneth Rogoff's (1996) words, this could be called "the law of one price puzzle" in a transitional economy: how can one recon-

[1] Throughout this paper "price level" means the aggregated price of a broad (near-exhaustive from the viewpoint of share in consumer expenditures) set of large-scale consumer commodities.

cile the enormous volatility of price levels across Russian regions with the fact that these regions belong to one country with a common currency? In other words, does the law of one price hold at all in a transitional economy, and what restrains interregional arbitrage?

This study attempts to answer these questions through analysis of consumer price level dynamics over the time period 1992 – 1998 in 7 regions constituting West Siberia. Standard methodology is adopted for the analysis, namely, testing for stationarity of the relative price level time series with the use of the autoregressive model. In addition to this, the threshold model put forward by M.Obstfeld and A.Taylor is estimated, which involves a wider notion of interregional equilibrium (as a price band rather than a point).

The overall consumer price level (cost of living) and its three components, the price levels of food, manufactured goods, and services are used for the analysis. The levels are constructed from the corresponding monthly consumer price indices (CPIs) of the Russian Goskomstat. Using these data, evidence is sought for regional price level convergence to the average Russian level, and for convergence in each pair of West-Siberian regions. The analysis is conducted over the whole time span of January 1992 – June 1998 and again over a part of this time, January 1994 – June 1998, in which the early stage of the market transformation is eliminated.

It is found that the tendency for regional price levels to converge across West-Siberian regions, though masked by many and varied frictions, does exist in principle (surprisingly, the convergence involves services, too, albeit these are pure nontradables). But the behavior of food prices and manufactured goods prices is quite different. The food price levels tend to converge in most regions; the tendency is augmented when the early stage of the market reforms is eliminated. As for the manufactured goods price levels, the situation becomes much worse during the span of 1994 – 1998 (*vs*. 1992 – 1998); the convergence is very weak. Threshold model estimations indicate that if one controls for (integral) arbitrage transaction costs, then the pattern of convergence improves. At the same time these costs, *i.e.*, thresholds isolating West-Siberian regions from one another, are abnormally high in a number of cases. The results obtained suggest that, on one hand, there are market forces acting across West-Siberian market, but, on the other hand, opposing forces exist as well, and therefore this market still remains to be poorly integrated.

The analysis performed is related to papers by Gardner and Brooks (1993), De Masi and Koen (1995), Goodwin *et al*. (1996), Berkowitz *et al*. (1998), Berkowitz and DeJong (1999), Rayskaya *et al*. (1997, 1998), Zarova and Prozhivina (1997), which study the behavior of prices across Russian locations.[2]

Gardner and Brooks (1993) used food price data spanning the early stage of the market transformation; they found substantial price differences across regions. Their explanation is that this is partially the result of regional resistance to the reforms. That is the case, but just partially; in my opinion as stated above, the main reasons have been unequal excess demand. De Masi and Koen (1995) analyzed data covering 1992 – 1994; they also documented unusually wide spatial dispersion of food prices. At the same time, their analysis suggests that these differences have decreased with time. More recently, Koen and De Masi (1997) identified the main features of inflation in transitional economies; one of these features is that prices and inflation rates converge across regions within countries with time.

With a time series of food prices for 1993 – 1994, Goodwin *et al*. (1996) analyze the strength of economic linkages between local markets by the means of cointegration and causality tests. They find evidence that there are such linkages, but not in all cases. Berkowitz *et al*. (1998) use similar methodology with other data (in particular, spanning 1992 – 1995 and involving much more locations). Their analysis focuses on the relationship between state and market prices as well as on the interactions of these prices across locations. The authors found that differences in these prices had gradually diminished following the 1992 price liberalization, and obtained widespread evidence of cointegration and causality between state and market prices across cities. In subsequent study, Berkowitz and DeJong (1999) unmasked an important culprit of abnormal food price dispersion across Russian regions; that is the separation of regions into two relatively isolated clusters: "the Red Belt" and the rest Russia.

The methodology of Rayskaya *et al*. (1997, 1998) lies in quite other plane than the usual methodologies for examining spatial price behavior. They attempt to adapt the monetary theory to regional level. Based on the analysis of the CPI for 1993 – 1997 across 76 Russian regions, five groups of regions are isolated, each group with its own type of price behavior. The first extreme group involves regions that only deliver commodities to the rest of the economy under the influence of interregional price parity changes (out of West-Siberian regions, the group includes the Altai Krai); the regions from another extreme group (among them the Tyumen Oblast) are marked by a prevailing in-flow of goods over out-

[2] Curiously, foreign researchers rather than Russian ones fulfilled most of the relevant empirical work.

flow. The pattern stated could be named as "unbalanced arbitrage." Using the average prices for 10 foods across 76 regions in 1995, Zarova and Prozhivina (1997) look for a relationship between regional prices and level of economical development of a region, its sectoral structure, and the performance of the regional economy. The first relation is found to be positive, the second to be negative, and no relation is detected with the third index.

The analysis in this study is related to the paper by Obstfeld and Taylor (1997) as well. Here, the model put forward by them is used, and the results obtained are compared with those concerning US cities from their paper. More distantly, the study is also related to a number of papers that are devoted to examining the consumer price behavior across locations in market economies.

This paper is organized as follows. In Section 2, empirical data are presented as well as the reliability of the raw data and assumptions implemented are considered. Section 3 contains a formal statement of the problem and the econometric model specifications. In Section 4, estimation results are reported and discussed. Section 5 is devoted to the interpretation of results obtained. In Section 6, the results are briefly summarized, and ways for further research are suggested.

2. DATA

2.1. Price Levels in West Siberia

The raw data used are time series of monthly CPIs for 7 regions constituting West Siberia and for all of Russia. These CPIs are denoted as J_{irt}, where i indexes aggregate of commodities, r indexes region, and t indexes time (month). Four aggregates of commodities are represented by the overall CPI and its sub-categories: all goods and services ($i = 0$), food ($i = 1$), manufactured goods ($i = 2$), and services ($i = 3$). The regions under consideration are the Republic of Altai, the Altai Krai, the Kemerovo Oblast, the Novosibirsk Oblast, the Omsk Oblast, the Tomsk Oblast, and the Tyumen Oblast. The time series include 78 observations from January 1992 up to June 1998.

Given the value of the price level (subject to an aggregated commodity i) in a region at the initial period (December 1991 is taken as $t = 0$), the *absolute* regional price level at time t can be calculated by the chain method as

$$\tilde{P}_{irt} = \tilde{P}_{ir0} \times J_{ir1} \times J_{ir2} \times \ldots \times J_{ir,\,t-1} \times J_{irt} = \tilde{P}_{ir0} I_{irt}. \qquad (1)$$

(notice that price indices are of the form P_t/P_{t-1} rather than $(P_t - P_{t-1})/P_{t-1}$ in the Russian statistics).

The subject of the analysis is the difference in prices between regions r and s, which is represented by the *relative* price levels. The initial (at December 1991) absolute price levels are assumed to be equal in all regions. And so, since $\tilde{P}_{ir0} = \tilde{P}_{is0}$ for each r and s, relative price levels do not depend on initial values; they are the ratios of cumulative CPIs:

$$P_{irst} = \tilde{P}_{irt} / \tilde{P}_{ist} = I_{irt} / I_{ist} . \qquad (2)$$

The average national price level is taken as the common benchmark.[3] Russia as a whole is denoted by subscript 0 ($s = 0$); the second subscript will be omitted in the designation of the price level in a region r related to the national level, *i.e.*, it is implied that $P_{irt} \equiv P_{ir0t} = \tilde{P}_{irt} / \tilde{P}_{i0t}$ (note that P_{irt} can be interpreted as a spatial price index).

To conserve space, the data are reported in graphical form. Values of P_{irt} are plotted in Fig. 1 through 4.[4] Table 1 tabulates some summary statistics; these are means and standard deviations (over all West-Siberian regions and over all months of a given year) of the relative price levels P_{irt}.

Table 1. Summary Statistics.

Year	Overall Price Level		Food Price Level		Manufactured Goods Price Level		Service Price Level	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
1992	0.948	0.145	0.746	0.100	0.893	0.247	1.478	0.747
1993	1.136	0.178	0.748	0.161	1.152	0.379	2.083	1.298
1994	1.207	0.146	0.766	0.179	1.134	0.356	3.678	3.314
1995	1.146	0.148	0.751	0.174	1.060	0.371	3.526	3.030
1996	1.149	0.160	0.759	0.185	1.098	0.422	3.350	2.921
1997	1.158	0.159	0.756	0.193	1.105	0.417	3.452	2.831
1998*	1.149	0.147	0.751	0.190	1.098	0.410	3.348	2.671

* 6 months.

[3] With this, a potential problem may be that there are lags in the movement of regional prices after the movement of average Russian prices. But, as Rayskaya *et al*. (1997, 1998) found, the problem is not actual. Their analysis of the 1993 – 1997 time series demonstrates that changes in consumer prices are practically synchronous across regions.

[4] The qualitative analysis of the behavior of these price levels is presented in Gluschenko (2000).

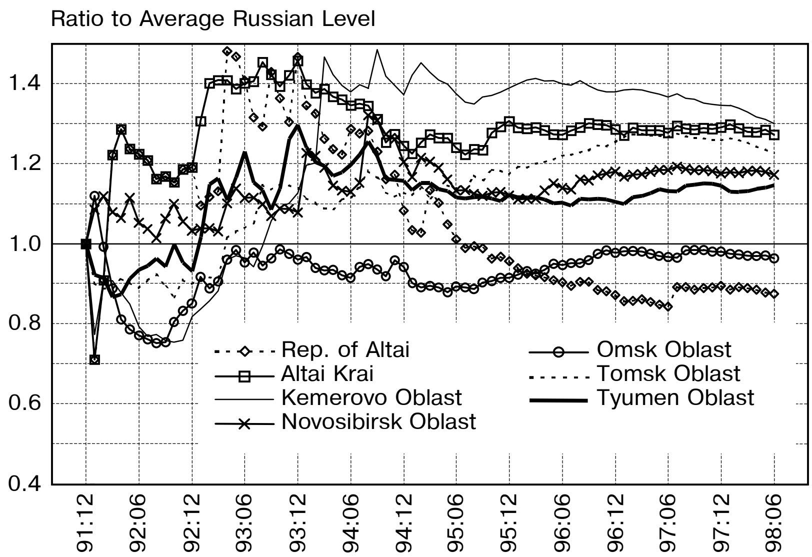

Fig. 1. Overall Consumer Price Levels in West-Siberian Regions.

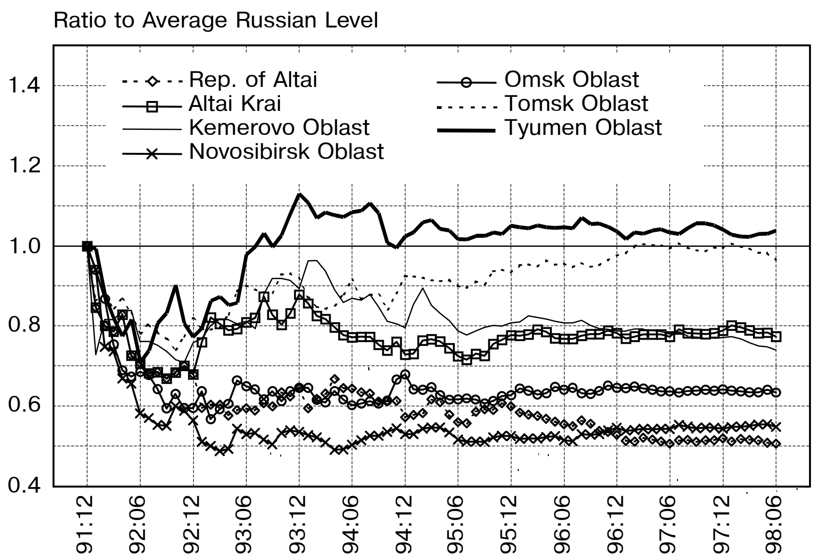

Fig. 2. Food Price Levels in West-Siberian Regions.

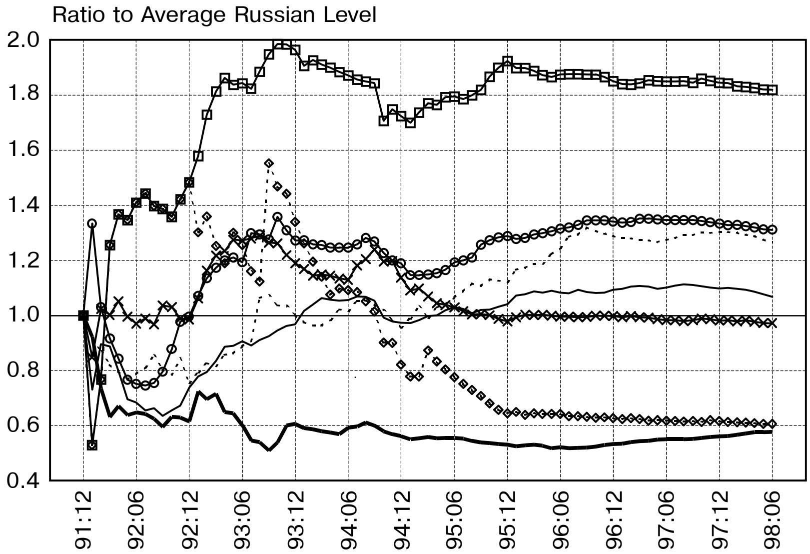

Fig. 3. Manufactured Goods Price Levels in West-Siberian Regions.

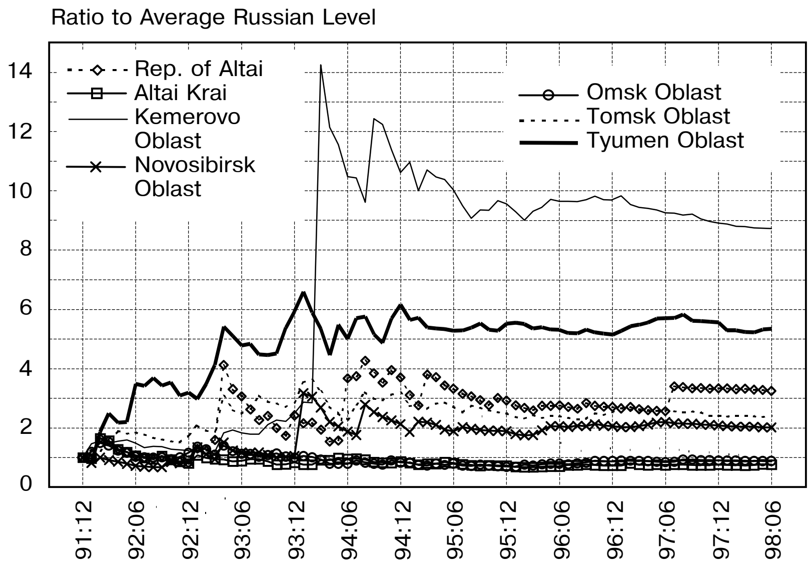

Fig. 4. Service Price Levels in West-Siberian Regions.

Judging from Figs 2 and 3, one may conclude that rapid divergence of the food and manufactured goods price levels has come to an end approximately by the beginning of 1994. Therefore, the span of 1992:1 – 1993:12 can be considered as the early stage of the market transformation, that is, "the price divergence stage" (see Introduction). However, the price level behavior pattern provided by Figs 1 to 4 and Table 1 yield no clear evidence that prices tend to equalize across regions later on. This would be expected for prices of services which are nontradables, as well as for the overall price levels in which services have a marked share: from 8% in 1992 to 15% in 1997 (Goskomstat, 1998; p. 106). But price levels of foods and manufactured goods also demonstrate similar behavior, though these include mostly tradable goods.[5] As Table 1 suggests, the standard deviations of the food and manufactured goods price levels are higher than those of the overall price level and do not tend to diminish with time. Along with this, the real pattern could be shaded by features of the data used themselves, and so, let us briefly consider the relevant potential distortions.

2.2. Potential Inaccuracies of the Data

One of the problems is that of uniformity of initial values, $\tilde{P}_{ir0}$. The assumption that absolute regional price levels have been uniform across regions in December 1991 is open to argument. There are some data contradicting this assumption. Table 2 reports available annual CPIs for 1991.

Regional indices from the table are not officially approved; official data for 1991 exist only for Russia as a whole. The last two columns are P_{irt}, *i.e.*, regional price levels related to the average Russian level. These figures are calculated by Formulas (1) and (2) with i corresponding to the overall price level, and t corresponding to June 1998. The second to last column is based on the official data for 1992 – 1998; initial price levels (December 1991) are set equal to 1 in each region. The last column differs in that the initial values are made equal to the annual rise in prices for 1991, that is, to the values from the column "Overall CPI" (this implies that the price levels are taken to be equal across regions in December 1990). A comparison between the two last columns of Table 2 indicates that if one took into account inflation for 1991, then regional relative price levels would, indeed, change substantially.

[5] The list of goods and services covered by overall CPI and its sub-categories is provided by Goskomstat (1996a), pp. 439 – 451.

But, the regional CPIs from Table 2 are extremely unreliable. It comes as no surprise that these were never accepted officially. The reason is that price indices had been calculated in each region in its own way in 1991 (and these were recalculated subsequently by the unified methodology only in a few regions).

Table 2. Consumer Price Indices in West Siberia and Russia in 1991.

Region	CPI, December 1991 to December 1990, %				Overall price level in June 1998 relative to average Russian level	
	Overall CPI	Food	Manufac. goods	Services	Without regard for inflation during 1991	With regard for inflation during 1991
Russia	260.4	236.3	310.7	178.6	1.00	1.00
Republic of Altai*	—	—	—	—	0.87	1.18
Altai Krai	354.1	340.0**	510	190	1.27	1.73
Kemerovo Oblast	236.8	222.8	186.4	—	1.30	1.18
Novosibirsk Oblast	322.9	301.1	416.9	248.9	1.17	1.45
Omsk Oblast	264.8	192.8	284.1	156.8	0.96	0.98
Tomsk Oblast	428.8	445.1	400.9	206.1	1.22	2.01
Tyumen Oblast	211.6	259.7**	214.2	162.6	1.15	0.93

* — CPIs for the Republic of Altai are calculated only from 1993; formerly the republic had been considered as a part of the Altai Krai, and so indices have been common for both the regions in 1991 – 1992.

** — Without alcohol.

Sources: regional statistical offices, private communications; data for Russia — Goskomstat of Russia; second to last and last columns — author's calculations.

Analysis of the data from Table 2 indicates a low likelihood of these figures. In reality, such great price divergence was not observed in 1991. Most probably, this is wholly caused by defects in the primary price registration and the CPI calculation. The most prominent example is the overall CPI in the Omsk Oblast: this is greater than the average Russian

CPI while *all* its components are smaller. Some other values, both the raw and derivative (*e.g.*, twofold exceeding the Russian level in the Tomsk Oblast in the last column), are not consistent with reality as well. Thus, it seems that there is little point in using data reported in Table 2.

Other information on prices, albeit fragmented, suggests quite another pattern, indicating that regional price levels did not differ much even in the end of 1991. It was "state-run" inflation that contributed the most to the rise in prices for 1991, that is, the one-occasion twofold rise in state retail prices in April (the so-called "price reform" of 1991). This leap was uniform across the whole country. Then, inflation in excess of this, seen from the figures in Table 2, should be attributed to the market price movement. But there are various reasons for believing that the share of the cost of commodities with free prices was relatively small in the population's total consumer expenditures up to the end of 1991. Hence, even though market prices differed dramatically across regions, substantial volatility of *aggregated* price levels could not arise from this (since these differences should be smoothed off by small aggregating weights).

These considerations leave, nevertheless, room for doubts. In light of the lack of comprehensive data, we must not rule out the possibility that annual inflation rates for 1991 do differ across regions (but if so, volatility of the rates across regions could not be high; most likely, it does not exceed 10 – 15%). If initial values of regional price levels are, indeed, not equal, then the assumption of their equity will distort somewhat the pattern of price behavior. Both numbers and plots become unreliable for direct deduction in this case. For example, difference in regional price levels in some period may be evidence of convergence of prices, which compensates for initial divergence (and vice versa).

However, for econometric analysis the problem of initial values does not matter. As it will be argued in Section 3.2, any change in initial values does not afford *properties* of price dynamics (namely, the presence/absence of convergence to equilibrium) at all.

But there are more severe problems. First, the chain method being used to construct price levels has a disadvantage of possible accumulation of errors: once committed, an error will be present permanently in the product of indices. Second, CPIs are not fully comparable across years and regions. The point is that the aggregating weights are changed yearly; the list of commodity representatives has been changed several times during 1992 – 1998; besides that, the price weights are individual for each region. Though, according to the words of experts from the statistical offices, the weights do not differ sharply across regions (the weights themselves are inaccessible for any analysis for they are "top secret" of Goskomstat). Third, having performed sophisticated analysis of Russian CPI properties, Bessonov (1998) has found that the methodology of the CPI calculation yields noticeable upward bias of the rise-in-price estimate (and this, probably, is unequal across regions).

Summarizing, one can state that the reliability of the official CPIs is not high. Thus, it is necessary to bear in mind possible inaccuracies of the regional price levels caused by this unreliability. Though, since the ratio of CPIs is used (see (2)), it is hoped that some biases in a pair of CPIs will cancel each other.

Why then are the aggregated price levels used in the study despite their deficient reliability? The reason is that examining behavior of such indicators across regions is, as it seems, of considerable interest.

This provides us with a general grasp of the existence of price convergence for the *entire* set of large-scale consumer commodities. If individual good prices are used, a good sample should be rather broad: it is inconceivable that, under present Russian conditions, the pattern of price dynamics of diverse goods would be very mixed (*e.g.*, because the possibilities and intensity of arbitrage are very different across goods). And so, one would obtain mere separate pieces in a mosaic of the whole pattern; it is probable that such dynamics would be far from being representative of the general behavior of prices.[6] Thus, it seems to be worthwhile to start a comparative examination of price behavior across regions just from the aggregated price levels, and only then turn to the analysis of prices of individual goods or narrow good groups. Results obtained would be a "benchmark" for further more detailed studies; these make it possible to gauge to what extent behavior of particular components of a regional price level fits with the behavior of this level *as a whole*.

Besides that, the issue of whether there is a tendency for the cost of living and its components to converge across regions is of importance in itself from the viewpoint of spatial variability dynamics of the living standard. That is exactly why this analysis involves, along with good aggregates, price composites that should not necessarily be subject to the law of one price, *i.e*. the service price level and the overall price level (which include services).

[6] This may occur even within a market economy. So, Parsley and Wei (1996) have studied the behavior of individual commodity prices across 48 cities of the US, and their results indicate that absence of convergence to the law of one price can not be rejected for about 15% of the considered *highly tradable* goods.

3. MODEL SPECIFICATIONS

3.1. Formalization of the Problem

By the law of one price, perfect arbitrage will force equating prices of all goods $\{i\}$ that are tradable:

$$\tilde{P}_{irt} = \tilde{P}_{ist} \text{ or } P_{irst} \equiv \tilde{P}_{irt} / \tilde{P}_{ist} = 1 \quad (3)$$

(designations are in Section 2.1). In logarithms (so that $\tilde{Q}_{irt} \equiv \ln \tilde{P}_{irt}$, $Q_{irst} \equiv \ln P_{irst}$), this relation looks like

$$Q_{irst} = \tilde{Q}_{irt} - \tilde{Q}_{ist} = 0. \quad (4)$$

Because of various disturbances, we will observe other relation in reality, irrespective of whether (4) holds or does not, namely,

$$Q_{irst} = \eta_{irst}, \quad (5)$$

where η_{irst} is some stochastic variable. Thereby, the problem arises to recognize whether the observed process (5) is really the realization of the law (4). If the law of one price holds, then the observed process is a result of the permanent combating of shocks disturbing prices from the interregional equilibrium, and market forces making prices return to the equilibrium. This implies that the stochastic process η_{irst} is merely stationary noise with the mean equaling to the equilibrium (zero) value. If the law of one price does not hold, shocks will have sustainable effects, thus pushing prices further and further away from the equilibrium. Hence, the problem of the law of one price testing comes down to finding out whether the process (5) is stationary.

In econometric terms, relation (5) is the cointegration equation with known — predetermined — cointegrating vector (1, −1). It is the construction itself of the variable Q_{irst} as $Q_{irst} = \tilde{Q}_{irt} - \tilde{Q}_{ist}$ that defines this vector. If the η_{irst} is stationary, then prices $\tilde{Q}_{irt}$ and $\tilde{Q}_{ist}$ are cointegrated.

The literature on purchasing power parity (PPP) suggests that if CPIs are dealt with rather than absolute prices, then the equilibrium price difference could be nonzero. This implies that η_{irst} can be represented as $\eta_{irst} = a'_{irs} + \nu'_{irst}$, where a'_{irs} is some constant (the mean of η_{irst}), and ν'_{irst} (as well as ν''_{irst} and ν_{irst} below) is a stochastic variable, to which the previous comments regarding η_{irst} pertain. Furthermore, a number of authors – *e.g.*, Obstfeld (1993), Chinn and Johnston (1996), Obstfeld and Taylor (1997) – argue the possibility that the mean is time-dependent; the dependence is modeled by the long-run deterministic trend: $\eta_{irst} = a'_{irs} + b'_{irs}t + \nu'_{irst}$ (where b'_{irs} is the trend parameter). Both the effects are treated as inherent in *measured* price differences rather than in real ones. Therefore, *convergence to equilibrium* is identified with *price convergence*.

The presence of the constant is caused by the fact that real price levels are unobserved. In fact, if ν'_{irst} is stationary and $\bar{\nu}'_{irst} = 0$, the constant is equal to the log ratio of prices in countries *r* and *s* in the initial period. As it follows from Section 2.2, the same could occur in our case. If the assumption of equal price levels across all regions in 1991 does not hold, but these levels were uniform by the end of 1990, then all relative prices should be multiplied by I_{ir0}/I_{is0} (that is, by the ratio of the rise in the price of aggregate *i* in regions *r* and *s* in 1991). Then $a'_{irs} = \ln(I_{ir0}/I_{is0})$.

According to the papers mentioned, a trend can arise from aggregation (as a consequence of the distinct commodity sets and weight systems used in national CPIs), from the presence of non-tradable components in CPIs, and from quality differences. As seen from what has been said in Section 2.2, this effect is possible, again, in our case. Though the commodity set in CPI is unified for all regions, the aggregating weight systems are different across regions. As for the role of non-tradable components in regional CPIs, this is no different from that of the PPP case.

Thus, it is necessary to assume that, in general, the observed process is of the form

$$Q_{irst} = a'_{irs} + b'_{irs}t + \nu'_{irst} \,. \tag{6}$$

If convergence to the law of one price takes place, then (6), with $b_{irs} = 0$, will be a stationary process with some nonzero — in contrast to (5) — mean; with $b_{irs} \neq 0$, the process will be stationary, too, but about a linear trend, that is, having a mean which is time-dependent.[7]

[7] With such processes, a pattern of price dynamics becomes vague since constant shifts and trends may mask a tendency for convergence of regional price levels, if this exists. As results of the statistical analysis suggest, this is just what we come up against when Figures 1 – 4 are considered. And so, visual analysis of the price dynamics plots is not a proper way to judge the nature of price behavior.

The coefficients a'_{irs} and b'_{irs} are parameters of the long-run equilibrium price difference. Properties of the *long-run* trend of the difference are of some interest, but this study is focused on *short-run* properties of adjustment to equilibrium; its emphasis is on whether convergence to the law of one price exists. Following the PPP literature, the convergence to equilibrium will be treated as convergence of prices.

The strict law of one price (3) requires prices to be equal across various locations. However, as Rogoff (1996) notes, the law holds mainly in breach. Because of transportation costs, local taxes and other factors that may be interpreted as arbitrage transaction costs (in a broad sense), some band arises within which relative prices can fluctuate (moreover, time variation in these costs suggests the band itself would shift — see, *e.g.*, Parsley and Wei, 1996). From this the weak version of the law of one price follows

$$1/(1+C_{irs}) \le \tilde{P}_{irt} / \tilde{P}_{ist} \le 1+C_{irs}\ , \tag{7}$$

(where C_{irs} is arbitrage transaction costs in percentage of the price for a good), or, in logarithms (with $c_{irs} \equiv \ln(1 + C_{irs})$),

$$|Q_{irst}| \le c_{irs}. \tag{8}$$

With this, two treatments of the equilibrium are possible: (a) the equilibrium is reckoned as some point within the band $[1/(1 + C_{irs}),\ 1 + C_{irs}]$, which is the mean of the price differential, and (b) each point within $[1/(1 + C_{irs}),\ 1 + C_{irs}]$ is considered as an equilibrium one, that is, the equilibrium is the entire band. This study deals with both treatments. Individual models used for the statistical analysis are associated with each of these; the models are described in Sections 3.2 and 3.3 correspondingly.

Let us address the more usual treatment (a). It is obvious that the equilibrium point will depend on the value of the arbitrage transaction costs. In turn, these costs are conditioned by the action of a number of *deterministic* factors $\mathbf{X}_{irst} = (X_{irst,\,k})$, where k indexes factors. Then, $P_{irst} = f(C_{irs}(\mathbf{X}_{irst}))$. Assuming function $f(C(\cdot))$ to be log-linear, the observed process can be represented as

$$Q_{irst} = a''_{irs} + \sum_k b''_{irs,k} x_{irst,k} + \nu''_{irst}\ , \tag{9}$$

where $x_{irst,k} \equiv \ln X_{irst,k}$. Thus, with the weak version of the law of one price, additional variables $\mathbf{x}_{irst}$ (that explain long-run deviations from the strict low) may be required for cointegration.

Time variation of the determinants of the arbitrage transaction costs, $\mathbf{X}_{irst}$, can cause the equilibrium point to shift. Having no information on values of $\mathbf{X}_{irst}$, the joint effect of these factors could be modeled by some regular function of time. It is reasonable to adopt a log-linear trend as such function. Then, using $b''_{irs}t$ as a model of the sum in the right-hand side of (9), we have a relation akin to (6):

$$Q_{irst} = a''_{irs} + b''_{irs}t + \nu''_{irst} . \qquad (10)$$

At the same time, all the aforesaid as to measurement effects in values of Q_{irst} still holds. Taking into account these effects, we have

$$\begin{aligned} Q_{irst} &= (a'_{irs} + a''_{irs}) + (b'_{irs} + b''_{irs})t + (\nu'_{irst} + \nu''_{irst}) = \\ &= a_{irs} + b_{irs}t + \nu_{irst}. \end{aligned} \qquad (11)$$

This provides evidence that the treatment of parameters a_{irs} and b_{irs} as caused *only* by measurement effects suffers – both in the PPP case and in ours – from some conventionality. It is not improbable that these parameters could also reflect the effect of any *real* economical processes.

Let the arbitrage transaction costs be determined only by transportation costs: $\mathbf{X}_{irst} = \tau_{irst}$, where τ_{irst} is a tariff for shipping between locations *r* and *s* per unit of a good *i*. If a good is shipped from *s* to *r*, then

$$\tilde{P}_{irt} = (1 + C_{irs}(\tau_{irst}))\,\tilde{P}_{ist} = (1 + \tau_{irst}/\tilde{P}_{ist})\,\tilde{P}_{ist} . \qquad (12)$$

When transportation tariffs and good prices rise with the same (at least, roughly) rates, then the ratio $\tau_{irst}/\tilde{P}_{ist}$ is constant with time. In such an event, the distance between *r* и *s*, L_{rs}, may be used as a proxy of the arbitrage transaction costs C_{irs}, and (9) takes the form $Q_{irst} = a^{\circ}_{irs} \ln L_{rs} + \nu''_{irst}$. Thus, the constant in (11) can implicitly reflect — in addition to measurement effects — geographical factors.

In the case of Russia, the assumption of similar rates in the rise in tariffs and prices is far from the truth. Over 1992 – 1997, freight transportation tariffs rose by 7.7 thousands times in the country (by 9.1 thousands times for rail freightage, and by 5.7 thousands times for road freightage), while consumer prices rose by 2.4 thousands times, food prices rose by 2.1 thousands times, and manufactured good prices rose by 1.5 thousands times (Goskomstat, 1998, pp. 35, 159). And so, the ratio $\tau_{irst}/\tilde{P}_{ist}$ turns out to be time-dependent. Therefore, it is not inconceivable that the trend in (11) may incorporate, side by side with aggregation effects, the effect of divergence between transportation tariffs and good prices.

Unfortunately, the univariate (*i.e.*, without involving additional indicators $\mathbf{X}_{irst}$) model of the law of one price that is used in the study gives no possibility to isolate effects caused by measurement and those caused by real economic processes.

3.2. Basic Specification

The basic model specification being used for the statistical analysis is based on the representation of the observed process as (11). The objective of the analysis is to recognize whether reversion to the mean occurs in this process, *i.e.*, whether the errors ν_{irst} are stationary. The conventional approach is to model these as an autoregressive process $\nu_{irst} = \rho_{irs}\nu_{irs,t-1} + \varepsilon_{irst}$, and to test the absence of the unit root, *i.e.*, to check the fulfillment of the condition $|\rho_{irs}| < 1$. In this study, the process is assumed to be autoregressive of order one, AR(1). This assumption is needed to provide comparability of the basic specification with the non-linear specification described in the next section, since the latter is tested against the AR(1) specification.

With this, model (11) rearranges to[8]

$$\Delta Q_{irst} = \alpha_{irs} + \beta_{irs}t + \lambda_{irs}Q_{irs,t-1} + \varepsilon_{irst}\,, \qquad (13)$$

where Δ is the first difference operator, $\Delta Q_{irst} \equiv Q_{irst} - Q_{irs,\,t-1}$, and $\lambda_{irs} = \rho_{irs} - 1$.

The parameter λ_{irs} to be estimated represents convergence speed of a process, *i.e.*, the speed with which market forces bring prices back to an equilibrium. The derivative indicator called "half-life time of price gap" is more descriptive, which is calculated as

$$T_{irs} = \ln 0.5 \,/\, \ln |1 + \lambda_{irs}|. \qquad (14)$$

This is the time (in accepted units of time; in months in this study) it takes to reduce by half the magnitude of a deviation from the equilibrium caused by an individual shock (price gap between regions *r* and *s*).

The dynamics of a relative price is stationary (and hence, converges to the law of one price) if $-2 < \lambda_{irs} < 0$. As (14) indicates, when $\lambda_{irs} = 0$ (or $\lambda_{irs} = -2$), the half-life time is infinite; this means that the effect of a shock is sustained; with $\lambda_{irs} = -1$, deviations from the equilibrium are eliminated instantly ($T_{irs} = 0$).

[8] The parameters of (11) and (13) are related as $\alpha_{irs} = -\lambda_{irs}a_{irs} + (\lambda_{irs} + 1)b_{irs}$, $\beta_{irs} = -\lambda_{irs}b_{irs}$ (with $-2 < \lambda_{irs} < 0$).

It is easily seen that the correction for unequal initial (at December 1991) values of the variables Q_{irst} would not be essential. Multiplying P_{irst} by constant I_{ir0} / I_{is0} for each t just changes the intercept; values of λ_{irs} and β_{irs} remain the same. This implies that properties of the process are unaffected. Hence, inaccuracies in initial values are of no importance; moreover, these values could be quite arbitrary.

The variable Q_{irst} in (13) can be replaced by a demeaned and detrended component of the price differential, so that

$$Q^{*}_{irst} = Q_{irst} - (\hat{a}_{irs} + \hat{b}_{irs}t), \tag{15}$$

where $\hat{a}_{irs}$ and $\hat{b}_{irs}$ are estimates of a_{irs} and b_{irs} in (11), *i.e.*, Q^{*}_{irst} = ν_{irst}. Then (13) will look like

$$\Delta Q^{*}_{irst} = \lambda_{irs} Q^{*}_{irs,t-1} + \varepsilon_{irst} . \tag{16}$$

The variable replacement (15) is, in fact, the transformation of the system of coordinates t, Q_{irs}, that is, the shift along the axis Q_{irs} by $\hat{a}_{irs}$ and the rotation by angle $\operatorname{arctg} \hat{b}_{irs}$. Thus, the "equilibrium line," whether it be a horizontal line or trend line initially, is matched with the horizontal axis $Q^{*}_{irst} = 0$.

To test the convergence to the law of one price, the model of the form of (16) is used. The null hypothesis is the absence of convergence, *i.e.*, the unit root hypothesis H_0: $\lambda_{irs} = 0$. The alternative hypothesis is H_A: $\lambda_{irs} < 0$, *i.e.*, that a process converges. At the same time, these are hypotheses of no-cointegration against cointegration. The cases of $\lambda_{irs} < -1$ are rather exotic; nevertheless, these occur (when the threshold model is estimated). In such cases, the hypotheses are H_0: $\lambda_{irs} = -2$ against H_A: $\lambda_{irs} > -2$. Dickey – Fuller tau-test is implemented to test the hypotheses. Although model (16), formally, does not contain a constant and trend, it involves them implicitly (see (15)). And so, the statistic for the specification with a constant and linear trend is used (like for model (13)) to obtain p-values, that is, τ_{τ}-test in terms of Dickey and Fuller (1979).

The assumption that the process to be studied is AR(1) could be too restrictive. To check this, all the time series were additionally tested with the use of the augmented Dickey – Fuller test. The starting number of lags of first differences, $\Delta Q^{*}_{irs,\, t-n}$, was set to 5 ($n$ = 1, ..., 5). Then this number was reduced to a last n with which the lag was significant. This always turned out to be the only (if any) lag with $n = 1$. The use of the augmented Dickey – Fuller test did not change the qualitative pattern obtained under the AR(1) assumption, that is, convergence and divergence cases remained the same regardless of the use of the simple or augmented test.

3.3. Non-linear Threshold Model

Albeit equation (16) can implicitly model the weak version of the law of one price, the equation originates, in fact, from the strict version. In addition to this linear specification, the non-linear threshold autoregression (TAR) model put forward by Obstfeld and Taylor (1997) is used which is explicitly based on the weak version (8) of the law.

The theoretical framework of the model is the following. Arbitrage takes place only when its gain exceeds transaction costs, $|Q^*_{irst}| > c_{irs}$. If the price gap is inside the band $[-c_{irs}, c_{irs}]$, then unprofitableness prevents arbitrage; hence, arbitrage does not affect the ratio of prices in r and s. Thus the transaction costs create a threshold for arbitrage; therefore, arbitrage can narrow a price gap only to the threshold value. From this it follows that prices would converge to the external edge of the band $[-c_{irs}, c_{irs}]$. If the price difference is less than the threshold value, then price behavior may be arbitrary, including non-stationarity.

Hence, price dynamics is assumed to be the superposition of two processes: one converging, and one being not necessarily stationary. The TAR model explicitly pulls apart these components. This makes it feasible — in contrast to (16) — to estimate the "arbitrage inaction band." With designations of the current paper, the model specification is

$$\Delta Q^*_{irst} = \begin{cases} \lambda^{out}_{irs}(Q^*_{irs,\,t-1} - c_{irs}) + \varepsilon_{irst}, & \text{if } Q^*_{irs,\,t-1} > c_{irs}; \\ \varepsilon_{irst}, & \text{if } c_{irs} \geq Q^*_{irs,\,t-1} \geq -c_{irs}; \\ \lambda^{out}_{irs}(Q^*_{irs,\,t-1} + c_{irs}) + \varepsilon_{irst}, & \text{if } Q^*_{irs,\,t-1} < -c_{irs}. \end{cases} \tag{17}$$

So, a process below the threshold c_{irs} is set to be a pure random walk. However, this is not obligatory; the second line in (17) may look like $\lambda^{in}_{irs} Q^*_{irs,\,t-1} + \varepsilon_{irst}$ if $c_{irs} \geq Q^*_{irs,\,t-1} \geq -c_{irs}$, *i.e.*, having no constraint $\lambda^{in}_{irs} = 0$. The estimations reported in Section 4.2 were also performed without this constraint. In many cases, processes within $[-c_{irs}, c_{irs}]$ were found to be non-stationary, indeed, with λ^{in}_{irs} close to zero or positive.

Parameters to be estimated are convergence speed λ_{irs}^{out} and threshold c_{irs}. Two tests are used. The first one is the specification test: (16) against (17), *i.e.*, the null hypothesis is the AR(1) process with parameter λ_{irs}, the alternative is the TAR process with parameters λ_{irs}^{out} and c_{irs}. The statistic to provide this test is the ratio of the logarithmic likelihood functions (LLR) of the null and alternative model; the empirical distribution of the LLR is calculated using the Monte Carlo simulation method (with 1000 simulations) to obtain p-values. Henceforward this test is referred as the LLR test. The second test is the same unit root test as in Section 3.2, but this is applied only to observations outside the equilibrium band (*i.e.*, satisfying the condition $|Q_{irst}^{*}| > c_{irs}$).

4. EMPIRICAL RESULTS

Section 4.1 presents the estimation results obtained with model (16); Section 4.2 provides those results of model (17). Both the models are estimated over two time spans, namely, the whole span of 1992:1 – 1998:6, and the period of 1994:1 – 1998:6. In the latter, the "price-divergence stage" which is assumed to come to an end in December 1993 is excluded. December 1991 is not taken as an observation, and so there are 77 observations (of first differences) for 1992 – 1998; this number is 54 for 1994 – 1998.

Two types of estimations are conducted. An estimation of the first type is performed using a regional price level related to the average Russian level, Q_{irt}^{*}. It implies that an answer is sought to the question: does the price level of a region converge to that of Russia as a whole? Or, similarly, is price dynamics in a region cointegrated with the national dynamics?

An estimation of the second type is performed using a regional price level related to a level of other region, Q_{irst}^{*}. There are $21 = 7 \times (7 - 1)/2$ region pairs to be considered (or 42, if one distinguishes reverse pairs, *i.e.*, $\{r, s\}$ and $\{s, r\}$). Here, the question to answer is: does the price level in one region converge to that of other region (are behaviors of prices in a pair of regions cointegrated)?

Generally, the analysis involves prices for only those goods that could be the subject of arbitrage, that is, price levels of food and manufactured goods. However, there is one case (in Section 4.1) when the overall price level and service price level are covered as well.

4.1. The Basic Model

The significance level of 10% is used to reject the unit root hypothesis. In Tables 3 through 6 as well as in Tables A1 and A2 of Appendix A, italic font in the columns of *p*-values marks cases when the null hypothesis is rejected (*i.e.*, when price level convergence exists).

An important note is needed in relation to the unit root test. The implementation of the test yields a serious problem. This test is too tough as applied to processes with a deterministic trend. For the significance level of 10%, the critical values of the Dickey – Fuller tau-statistic are −3.162 with 77 observations, and −3.177 with 54 observations for specification (13) as compared to −1.614 and −1.613 if the specification without a constant and trend is adopted (or to −1.665 and −1.674 of conventional *t*-statistic). Seemingly, the issue is that the time series used are too short (*e.g.*, Froot *et al*. (1995) deal with data spanning several centuries). But this is not so, since even an infinite sample would reduce the relevant critical value to as low as −3.127. Due to the low power of the test implemented, there are a number of cases in the results presented where non-rejection of the unit root hypothesis gives no confidence that cointegration is really absent; one may suspect that relevant processes do converge, but at a moderate rate.

Results reported in Table 3 to 6 were obtained for price levels related to the national level. In this case, the analysis also involves, in addition to good price levels, overall price level and service price level. This additional analysis should answer one more question: may one hope that differences in the cost of living across regions will diminish with time, or will their spread tend to become wider and wider, strengthening spatial inequalities?

Besides that, alongside the estimations on individual regional time series, the estimations are run here over panels of all regions as well ($539 = 77 \times 7$ observations in 1992 – 1998, and $378 = 54 \times 7$ observations in 1994 – 1998). In doing so, the Levin – Lin test for panel unit root is implemented (Levin and Lin, 1992); critical values of the test statistic are taken from Table 3 of the paper cited (given $N = 5$ and $t = 50$).

Table 3 contains results for the overall price level (cost of living). For 1992 – 1998, the unit root can be rejected for 3 of the 7 regions. Turning to the span of 1994 – 1998, the pattern improves: one more region is added and the rest are under suspicion that convergence exists there, too, judging from their half-life times. Over the panel, convergence is highly significant for both time spans (not worse than at the 1% level); its speed increases in the second: the half-life falls from 3.4 to 2.6 months (though it rises in 3 regions).

These results can be correlated with those of Obstfeld and Taylor (1997) which have been obtained in comparable conditions: AR(1) model, monthly frequency, aggregated data. For the overall CPI ("CPI-All"), they found the half-life to be equal to 4.9 months for a panel of 4 US cities, and to be in the range of 1.9 to 12.8 months for individual cities (with 1.4 to 21.2 months in West Siberia).

Hence, it can be stated that the tendency for convergence of the cost of living in West-Siberian regions exists; during 1994 – 1998, it exists in at least more than half of the regions. Therewith, the tendency somewhat becomes enhanced if we leave the early stage of the reforms from consideration.

Table 3. Estimation and Unit Root Test Results for Overall Price Level.

Region	1992:1 – 1998:6			1994:1 – 1998:6		
	DF-test *p*-value	λ	Half-life *T*	DF-test *p*-value	λ	Half-life *T*
Republic of Altai	*0.000*	−0.312 (0.050)	1.9		−0.122 (0.058)	5.3
Altai Krai	*0.000*	−0.380 (0.042)	1.4	*0.044*	−0.200 (0.056)	3.1
Kemerovo Oblast	0.936	−0.032 (0.032)	21.2	*0.000*	−0.425 (0.079)	1.3
Novosibirsk Oblast	0.121	−0.225 (0.073)	2.7	*0.041*	−0.341 (0.094)	1.7
Omsk Oblast	*0.003*	−0.224 (0.049)	2.7	0.368	−0.157 (0.065)	4.0
Tomsk Oblast	0.857	−0.066 (0.047)	10.1	0.629	−0.168 (0.088)	3.8
Tyumen Oblast	0.515	−0.097 (0.045)	6.8	*0.087*	−0.195 (0.060)	3.2
Panel	< *0.01**	−0.187 (0.018)	3.4	< *0.01**	−0.230 (0.027)	2.6

* — Levin – Lin test *p*-value.
Standard deviations are in parentheses.

As Table 4 demonstrates, the food price level behavior gives a similar (and more encouraging) pattern. Here, one can certainly see convergence of prices to the national level in 4 or 5 regions, depending on the time span and there are reasons to assume its existence in all of the rest of the cases. During 1992 – 1998, the half-lives of the price gap are in the range of 1.7 to 5.1 months; the panel provides the value of 2.7

months. When the 1992 – 1993 interval is eliminated, the price-equating tendency is enhanced: the panel half-life decreases by 1.4 times (in comparison with 1.3 times in the case of the overall price level); individual half-lives become smaller in 6 of the 7 cases.

Obstfeld and Taylor (1997) have obtained half-life values equaling to 12 months over a panel of 4 US cities, and to 7.9 to 24.7 months across individual cities for food prices ("CPI-Food").

Table 4. Estimation and Unit Root Test Results for Food Price Level.

Region	1992:1 – 1998:6			1994:1 – 1998:6		
	DF-test *p*-value	λ	Half-life *T*	DF-test *p*-value	λ	Half-life *T*
Republic of Altai	*0.016*	−0.251 (0.064)	2.4	*0.058*	−0.373 (0.108)	1.5
Altai Krai	0.132	−0.192 (0.063)	3.3	*0.013*	−0.229 (0.057)	2.7
Kemerovo Oblast	0.245	−0.148 (0.055)	4.3	0.218	−0.255 (0.093)	2.4
Novosibirsk Oblast	*0.000*	−0.287 (0.038)	2.1	0.185	−0.237 (0.083)	2.6
Omsk Oblast	*0.000*	−0.340 (0.050)	1.7	*0.022*	−0.424 (0.110)	1.3
Tomsk Oblast	*0.079*	−0.244 (0.074)	2.5	*0.015*	−0.457 (0.114)	1.1
Tyumen Oblast	0.407	−0.127 (0.054)	5.1	*0.028*	−0.342 (0.091)	1.7
Panel	< *0.01**	−0.227 (0.020)	2.7	< *0.01**	−0.309 (0.034)	1.9

* — Levin – Lin test *p*-value.
Standard deviations are in parentheses.

However, the behavior of manufactured goods prices (Table 5) is quite different from that of the overall and food price levels. When the whole span of 1992 – 1998 is considered, the unit root is rejected for 4 regions; half-lives are from 1.7 to 8.6 months, with 2.3 months over the panel. The figures resemble those of the food price level. But for 1994 – 1998, there is no one case of convergence; only in one or two regions (the Altai Krai and Kemerovo Oblast) prices may be suspected to converge. Nevertheless, the panel estimate is significant and shows that the price gap half-life increases 3.7-fold in this time segment. Hence, it can be concluded that in the early stage of the market transformation, 1992 – 1993, the price divergence gave way after a short time to price equating across some West-Siberian regions, but soon the latter tendency diminished (unless it vanished) sharply, and so it is not detected if one excludes this stage from consideration.

Table 5. Estimation and Unit Root Test Results for Manufactured Goods Price Level.

Region	1992:1 – 1998:6			1994:1 – 1998:6		
	DF-test *p*-value	λ	Half-life *T*	DF-test *p*-value	λ	Half-life *T*
Republic of Altai	*0.000*	−0.329 (0.045)	1.7	0.645	−0.075 (0.040)	8.9
Altai Krai	*0.000*	−0.335 (0.032)	1.7	0.322	−0.159 (0.063)	4.0
Kemerovo Oblast	0.761	−0.077 (0.047)	8.6	0.657	−0.126 (0.068)	5.1
Novosibirsk Oblast	*0.026*	−0.153 (0.041)	4.2	0.858	−0.071 (0.052)	9.4
Omsk Oblast	0.263	−0.115 (0.044)	5.6	0.844	−0.063 (0.044)	10.6
Tomsk Oblast	0.154	−0.194 (0.066)	3.2	0.905	−0.076 (0.064)	8.6
Tyumen Oblast	*0.000*	−0.336 (0.061)	1.7	0.935	−0.042 (0.042)	16.2
Panel	< *0.01**	−0.264 (0.017)	2.3	< *0.01**	−0.077 (0.017)	8.6

* — Levin – Lin test *p*-value.
Standard deviations are in parentheses.

Results for the service price level are presented in Table 6. Here, the unit root can be rejected for only two regions for 1992 – 1998 (albeit half-lives are rather small in other regions, excluding the only case). However, the panel estimate suggests that convergence of prices does exist for the whole West Siberia. The convergence rate increases drastically when 1994 – 1998 is taken instead of 1992 – 1998: the range of the individual half-lives changes from 1.6 – 11.1 months to 0.3 – 2.9 months; the panel half-life falls 3.4-fold.

This is seemingly paradoxical: the low of one price holds better for services, purely nontradables, than for goods, especially for manufactured ones. Specific features of the service price dynamics can explain this. After a giant leap in the service price level in a region (as happened from the beginning of 1994) prices of housing and utilities do not change for a long time while these prices continue to rise in the country, so it causes a relatively rapid decrease in the gap between the regional price level and the national one.

Table 6. Estimation and Unit Root Test Results for Service Price Level.

Region	1992:1 – 1998:6			1994:1 – 1998:6		
	DF-test *p*-value	λ	Half-life *T*	DF-test *p*-value	λ	Half-life *T*
Republic of Altai	0.159	−0.196 (0.067)	3.2	0.189	−0.266 (0.093)	2.2
Altai Krai	*0.029*	−0.313 (0.085)	1.8	0.322	−0.219 (0.088)	2.8
Kemerovo Oblast	0.850	−0.060 (0.043)	11.1	*0.001*	−0.421 (0.084)	1.3
Novosibirsk Oblast	0.202	−0.192 (0.069)	3.2	*0.000*	−0.867 (0.106)	0.3
Omsk Oblast	0.457	−0.130 (0.058)	5.0	0.178	−0.210 (0.073)	2.9
Tomsk Oblast	0.135	−0.165 (0.055)	3.9	*0.074*	−0.351 (0.106)	1.6
Tyumen Oblast	*0.000*	−0.346 (0.047)	1.6	*0.002*	−0.595 (0.124)	0.8
Panel	< *0.01**	−0.145 (0.021)	4.4	< *0.01**	−0.425 (0.035)	1.3

* — Levin – Lin test *p*-value.

Standard deviations are in parentheses.

Linkages of regions' price dynamics between each other provide a more detailed pattern of price behavior. Results for interregional relative prices are presented in Appendix A: Table A1 refers to foods, and Table A2 to manufactured goods.

Table A1 reports that the cointegration hypothesis fails in 7 cases of the 21 if the food price level is considered for 1992 – 1998 (so, 14 region pairs are cointegrated). Of these cases, 5 are pairs with the Tyumen Oblast; food price dynamics in this region is cointegrated only with that of the Kemerovo Oblast. While the price level in the Kemerovo Oblast is not accepted as converging to the average Russian level (see Table 4), it is cointegrated with price levels of all the rest of the regions; a similar pattern is observed for the Altai Krai. This provides a reason to suspect that price levels in these regions are cointegrated with the national level as well.

When the time span without the early stage of the market transformation, 1994 – 1998, is considered, the pattern becomes more mixed: In this time span there are 11 cointegrated region pairs, *i.e.*, about a half of the pairs. Each region's price dynamics is cointegrated only with one to three of that of other regions. The Tyumen Oblast does not stand out here against the background of the rest of West Siberia. Curiously, there is no linkage between cointegration and proximity of regions. So, price dynamics in a region can be not cointegrated with the dynamics of its neighbors, and at the same time be cointegrated with the dynamics in remote regions. That is just the case for the Tyumen Oblast. Half-lives are rather small across all region pairs in 1994 – 1998. And so, it can be believed that the unit root test fails here to recognize a number of cointegration cases due to its low power; it looks like food price levels converge to each other in reality in most of the region pairs. While mean (over all region pairs) half-life is equal to 2.8 months for the span of 1992 – 1998, it falls to 2.1 months for 1994 – 1998 (however, at the same time, half-lives rise in 6 region pairs).

Results presented in Table A2 suggest that the detailed pattern of price behavior of manufactured goods is more consistent with the general one (see Table 5) than in the case of food (assuming similar considerations about the unit root test failures). Price levels' convergence to each other exists in 16 of the 21 region pairs in 1992 – 1998; convergence to the national level is evident in 4 regions of the 7. As for 1994 – 1998,[9] there are only two cointegrated pairs: Kemerovo Oblast – Altai Krai and Kemerovo Oblast – Omsk Oblast (though a few more pairs with low half-lives are "candidates"). Therefore, the lack of cointegration with the national dynamics is quite natural. Half-lives rise sharply while changing 1992 – 1998 to 1994 – 1998. In the first case, mean half-life is 3.4 months, while this is 13.4 months in the second case (apart from the pair Omsk Oblast–Tyumen Oblast).

Dramatic loss in the power of the unit root test with assuming deterministic trends gives rise to the issue of the validity of this assumption. Model estimations prove that this is really the case. Appendix C reports trends in the time series used: Table C1 for the region–Russia pairs, and Tables C2 and C3 for the region–region pairs (food and manufactured goods price levels, correspondingly). The figures in these tables are

[9] An "almost confident" unit root can be seen here: in the pair Omsk Oblast – Tyumen Oblast with its $\lambda = 0.003$.

1000-fold enlarged parameters β_{irs} of the regression (13) and their *p*-values of the conventional *t*-statistic. The *p*-values are given only where the unit root is rejected (otherwise one could not say whether a trend is really deterministic or stochastic); italic font marks cases where the hypothesis $\beta = 0$ is rejected at the significance level of 10%. As can be seen from Tables C1 – C3, many time series with rejected unit root are, indeed, trend-stationary processes.

4.2. Threshold Model

Results of the threshold model estimations are summarized in Tables 7 and 8 as well as in Tables B1 – B4 of Appendix B. For more descriptiveness, thresholds are given in percent rather than in logarithm, $C_{irs} = \exp(c_{irs}) - 1$, in these tables.

Italic font in the tables marks *p*-values in the cases that the hypotheses of the AR(1) specification is rejected and the Dickey – Fuller test contemporaneously rejects the unit root hypothesis (the significance level of 10% is assumed).

In principle, from non-rejection of the TAR specification, it should follow — by construction of the model — that a process beyond the "arbitrage inaction band" is deliberately stationary. But features of the threshold model are as yet poorly understood, and it is not known whether this guarantees stationarity of the process. Among results obtained, there are cases casting doubts as the standard error of λ^{out} is close to or even exceeds the estimate itself (*e.g.*, for the Kemerovo Oblast in the upper panel of Table 8). For this reason, the Dickey – Fuller test is performed, too, in addition to the LLR test. However, omitting "below-threshold" observations can significantly cut the size of a sample thus lowering the power of unit root tests. And so, the Dickey – Fuller test plays here a purely auxiliary role. If it does not reject the unit root hypothesis, this – from the aforesaid – says nothing. But if it does, this provides strong confidence in the stationarity of the process outside the "arbitrage inaction band."

Explicitly taking into account arbitrage transaction costs, differences between West-Siberian regions' and national food price levels turn out to converge to the equilibrium band in all regions (Table 7). The TAR specification is rejected only once, namely, for the Republic of Altai for 1992 – 1998, but this time series is stationary in the AR(1) model. This suggests the absence of barriers to arbitrage between the Republic of Altai and the aggregated remaining part of Russia in that time span. Elimination of the "arbitrage inaction band" yields a substantial rise in convergence speed. The range of half-lives becomes 1.0 to 2.8 months instead of 1.7 to 5.1 months from Table 4 for 1992 – 1998, and 0.1 to 2.1 months as opposed to 1.1 to 2.7 months for 1994 – 1998. Only once, in the Novosibirsk Oblast, convergence speed decreases in TAR — as well as in AR(1) — when the early stage of the transition, 1992 – 1993, is eliminated.

Table 7. Results of the Threshold Model Estimation: Food Price Level.

Region	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
		1992:1 – 1998:6			
Republic of Altai	0.118	0.006	−0.268 (0.063)	2.2	0.7
Altai Krai	*0.000*	0.280	−0.218 (0.084)	2.8	0.9
Kemerovo Oblast	*0.000*	0.429	−0.162 (0.071)	3.9	1.1
Novosibirsk Oblast	*0.000*	*0.003*	−0.542 (0.091)	1.0	8.2
Omsk Oblast	*0.021*	*0.000*	−0.421 (0.070)	1.3	2.3
Tomsk Oblast	*0.004*	0.217	−0.325 (0.118)	1.8	1.4
Tyumen Oblast	*0.000*	0.596	−0.357 (0.182)	1.6	7.7
		1994:1 – 1998:6			
Republic of Altai	*0.027*	*0.007*	−0.445 (0.103)	1.2	0.7
Altai Krai	*0.015*	0.102	−0.283 (0.088)	2.1	1.1
Kemerovo Oblast	*0.002*	0.272	−0.300 (0.114)	1.9	0.6
Novosibirsk Oblast	*0.023*	0.223	−0.334 (0.121)	1.7	0.8
Omsk Oblast	*0.002*	0.278	−0.672 (0.257)	0.6	1.6
Tomsk Oblast	*0.019*	*0.019*	−1.004 (0.245)	0.1	1.6
Tyumen Oblast	*0.030*	0.540	−0.556 (0.272)	0.9	1.9

Standard deviations are in parentheses.

Thresholds (barriers to arbitrage) are in the range of 0.9 to 8.2% for 1992 – 1998. In two cases, for the Novosibirsk and Tyumen Oblasts, these seem to be too high. However, over the 1994 – 1998 interval, the thresholds are considerably lowering, up to 0.6 to 1.9% (the value slightly rises only in the Altai Krai). Such values are comparable with those of advanced market economies as Obstfeld and Taylor (1997) obtained estimates of *C* for food price level ("CPI-Food") having the range of 0.6 to 4.3% across 4 US cities.

Table 8 reports relevant results for manufactured goods. For 1992 – 1998, there are not rejections of the TAR specification. However, convergence is doubtful in the Kemerovo Oblast because of a high standard error of λ^{out}. The unit root is rejected for the same regions as in Table 6, and for one more region.

As for 1994 – 1998, while the AR(1) estimations do not detect convergence at all, the TAR model demonstrates that convergence does occur. In fact, the TAR estimations suggest lack of convergence in the only case, namely, in the Tomsk Oblast, the price level time series of this region being non-stationary in the AR(1) model as well. However, one may also have doubts as to the stationarity of the series for the Kemerovo and Omsk Oblasts because of comparable-valued estimates and their standard errors. Along with this, the price level dynamics outside the "arbitrage inaction band" turns out to be stationary in 3 regions even by the Dickey – Fuller test. The TAR model supports results of the AR(1) estimations which provides evidence of worsening price behavior over this time interval as compared with 1992 – 1998.

The values of thresholds are abnormally high in a number of cases, especially over the 1992 – 1998 span, reaching as much as 20%. It is characteristic that 3 of the 4 such threshold values are present in the series that are stationary as determined by both tests. Albeit price dynamics deteriorates over the 1994 – 1998 interval, thresholds become lower, nevertheless, excepting one case. However, these are rather high here too in some cases. Obstfeld and Taylor provide no analogous results to make a comparison; for clothing, their estimations of *C* are in the range of 0.7 to 2.2% across 4 US cities. These are considerably lower than West-Siberian figures for all manufactured goods.

It catches one's eye that the thresholds of the neighboring Republic of Altai and Altai Krai differ sharply, while capital cities of these areas are located as near as 200 km to one another, trade flows to the Republic of Altai moving only through the Altai Krai.

Table 8. Results of the Threshold Model Estimation: Manufactured Goods Price Level.

Region	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
1992:1 – 1998:6					
Republic of Altai	*0.000*	*0.027*	−0.618 (0.127)	0.7	20.2
Altai Krai	*0.000*	*0.010*	−0.576 (0.098)	0.8	18.5
Kemerovo Oblast	*0.000*	0.948	−0.104 (0.123)	6.3	7.2
Novosibirsk Oblast	*0.000*	*0.069*	−0.251 (0.075)	2.4	3.7
Omsk Oblast	*0.001*	0.823	−0.424 (0.333)	1.3	19.2
Tomsk Oblast	*0.003*	*0.005*	−0.298 (0.068)	2.0	2.5
Tyumen Oblast	*0.000*	*0.061*	−0.955 (0.242)	0.2	11.2
1994:1 – 1998:6					
Republic of Altai	*0.060*	*0.080*	−0.316 (0.093)	1.8	12.1
Altai Krai	*0.000*	*0.026*	−0.162 (0.043)	3.9	0.1
Kemerovo Oblast	*0.007*	0.900	−0.301 (0.269)	1.9	2.7
Novosibirsk Oblast	*0.027*	0.729	−0.807 (0.543)	0.4	6.8
Omsk Oblast	*0.006*	0. 916	−0.129 (0.125)	5.0	2.8
Tomsk Oblast	0.344	0.905	−0.079 (0.067)	8.4	0.1
Tyumen Oblast	*0.077*	*0.077*	−1.038 (0.213)	0.2	6.5

Standard deviations are in parentheses.

The pattern of the "intra-West-Siberian" market is seen from Tables B1 and B2 of Appendix B. With the time span of 1992 – 1998 which includes the early stage of the market transformation, the TAR specification is rejected in 3 cases of the 21. For the pair Altai Krai–Tyumen Oblast this suggests that there are no impediments to arbitrage between these regions (as the time series converges in the conventional AR(1) model, see Table A1); in the remaining two cases, this is evidence of the lack of convergence in any sense. The elimination of the "arbitrage inaction band" yields dramatic acceleration of price level convergence. Half-life times come to be in the range of 0.5 to 2.4 months with the mean value equaling to 1.1 months (without regard for pairs rejected by the LLR test) as against 1.0 – 7.0 and 2.8 months provided by the AR(1) estimations. Thresholds have the range of 1.1 to 14.6% with the mean equaling to 6.1%. It engages our attention that thresholds are rather high between neighboring regions: 8.0% for Altai Krai–Novosibirsk Oblast, 8.5% for Kemerovo Oblast – Novosibirsk Oblast, 10.3% for Novosibirsk Oblast – Tomsk Oblast.

If the initial "price divergence stage" is eliminated, thus providing the span of 1994 – 1998 (Table B2), then thresholds are significantly lower; their range turns out to be 0.3 to 7.2%, and the mean to be 2.4%. The TAR specification is rejected in 4 cases, in one of which the AR(1) process is convergent (the pair Altai Krai – Tyumen Oblast), and in the rest three this process is divergent. Half-lives are predominantly lowering, though they rise in 7 pairs.

Tables B3 and B4 of Appendix B report results for manufactured goods price level. As for the 1992 – 1998, there is no one case of TAR-specification rejection. The mean half-life is 1.5 months with the range of 0.4 to 10.0 months. But the thresholds are very high, having a mean which equals 14.2%, and ranges from 4.6 to 33.9%.

Excluding the initial "price divergence stage," the pattern degrades dramatically. The TAR specification is rejected in 8 cases, thus testifying, along with Table A2, to the non-stationarity of the price level time series of relevant region pairs. The pair Kemerovo Oblast – Tyumen Oblast should be added to these, for which the TAR model provides a strange result of $\lambda^{out} < -2$, *i.e.*, a divergent "beyond-threshold" process. The mean (over region pairs for which the TAR specification is not rejected) half-life increases threefold, up to 4.6 months, with the range of 0.4 to 21.2 months. It should be noted, however, that thresholds are lower; their range becomes 0.2 to 17.2% with the mean equaling 6.0%. Price level divergence is typical for region pairs involving the Tyumen Oblast (4 of the 6 pairs), the Tomsk Oblast (4 of the 6 pairs), and the Novosibirsk Oblast (3 of the 6 pairs). Surprisingly, price levels diverge between the closely-spaced Altai Krai and the Republic of Altai.

Looking through all the tables with the results of the threshold model estimations, one can see that there are only 2 cases of the 14 when this model is rejected in favor of the AR(1) model for the region–Russia pairs

(Tables 7, 8), and 15 cases of the 84 for the region–region pairs (tables of Appendix B). Even with all doubtful cases of convergence, this gives grounds to conclude that in most cases testing for stationarity in the AR(1) model owes its failures to the improper representation of a fundamentally non-linear process by the linear model, which yields a downward bias of estimates of λ (and so, it must be admitted that the threshold model better describes the real dynamics of price levels).

Along with this, in a number of cases, the values of the barriers to inter-regional trade turn out to be far too high to be assigned to only transportation costs, especially when the case considered is manufactured goods. This fact bears witness that there are serious impediments to inter-regional trade flows.

5. WHAT HINDERS CONVERGENCE OF PRICE LEVELS?

The economic reality suggests a great deal of reasons causing the segmentation of the Russian consumer market. Here, only main factors are discussed that are, as it seems, of primary importance.

One group of factors is the administrative controls over trade. Among these are price controls by local authorities. For the most part, these controls stretch over foodstuffs; among manufactured goods, the subject of controls is a narrow set of children's articles. Results of a survey performed by Goskomstat of Russia that are reported in Table 9 give us a grasp of the extent of price controls.

Table 9. The Scale of Food Price Controls in 1995 (percentage of cities and items observed by Goskomstat).

Region	March	June	September	December
Russia as a whole	31.0	23.9	19.2	16.7
West Siberia	23.5	26.2	13.9	17.4

Source: Goskomstat, 1996b, p. 89.

More detailed data are provided by the TACIS (1996) reports. The report attributes to each Russian region a rank from 6 through 1 indicating the degree of price controls. In West Siberia the Omsk Oblast has the maximum rank, 6. The Republic of Altai, Altai Krai, and Novosibirsk Oblast have the rank 4; the Tyumen Oblast and Kemerovo Oblast have the rank 3; the Tomsk Oblast has the rank 2. These ranks agree rather well with the mean values of thresholds for foodstuffs for 1994 – 1998 (calculated from the data from Table B2 of Appendix B). The Omsk Oblast also has the maximum mean threshold which equals 3.5%. The Republic of Altai (3.3%) and the Altai Krai (2.8%) rank below it. The Tyumen Oblast and Kemerovo Oblast have mean thresholds that are equal to 2.2 and 1.8%. The Tomsk Oblast has the minimum value equaling 1.4%. Only the Novosibirsk Oblast (with the mean threshold 1.7%) drops out.

It should be noted that to date the list of goods with controlled prices is very narrow. Attempts to strengthen and to widen local controls have been resumed after the August crisis of 1998, but these have primarily failed. In parallel with direct price controls, indirect controls are used, too, by means of subsidies for some basic commodities (primarily, bread). In West Siberia, this is peculiar to the Tyumen Oblast; the price subsidization has been abolished there only in recent years.

Besides price controls, some regional authorities create direct bars to inter-regional trade, despite the unlawfulness of this. For example, the export of agricultural products to other regions was barred for some time in the Altai krai and Omsk Oblast. Again, this has been in common practice for certain time after the crisis of 1998. According to Starikov (1999), decrees prohibiting or limiting removal of goods from a region were issued in 11 subjects of the Russian Federation.

A protectionist policy aimed at limiting the importation of certain goods (primarily, alcohol, sometimes, bear, meat and dairy produce as well) is pursued in a number of regions. In West Siberia, these are the Altai krai, Kemerovo and Omsk Oblasts (Bazhenova, 1999). One tool of such policy is the establishment of repeat certification, marking, and identification of products; the costs of these procedures being 3 to 5 times dearer for imported products than for those of local producers. For example, the identification procedure was established in the Omsk Oblast for imported alcohol, which made its import to be quite unprofitable. Another practice, again in the Omsk Oblast, is numerous inspections of stores selling products from the Novosibirsk Oblast by various inspecting institutions. Although very rarely, even direct prohibitions of imports are issued by local authorities.

Prohibiting the export of some products, regional authorities aim to prevent a rise in the prices of these products in a region. As for barriers to import, these are built up in an effort to restrict competition to local producers that is potentially fraught with job losses. Although in the case of alcohol (the import of which is barred most commonly), the motive is different. Since the alcohol excise tax is raised by production points, the slump in sales of local producers would cut tax revenues for the regional budget.

The impact of organized crime is a direct restriction on arbitrage and a rise in distribution costs. In the first case, criminal groups aiming at the maintenance of their "rent" directly block the entry into markets for goods from regions where they are cheaper and force traders not to lower prices below a "prescribed" limit. Distributions costs are raised by the racket (of wholesale and retail traders) and by road extortion (*e.g.*, on the road from Novosibirsk to Kemerovo). Specific examples are given, in particular, in Berkowitz *et al*. (1998).

An important factor of inter-regional discrepancies of prices is the wide variation of retail markups across regions.[10] On the one hand, this is due to the difference of the non-tradable component in prices of tradable goods, namely, the uneven price of labor (wages in retail trade vary 2.5 to 2.6 times across West Siberia), and of other input services: rent, local transportation, electricity, etc. On the other hand, the profit rate in retail prices is different in various regions, too; even keen competition in retail trade does not force traders to reduce the rate. This is just a feature of the present Russian trade; overall, traders are inclined nowadays to derive profit more from high markups rather than from increases in turnover.

The different arbitrage risk across regions is also worth mentioning. Because of the current capital shortage, retail traders often agree to take goods on commission only.

However, as it seems, on a whole-country scale, of much more importance is the lack of a nation-wide infrastructure of the consumer commodity market as well as the unequal intensity of its development across regions. Up to the present, there is no advanced system of distributive networks in Russia (its separate islands are represented by distributive chains of a few — to the end of 1998, mostly foreign — goods, *e.g.*, chewing gum, cigarettes, and the like). The share of stable direct business relations with deliverers is small in wholesale (and partially in retail) trade of all levels; "one-occasion-only" (accidental) bargains prevail. With this, an article passes through many resellers, so losing "along the way" the arbitrage gain. Most local producers have no funds for marketing, and so their market is usually bounded by their own region (sometimes, by neighboring ones as well).

One more infrastructure aspect is the highly imperfect information base of the market. Because of this, market agents (both traders and buyers) simply do not receive many "price signals."

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[10] Markup in accounting terms is meant, *i.e.*, the difference between the retail and wholesale price. Thus the markup includes both costs and profits of retail trade.

There are no nation-wide (or, at least, multi-region-wide) department store chains in Russia. And so, final consumers (as well as retail traders) have no common "benchmark" of retail prices for the whole country, or for a group of regions; they are guided by local-specific prices only. The information needed for inter-regional arbitrage activity is very poor and not easily accessible; there are no any means to obtain more or less complete, systematized and regular information about the demand and supply prices across regions. Therefore, when arbitrageurs choose a sales location, they base their decision not on clear-cut knowledge of prices in various regions, but on their own idea about the population's incomes in one or another region. It is just why the Tyumen Oblast (and to some extent the Kemerovo Oblast as well) have become a "center of attraction" for commodity flows (this correlates with the results of Rayskaya *et al*. (1997) and partially explains why commodity price levels are higher in some poorer West-Siberian regions than in these regions).

By and large, one may say about the consumer commodity wholesale trade in the country that it is characterized by a considerable share of accidental bargains, and that it is rather chaotic than ordered. As a result, equating prices in some regions, the arbitrage activity can cause, as a side effect, an increase in price divergence in other regions. For example, Voronov (1995) found a curious phenomenon which he called the "Tyumen price jam." In 1993 – 1994, the Tyumen Oblast was characterized by high prices and demand. For this reason, most of the share of goods coming from the west settled here, and so the region became a "dam," inhibiting their further movement east, to other regions of West Siberia. As a result, the relative good price level decreased in the Tyumen Oblast whereas it increased in some other regions of West Siberia.

There are grounds for believing that the institutional factor is of no small importance in poor market integration, namely, the fact that arbitrage activity as an institution is still in its infancy in Russia. An argument in favor of this is supported by the results of a survey that involved experts from a number of Novosibirsk wholesale and retail firms. In all these firms, arbitrage is not thought to be at all a serious means to improving firm's performance. Hence, it is natural that arbitrage is not practiced, or is used only to a small extent. The reason is not only the poor infrastructure mentioned, but also the attitude itself to such kind of activity. The cause of this is the fact that arbitrage is unwanted in Russian trade; there are no relevant skills, customs, and traditions. And so, inasmuch as mentality is rather inertial thing, it seems that it will take much time for arbitrage to become a common practice, and to begin working at its full potential.

In the results presented in the previous section, the striking difference in the behavior of food and manufactured goods price levels catches one's eye. Although price controls, import and export restrictions, and fixing price floors by gangs concern (almost) only foodstuffs, the behavior of food prices is more consistent with the law of one price. The reason is believed to be the fact that foodstuffs are much less differentiated than manufactured goods. So, the Russian CPI covers 83 foods, while the figure is 144 for manufactured goods; besides that, many items of the former are specific goods (*e.g.*, sugar, butter, etc.), whereas the largest part of the latter are low-aggregated groups (*e.g.*, printed-cotton textile, man's suit, etc.). If one took only basic foods which have the greater share in consumer expenditures (and therefore, sufficient weights in CPI), as few as 30 to 35 goods could be counted. Visibility and relative homogeneity of the food market make inter-regional comparison of prices and evaluation of demand easier, thus lowering arbitrage risk. The infrastructure of the food market is more developed, too (this also could be explained by more homogeneity of foodstuffs). Along with this, of great importance is the fact that the food market is more voluminous than that of manufactured goods, since, owing to their low standard of life, the Russian population spends their main share of income for food.

A disquieting aspect is the presence of a deterministic trend in a number of relative price levels (Appendix C). This implies that albeit prices converge to inter-regional equilibrium, the difference in prices widens in time (as the equilibrium point itself moves).[11] One possible reason is the outstripping rise in transport tariffs mentioned in Section 3. But it is probable, too, that the trends are artifacts caused by measuring price levels through CPI. Unfortunately, with the methodology used this issue remains open.

6. CONCLUSIONS

Differences of inflation rates in various regions of Russia observed year after year give rise to the question of their total effect. Do these merely reflect uneven propagation of inflation across the country, being temporary deviations from a common trend, or do these engender some persistent divergences between price levels in various regions?

[11] The intuition can be captured by a simple two-regional example. Let a good be supplied from the first region to the second, and let, at any instant, the difference in prices between these regions be exactly equal to the transportation costs per unit of the good. If transportation costs rise while the good price in the first region remains constant, the price difference will rise in the same way, although exact equilibrium holds at each instant of time.

As the analysis performed proves, it is beyond reason to believe the Russian economy in transition to be so peculiar that the law of one price does not hold here. The tendency for decreasing differences in price levels across regions, though masked by many and varied frictions, does exists, in principle. It is encouraging that this tendency involves the overall price level (cost of living), too, giving hope that gaps between the living standards of various regions will become not so great with time.

But the above-stated reservation "in principle" implies that there are considerable frictions which prevent the tendency to contribute, in full measure, to reducing interregional price gaps. And so, while one can say with confidence that prices of foods (taken together) converge, the pattern with manufactured goods (also treated as a whole) still remains obscure. Besides that, price gaps persist and are rather large even for foods, in spite of the tendency mentioned. This suggests that the Russian consumer market is far from being integrated. One could agree with Koen and De Masi (1997) in that "over time, prices and inflation rates have converged across regions", but with great caution. This would hold for a number of goods and for some regions, but Russian empirical data — at least, across West-Siberia — give as yet rather poor evidence in favor of such a wide generalization.

The results obtained should be treated with a certain caution, since we see a picture of price behavior as it is shown in a mirror of Goskomstat's indices. And this mirror may well be distorting. In any case, this concerns the quantitative aspect. If one could be satisfied with the numerical values of, say, the relative cost of living in a region obtained in a roundabout way (through monthly inflation rates for seven years) for scientific purposes, then these are unsatisfactory as a measure of real interregional difference. At the same time, it is not inconceivable that the picture is not quite reliable in a qualitative aspect as well.

To check the robustness of the results, it would be appropriate to perform the analysis with as large set of individual goods as possible. On the other hand, compelled restriction of the spatial scope of the sample has narrowed the capabilities of the analysis, having not allowed us to separate the role of individual frictions from their joint effect. More rich results could be yielded by further research that is supposed to widen the spatial coverage of behavior analysis of both aggregated indices and individual prices.

The research performed leads to an important methodological conclusion. The essence of cointegration analysis is the examination of deviations from long-run equilibrium. However, with a relatively short time span that is peculiar to transition, one can not have confidence in identifying the long-run equilibrium. It is not improbable that the entire process that we observe is just a shock. What is more, estimates provided by cointegration regressions average, in some sense, the behavior of prices over the time span considered. This implies that the nature of price behavior is explicitly supposed to be the same over this span. Such an assumption is quite reasonable for stable, "settled", economies, but it could be far from the truth for transitional ones. Sufficient distinction between estimates obtained over two time intervals (1992 – 1998 and 1994 – 1998) suggests that the behavior of prices significantly changes with time in Russia. The same is evident by discussion of the causes of poor market integration in Section 5; many factors are evolving (strengthening or weakening in time) processes. Because of this, cointegration analysis, is, perhaps, too rough tool to explore price dynamics in transitional economies. And so, alternative approaches are needed to be developed that could grasp the dynamics of changes in market integration during transition. This also will be the subject of further efforts.

APPENDICES

A. Basic model estimations for region pairs

Table A1. Food Price Level.

Region pair	1992:1 – 1998:6			1994:1 – 1998:6		
	DF-test *p*-value	λ	Half-life *T*	DF-test *p*-value	λ	Half-life *T*
Republic of Altai and						
Altai Krai	0.435	−0.124 (0.054)	5.2	*0.087*	−0.233 (0.072)	2.6
Kemerovo Oblast	*0.014*	−0.228 (0.058)	2.7	*0.089*	−0.333 (0.103)	1.7
Novosibirsk Oblast	*0.000*	−0.329 (0.060)	1.7	0.333	−0.205 (0.083)	3.0
Omsk Oblast	*0.001*	−0.429 (0.086)	1.2	0.137	−0.295 (0.098)	2.0
Tomsk Oblast	0.147	−0.197 (0.066)	3.2	0.130	−0.313 (0.103)	1.8
Tyumen Oblast	0.437	−0.132 (0.058)	4.9	*0.025*	−0.403 (0.106)	1.3
Altai Krai and						
Kemerovo Oblast	*0.000*	−0.399 (0.074)	1.4	*0.000*	−0.677 (0.092)	0.6
Novosibirsk Oblast	*0.008*	−0.203 (0.049)	2.9	0.377	−0.113 (0.047)	5.8
Omsk Oblast	*0.009*	−0.265 (0.064)	2.3	0.109	−0.243 (0.078)	2.5
Tomsk Oblast	*0.012*	−0.354 (0.088)	1.6	0.357	−0.186 (0.076)	3.4
Tyumen Oblast	0.252	−0.175 (0.066)	3.6	*0.031*	−0.329 (0.089)	1.7

Continued from p. 44

Region pair	1992:1 – 1998:6			1994:1 – 1998:6		
	DF-test *p*-value	λ	Half-life *T*	DF-test *p*-value	λ	Half-life *T*
Kemerovo Oblast and						
Novosibirsk Oblast	*0.000*	−0.244 (0.042)	2.5	0.302	−0.213 (0.083)	2.9
Omsk Oblast	*0.000*	−0.299 (0.052)	1.9	*0.034*	−0.400 (0.109)	1.4
Tomsk Oblast	*0.008*	−0.267 (0.064)	2.2	*0.055*	−0.364 (0.105)	1.5
Tyumen Oblast	*0.000*	−0.495 (0.082)	1.0	*0.004*	−0.514 (0.115)	1.0
Novosibirsk Oblast and						
Omsk Oblast	*0.000*	−0.462 (0.090)	1.1	*0.016*	−0.457 (0.116)	1.1
Tomsk Oblast	*0.000*	−0.268 (0.048)	2.2	0.194	−0.286 (0.101)	2.1
Tyumen Oblast	0.219	−0.094 (0.034)	7.0	0.308	−0.216 (0.085)	2.8
Omsk Oblast and						
Tomsk Oblast	*0.000*	−0.411 (0.068)	1.3	*0.005*	−0.546 (0.125)	0.9
Tyumen Oblast	0.233	−0.140 (0.052)	4.6	*0.094*	−0.326 (0.102)	1.8
Tomsk Oblast and						
Tyumen Oblast	0.204	−0.184 (0.066)	3.4	0.405	−0.232 (0.099)	2.6

Standard deviations are in parentheses.

Table A2. Manufactured Goods Price Level.

Region pair	1992:1 – 1998:6			1994:1 – 1998:6		
	DF-test *p*-value	λ	Half-life *T*	DF-test *p*-value	λ	Half-life *T*
Republic of Altai and						
Altai Krai	0.319	−0.064 (0.048)	10.5	0.919	−0.040 (0.036)	17.0
Kemerovo Oblast	*0.001*	−0.221 (0.045)	2.8	0.524	−0.085 (0.040)	7.8
Novosibirsk Oblast	*0.000*	−0.306 (0.058)	1.9	0.455	−0.104 (0.046)	6.3
Omsk Oblast	*0.000*	−0.368 (0.049)	1.5	0.907	−0.047 (0.041)	14.3
Tomsk Oblast	*0.000*	−0.335 (0.047)	1.7	0.940	−0.040 (0.041)	16.9
Tyumen Oblast	*0.000*	−0.431 (0.045)	1.2	0.394	−0.114 (0.048)	5.7
Altai Krai and						
Kemerovo Oblast	*0.000*	−0.323 (0.034)	1.8	*0.000*	−0.409 (0.077)	1.3
Novosibirsk Oblast	*0.000*	−0.379 (0.045)	1.5	0.913	−0.052 (0.046)	13.0
Omsk Oblast	*0.000*	−0.503 (0.034)	1.0	0.365	−0.205 (0.084)	3.0
Tomsk Oblast	*0.000*	−0.391 (0.035)	1.4	0.485	−0.192 (0.088)	3.2
Tyumen Oblast	*0.000*	−0.357 (0.037)	1.6	0.980	−0.021 (0.041)	32.5
Kemerovo Oblast and						
Novosibirsk Oblast	0.221	−0.134 (0.049)	4.8	0.828	−0.081 (0.055)	8.2
Omsk Oblast	*0.000*	−0.425 (0.073)	1.3	*0.003*	−0.321 (0.071)	1.8
Tomsk Oblast	*0.040*	−0.238 (0.067)	2.5	0.133	−0.263 (0.087)	2.3
Tyumen Oblast	*0.078*	−0.178 (0.054)	3.5	0.899	−0.058 (0.048)	11.6

Continued from p. 46

Region pair	1992:1 – 1998:6			1994:1 – 1998:6		
	DF-test *p*-value	λ	Half-life *T*	DF-test *p*-value	λ	Half-life *T*
Novosibirsk Oblast and						
Omsk Oblast	*0.000*	−0.455 (0.055)	1.1	0.966	−0.032 (0.044)	21.3
Tomsk Oblast	*0.001*	−0.254 (0.051)	2.4	0.981	−0.023 (0.047)	29.3
Tyumen Oblast	*0.000*	−0.276 (0.046)	2.1	0.499	−0.164 (0.076)	3.9
Omsk Oblast and						
Tomsk Oblast	0.285	−0.142 (0.055)	4.5	0.412	−0.204 (0.088)	3.0
Tyumen Oblast	0.924	−0.040 (0.037)	16.8	0.996	0.003 (0.035)	—
Tomsk Oblast and						
Tyumen Oblast	0.374	−0.135 (0.056)	4.8	0.990	−0.011 (0.045)	60.3

Standard deviations are in parentheses.

B. Threshold model estimations for region pairs

Table B1. Food Price Level, 1992:1 – 1998:6.

Region pair	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
Republic of Altai and					
Altai Krai	*0.000*	0.899	−0.731 (0.758)	0.5	13.4
Kemerovo Oblast	*0.000*	*0.036*	−0.580 (0.155)	0.8	7.8
Novosibirsk Oblast	*0.006*	0.156	−0.741 (0.235)	0.5	8.9
Omsk Oblast	*0.098*	*0.002*	−0.515 (0.110)	1.0	1.4
Tomsk Oblast	0.139	0.193	−0.242 (0.085)	2.5	1.3
Tyumen Oblast	*0.000*	0.307	−0.746 (0.294)	0.5	14.6
Altai Krai and					
Kemerovo Oblast	*0.000*	*0.001*	−0.706 (0.142)	0.6	3.2
Novosibirsk Oblast	*0.000*	*0.039*	−0.461 (0.125)	1.1	8.0
Omsk Oblast	*0.015*	*0.022*	−0.305 (0.080)	1.9	1.4
Tomsk Oblast	0.516	0.029	−0.463 (0.124)	1.1	1.6
Tyumen Oblast	*0.000*	0.843	−1.390 (0.479)	0.7	11.2
Kemerovo Oblast and					
Novosibirsk Oblast	*0.000*	*0.000*	−0.456 (0.076)	1.1	8.5
Omsk Oblast	*0.062*	*0.000*	−0.337 (0.062)	1.7	1.6
Tomsk Oblast	*0.008*	*0.034*	−0.382 (0.104)	1.4	2.6
Tyumen Oblast	*0.000*	*0.000*	−0.691 (0.125)	0.6	2.3

Continued from p. 48

Region pair	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
Novosibirsk Oblast and					
Omsk Oblast	*0.000*	*0.001*	−0.559 (0.117)	0.8	1.1
Tomsk Oblast	*0.000*	*0.000*	−0.715 (0.110)	0.6	10.3
Tyumen Oblast	0.209	0.104	−0.129 (0.041)	5.0	5.0
Omsk Oblast and					
Tomsk Oblast	*0.004*	*0.000*	−0.470 (0.085)	1.1	1.2
Tyumen Oblast	*0.000*	0.584	−0.255 (0.128)	2.4	7.7
Tomsk Oblast and					
Tyumen Oblast	*0.000*	0.418	−0.327 (0.141)	1.8	5.0

Standard deviations are in parentheses.

Table B2. Food Price Level, 1994:1 – 1998:6.

Region pair	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
Republic of Altai and					
Altai Krai	*0.004*	0.814	−0.409 (0.334)	1.3	5.0
Kemerovo Oblast	*0.002*	*0.009*	−0.376 (0.089)	1.5	0.5
Novosibirsk Oblast	*0.054*	*0.005*	−0.685 (0.134)	0.6	4.0
Omsk Oblast	*0.040*	*0.028*	−1.187 (0.176)	0.4	5.6
Tomsk Oblast	0.510	0.597	−1.381 (0.327)	0.7	5.3
Tyumen Oblast	*0.084*	*0.049*	−0.566 (0.160)	0.8	1.2
Altai Krai and					
Kemerovo Oblast	*0.028*	*0.000*	−0.799 (0.132)	0.4	0.8
Novosibirsk Oblast	*0.000*	0.494	−0.125 (0.058)	5.2	0.5
Omsk Oblast	*0.023*	0.660	−0.963 (0.585)	0.2	7.2
Tomsk Oblast	*0.058*	0.210	−0.193 (0.069)	3.2	0.3
Tyumen Oblast	0.369	0.770	−0.754 (0.513)	0.5	3.5
Kemerovo Oblast and					
Novosibirsk Oblast	*0.003*	0.723	−0.267 (0.157)	2.2	1.8
Omsk Oblast	*0.000*	0.438	−0.511 (0.227)	1.0	2.1
Tomsk Oblast	*0.000*	0.702	−0.553 (0.326)	0.9	3.1
Tyumen Oblast	*0.000*	0.684	−1.075 (0.556)	0.3	2.7

Continued from p. 50

Region pair	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
Novosibirsk Oblast and					
Omsk Oblast	*0.032*	*0.083*	−0.742 (0.233)	0.5	1.5
Tomsk Oblast	*0.000*	0.218	−0.343 (0.124)	1.7	0.5
Tyumen Oblast	0.126	0.190	−0.247 (0.087)	2.4	1.0
Omsk Oblast and					
Tomsk Oblast	*0.000*	*0.054*	−0.938 (0.262)	0.2	1.5
Tyumen Oblast	*0.004*	0.688	−0.516 (0.306)	1.0	2.8
Tomsk Oblast and					
Tyumen Oblast	0.267	0.374	−0.340 (0.142)	1.7	1.7

Standard deviations are in parentheses.

Table B3. Manufactured Goods Price Level, 1992:1 – 1998:6.

Region pair	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
Republic of Altai and					
Altai Krai	*0.000*	0.943	−0.227 (0.256)	2.7	14.1
Kemerovo Oblast	*0.000*	0.134	−0.607 (0.182)	0.7	33.9
Novosibirsk Oblast	*0.000*	0.103	−0.686 (0.208)	0.6	16.2
Omsk Oblast	*0.000*	*0.000*	−0.598 (0.099)	0.8	16.2
Tomsk Oblast	*0.000*	*0.025*	−0.646 (0.124)	0.7	21.7
Tyumen Oblast	*0.000*	*0.003*	−0.587 (0.109)	0.8	14.1
Altai Krai and					
Kemerovo Oblast	*0.000*	*0.000*	−0.374 (0.064)	1.5	4.6
Novosibirsk Oblast	*0.000*	0.131	−0.574 (0.166)	0.8	10.6
Omsk Oblast	*0.000*	*0.000*	−0.564 (0.072)	0.8	5.8
Tomsk Oblast	*0.000*	*0.002*	−0.553 (0.088)	0.9	15.2
Tyumen Oblast	*0.000*	*0.038*	−0.624 (0.121)	0.7	24.7
Kemerovo Oblast and					
Novosibirsk Oblast	*0.006*	0.155	−0.343 (0.115)	1.7	6.6
Omsk Oblast	*0.000*	0.320	−1.437 (0.224)	0.8	10.9
Tomsk Oblast	*0.000*	0.949	−1.611 (0.693)	1.4	14.9
Tyumen Oblast	*0.000*	0.871	−1.832 (0.175)	1.8	22.5

Continued from p. 52

Region pair	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
Novosibirsk Oblast and					
Omsk Oblast	*0.000*	*0.008*	−0.857 (0.157)	0.4	10.3
Tomsk Oblast	*0.000*	*0.008*	−0.676 (0.146)	0.6	9.5
Tyumen Oblast	*0.000*	*0.015*	−0.672 (0.143)	0.6	14.2
Omsk Oblast and					
Tomsk Oblast	*0.000*	0.890	−0.319 (0.374)	1.8	17.0
Tyumen Oblast	*0.002*	0.888	−0.067 (0.053)	10.0	4.6
Tomsk Oblast and					
Tyumen Oblast	*0.011*	0.472	−0.389 (0.178)	1.4	10.8

Standard deviations are in parentheses.

Table B4. Manufactured Goods Price Level, 1994:1 – 1998:6.

Region pair	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
Republic of Altai and					
Altai Krai	0.502	0.908	−0.059 (0.052)	11.4	6.0
Kemerovo Oblast	*0.085*	*0.036*	−0.751 (0.156)	0.5	17.2
Novosibirsk Oblast	*0.000*	0.892	−0.442 (0.482)	1.2	12.2
Omsk Oblast	*0.028*	0.878	−0.065 (0.051)	10.3	6.4
Tomsk Oblast	*0.007*	0.976	−0.032 (0.060)	21.2	9.7
Tyumen Oblast	*0.057*	0.412	−0.149 (0.064)	4.3	1.8
Altai Krai and					
Kemerovo Oblast	*0.001*	*0.019*	−0.751 (0.171)	0.5	1.8
Novosibirsk Oblast	*0.021*	0.926	−0.057 (0.055)	11.7	0.7
Omsk Oblast	*0.016*	0.263	−0.832 (0.312)	0.4	2.5
Tomsk Oblast	0.239	0.547	−0.249 (0.120)	2.4	0.9
Tyumen Oblast	*0.018*	0.166	−1.261 (0.241)	0.5	7.9
Kemerovo Oblast and					
Novosibirsk Oblast	*0.011*	0.867	−0.381 (0.515)	1.4	7.0
Omsk Oblast	*0.038*	*0.008*	−0.340 (0.080)	1.7	0.2
Tomsk Oblast	0.214	0.383	−0.456 (0.192)	1.1	2.2
Tyumen Oblast	*0.033*	0.950	−2.061 (1.011)	—	8.6

Continued from p. 54

Region pair	LLR-test *p*-value	DF-test *p*-value	λ^{out}	Half-life *T*	Threshold *C*, %
Novosibirsk Oblast and					
Omsk Oblast	0.106	0.684	−1.112 (0.572)	0.3	8.1
Tomsk Oblast	0.229	0.650	−0.737 (0.426)	0.5	9.7
Tyumen Oblast	0.482	0.331	−0.211 (0.085)	2.9	0.7
Omsk Oblast and					
Tomsk Oblast	*0.041*	0.945	−1.568 (0.738)	1.2	4.3
Tyumen Oblast	0.107	0.998	0.013 (0.047)	—	2.7
Tomsk Oblast and					
Tyumen Oblast	0.750	0.989	−0.015 (0.053)	45.0	2.0

Standard deviations are in parentheses.

C. Trends

Table C1. Trends of Price Levels Related to the National Level.

Region	1992:1 – 1998:6		1994:1 – 1998:6	
	β×1000	*P*-value	β×1000	*P*-value
Overall price level				
Republic of Altai	−2.230 (0.364)	*0.000*	−0.477 (0.534)	
Altai Krai	−0.319 (0.161)	*0.052*	0.054 (0.116)	0.643
Kemerovo Oblast	−0.146 (0.304)		−0.523 (0.221)	*0.021*
Novosibirsk Oblast	0.280 (0.178)		−0.228 (0.236)	0.339
Omsk Oblast	0.588 (0.154)	*0.000*	0.292 (0.044)	
Tomsk Oblast	0.180 (0.255)		0.457 (0.289)	
Tyumen Oblast	0.013 (0.174)		0.022 (0.131)	0.870
Food price level				
Republic of Altai	−0.971 (0.339)	*0.005*	−1.717 (0.561)	*0.004*
Altai Krai	0.151 (0.156)		0.283 (0.128)	*0.032*
Kemerovo Oblast	−0.294 (0.158)		−0.793 (0.348)	
Novosibirsk Oblast	0.161 (0.152)	0.294	0.371 (0.158)	
Omsk Oblast	0.147 (0.151)	0.332	0.277 (0.173)	0.116
Tomsk Oblast	0.761 (0.261)	*0.005*	1.422 (0.388)	*0.001*
Tyumen Oblast	0.432 (0.261)		−0.107 (0.142)	0.454

Continued from p. 56

Region	1992:1 − 1998:6		1994:1 − 1998:6	
	β×1000	*P*-value	β×1000	*P*-value
Manufactured goods price level				
Republic of Altai	−5.099 (0.650)	*0.000*	−0.082 (0.542)	
Altai Krai	0.357 (0.240)	0.142	0.115 (0.121)	
Kemerovo Oblast	0.233 (0.327)		0.061 (0.175)	
Novosibirsk Oblast	−0.586 (0.168)	*0.001*	−0.125 (0.240)	
Omsk Oblast	0.752 (0.305)		0.172 (0.141)	
Tomsk Oblast	1.453 (0.513)		0.380 (0.463)	
Tyumen Oblast	−0.508 (0.265)	*0.059*	0.234 (0.110)	
Service price level				
Republic of Altai	1.888 (1.295)		0.503 (1.224)	
Altai Krai	−1.724 (0.654)	*0.010*	−0.624 (0.508)	
Kemerovo Oblast	0.943 (1.652)		−1.578 (1.637)	0.340
Novosibirsk Oblast	1.964 (1.232)		−2.261 (0.992)	*0.027*
Omsk Oblast	−0.406 (0.474)		0.761 (0.459)	
Tomsk Oblast	−0.032 (0.521)		−1.561 (0.727)	*0.037*
Tyumen Oblast	1.458 (0.637)	*0.025*	−0.078 (0.464)	0.867

Standard deviations are in parentheses.

Table C2. Trends of Food Price Levels Related to Other Regions' Levels.

Region pair	1992:1 − 1998:6		1994:1 − 1998:6	
	β×1000	*P*-value	β×1000	*P*-value
Republic of Altai and				
Altai Krai	−0.508 (0.334)		−1.340 (0.404)	*0.002*
Kemerovo Oblast	−0.514 (0.323)	0.115	−0.495 (0.159)	0.159
Novosibirsk Oblast	−1.437 (0.268)	*0.000*	−1.256 (0.550)	
Omsk Oblast	−1.899 (0.418)	*0.000*	−1.555 (0.012)	
Tomsk Oblast	−1.327 (0.551)		−2.390 (0.861)	
Tyumen Oblast	−0.853 (0.517)		−1.709 (0.491)	*0.001*
Altai Krai and				
Kemerovo Oblast	0.667 (0.193)	*0.001*	2.425 (0.322)	*0.000*
Novosibirsk Oblast	−0.126 (0.236)	0.596	0.053 (0.682)	
Omsk Oblast	−0.027 (0.229)	0.905	0.107 (0.591)	
Tomsk Oblast	−0.900 (0.309)	*0.005*	−0.290 (0.298)	
Tyumen Oblast	−0.429 (0.284)		0.390 (0.168)	*0.024*
Kemerovo Oblast and				
Novosibirsk Oblast	−0.578 (0.232)	*0.015*	−1.004 (0.419)	
Omsk Oblast	−0.568 (0.230)	*0.016*	−1.508 (0.491)	*0.003*
Tomsk Oblast	−1.206 (0.294)	*0.000*	−2.257 (0.711)	*0.003*
Tyumen Oblast	−2.058 (0.367)	*0.000*	−1.359 (0.322)	*0.000*

Continued from p. 58

Region pair	1992:1 – 1998:6		1994:1 – 1998:6	
	β×1000	*P*-value	β×1000	*P*-value
Novosibirsk Oblast and				
Omsk Oblast	−0.154 (0.212)	0.471	0.346 (0.212)	0.109
Tomsk Oblast	−0.640 (0.273)	*0.022*	−0.451 (0.270)	
Tyumen Oblast	0.108 (0.251)		0.360 (0.242)	
Omsk Oblast and				
Tomsk Oblast	−1.169 (0.309)	*0.000*	−1.338 (0.376)	*0.001*
Tyumen Oblast	−0.181 (0.319)		0.317 (0.252)	0.215
Tomsk Oblast and				
Tyumen Oblast	−0.026 (0.233)		7.238 (0.422)	

Standard deviations are in parentheses.

Table C3. Trends of Manufactured Goods Price Levels Related to Other Regions' Levels.

Region pair	1992:1 – 1998:6		1994:1 – 1998:6	
	β×1000	*P*-value	β×1000	*P*-value
Republic of Altai and				
Altai Krai	−0.760 (0.888)		0.272 (0.501)	
Kemerovo Oblast	−4.771 (0.895)	*0.000*	−0.153 (0.584)	
Novosibirsk Oblast	−3.928 (0.731)	*0.000*	−0.238 (0.474)	
Omsk Oblast	−7.560 (0.932)	*0.000*	0.182 (0.683)	
Tomsk Oblast	−7.670 (0.994)	*0.000*	0.298 (0.833)	
Tyumen Oblast	−5.577 (0.563)	*0.000*	−0.771 (0.600)	
Altai Krai and				
Kemerovo Oblast	−1.324 (0.212)	*0.000*	−0.472 (0.188)	*0.011*
Novosibirsk Oblast	1.548 (0.350)	*0.000*	0.162 (0.244)	
Omsk Oblast	−1.479 (0.217)	*0.000*	−0.366 (0.221)	
Tomsk Oblast	−2.266 (0.244)	*0.000*	−1.016 (0.619)	
Tyumen Oblast	1.028 (0.389)	*0.010*	−0.148 (0.143)	
Kemerovo Oblast and				
Novosibirsk Oblast	1.114 (0.407)		0.118 (0.354)	
Omsk Oblast	−0.020 (0.269)	0.940	−0.303 (0.108)	*0.007*
Tomsk Oblast	−0.616 (0.266)	*0.024*	−1.315 (0.457)	
Tyumen Oblast	0.825 (0.561)	0.145	−0.302 (0.195)	

Continued from p. 60

Region pair	1992:1 – 1998:6		1994:1 – 1998:6	
	β×1000	*P*-value	β×1000	*P*-value
Novosibirsk Oblast and				
Omsk Oblast	3.524 (0.412)	*0.000*	−0.065 (0.304)	
Tomsk Oblast	−2.664 (0.508)	*0.000*	−0.063 (0.527)	
Tyumen Oblast	−0.470 (0.258)	*0.073*	−0.577 (0.250)	
Omsk Oblast and				
Tomsk Oblast	−0.192 (0.275)		−0.752 (0.431)	
Tyumen Oblast	0.011 (0.370)		−0.273 (0.161)	
Tomsk Oblast and				
Tyumen Oblast	0.901 (0.637)		−0.352 (0.399)	

Standard deviations are in parentheses.

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