Assessing a feasible degree of product market integration: a pilot analysis

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Abstract

Purpose – This paper aims to make a preliminary estimate of the degree of integration in the US product market (widely acknowledged to be the most integrated among geographically large economies) as an upper bound of spatial integration that is practically achievable in markets covering fairly large territories.

Design/methodology/approach – The approach takes the form of an econometric model derived from the fact that local price of a tradable good should not be dependent on local demand under the law of "one price is a tool to measure market integration". It is applied to data on the cost of a grocery basket and prices for three individual goods in 2000 across 29 US cities.

Findings – The regression results suggest that the US market is not perfectly integrated. Thus, the estimated degree of its integration can be deemed, indeed, as a feasible maximum. Applying this benchmark to the European part of Russia in 2000, its degree of market integration turns out to be comparable – by the order of magnitude – with the feasible one. The roles of a few factors that could potentially cause segmentation of the US market are estimated.

Research limitations/implications – The estimated degree of US market integration is crude because of the relatively small spatial sample. Further research has to substantially widen the spatial sample and estimate integration of the US market across a number of points in time.

Originality/value – The paper suggests a realistic benchmark standard for judging the extent of market integration in various (geographically large) economies.

Keywords International marketing, Pricing, United States, Russia

Paper type Research paper

JEL classifications – F14, F15, L81, R1

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1. Introduction

One way to judge the extent of market integration in any spatially dispersed product market is to compare it against a theoretical ideal, perfect integration (controlled for transportation costs). Such an ideal benchmark, however, can only suggest whether a particular market matches that ideal; it is silent as to the implications of the deviation. Gluschenko (2003), for example, estimates the degree of Russia's market segmentation in 2000 to be in the range of 0.05 to 0.10 (i.e. because of market frictions, a 1 per cent change in the per capita income difference between regions induces a 0.05 per cent to 0.1 per cent change in the price difference). We now tackle the question that figure raises: is this a lot or a little?

On the other hand, comparison to perfect integration overstates the shortcomings of Russia's product market. Based on such a comparison, Berkowitz and DeJong (2001, 2003) as well as Gluschenko (2003, 2004) concluded that the Russian economic space could not be deemed as "single" even in the late 1990s. At present, we consider this conclusion as questionable, since it is derived from the too strict standard. From an intuitive point of view, deviations of the Russian market from actual markets in advanced market economies is of interest rather than its deviations from theoretical conceptions.

The literature provides abundant evidence that such markets, despite a highly developed transportation system and market infrastructure, and absence of local protectionism, are also far from matching the theoretical ideal (at least, when the case in hands are markets covering fairly large territories). The point is that, in practice, goods arbitrage operates in a different way than it is supposed in idealized models. At least two substantial reasons constrain the efficiency of arbitrage.

The first is imperfect information. Arbitrageurs need comprehensive and timely information on prices in different spatial segments of the market to operate effectively. Even the US lacks such "perfect" price monitoring. For example, publication of the *ACCRA Cost of Living Index*, a thorough survey of retail prices in the US consumer market, appears months after the price registration period.

Second, and probably more important, is the institutional aspect. The mechanism of the law of one price is usually described as follows. As soon as the price for a good has fallen in one location, arbitrageurs rush in, buy the good, convey it to locations where the price is higher, and then sell the good. The process is repeated until the difference in prices is reduced to transportation costs. In fact, this simplified mechanism overlooks institutional structures in the market. Neither the good's supplier nor its buyer is entirely free in their selection of counteragents (e.g. due to long-term contracts, partnership traditions, and the reputation of potential counteragents). Such institutional constraints prevent some arbitrage possibilities from ever being realized.

We thus hypothesize the existence of an upper bound of spatial integration, or conversely, a non-zero lower bound of segmentation, that is practically achievable. The feasible degree of integration seems a more reasonable benchmark for measuring market integration of domestic and international markets than perfect integration.

Establishing the theoretical means for defining such a boundary presents a daunting task. Field studies of actual arbitrage (especially of its institutional aspects) would likely provide insight into its mechanism. However, we failed in finding such a work in the literature. An alternative is to use an actual market as the standard. Bearing in mind that our eventual aim is to obtain a benchmark for Russia, the reference market should cover a fairly large territory. Given that Russia occupies about a sixth of the world's land area, the choices are limited. Among large markets, there is a consensus that the US goods market is the most integrated. Therefore, we take it as a standard to measure the feasible degree of market integration.

We use a methodology put forward by Gluschenko (2003, 2004). It was designed, first of all, for measuring market integration in transitional economies. And so, the primary intention of our pilot analysis has been to check whether this methodology works when we deal with an advanced market economy rather than to obtain a definite estimate of US market integration. That is why we have taken a small cross section before working with a cumbersome panel of available data.

To obtain a crude preliminary estimate of the degree of integration of the US product market, we use data on prices for 27 grocery items across 29 cities of the United States in the first quarter of 2000 drawn from the *ACCRA Cost of Living Index*. Beyond a rather mundane finding that the US market is not perfectly integrated, our estimates tantalizingly suggest that the degrees of integration in the US and Russia (more exactly, in its European part) in 2000 are comparable by the order of magnitude.

The rest of the paper is organized as follows. In the next section, we briefly review the literature on US market integration. Section 3 provides a theoretical justification of the empirical methodology, as well as descriptions of the econometric models and data. In Section 4, empirical results are presented. These results are compared with estimates for Russia in Section 5. We conclude in Section 6.

2. Literature on US market integration

We consider here several of the key papers directly relating to market integration in the USA, as well as those considering the domestic US market in an international context.

Pryor (1995) studies a sample of annual prices for a number of commodity groups over the period 1950-1993 across five US cities. The price data are drawn from various sources. Eight commodity groups are tradable in which the government has little role in price formation. Measuring market integration by price variations, and having applied several statistical procedures, including unit root tests, he concludes that there was no increase in the degree of integration of US retail markets in that 23-year period. In the period 1976-1993, the coefficient of price variation ranged from 3.7 per cent to 15.1 per cent, with a 9.0 per cent average across goods.

Parsley and Wei (1996) deal with a panel of 51 prices (including those for 41 tradable goods) drawn from the *ACCRA Cost of Living Index* across 48 US cities. The panel covers 1975 through 1992 with quarterly frequency. Exploiting time-series analysis, they find prices for tradable goods to converge rapidly to the law of one price: the half-life of the price gap is roughly four or five quarters. Nonetheless, 17 per cent of the time series for tradable turn out to be non-stationary. Cecchetti *et al.* (2002) perform a similar analysis with the use of the consumer price index (CPI) across 19 US cities over the period 1918-1995. They find the CPI stationary, but with a slower rate of die-out in the deviations from the law of one price (about nine years). The authors regard their estimates of the speed of price-level convergence as an upper bound on the rates that members of the European Union are likely to experience. The data set used by O'Connell and Wei (2002) is substantially the same as in Parsley and Wei (1996). Each panel of the price data are analysed with a GLS unit root test, threshold auto regression estimation, and smooth threshold auto regression estimation. The analysis reveals that price discrepancies among US cities are stationary, and that the reversion of price discrepancies is non-linear.

Engel and Rogers (1996) apply a cross-sectional approach to examine price dispersion of 14 disaggregated CPIs among 23 cities of the US and Canada to estimate the role of the border between these countries[1]. Although Engel and Rogers do not treat market integration as such, they apply a regression specification somewhat similar to the one used in this study (see Section 3). The Engel-Rogers regressions control for the US-Canada border effect, i.e. the results can be interpreted as estimates of the degree of integration in the common market of the US and Canada.

Parsley and Wei (2001) examine the US-Japan border effect. Using the *ACCRA Cost of Living Index* as the source for the US price data (across 48 cities and 27 traded goods) for 1976-1997, they find price dispersion increased in the US during 1989-1997 (which corroborates one of our findings in Section 5).

Engel and Rogers (2001) exploit monthly CPI and price indexes for 43 different goods across 29 US cities from 1986 to 1996. Ignoring the dynamic properties of prices, they focus on time averages of variability in prices of similar goods across cities. They observe that, while the distance between cities partly accounts for the variation in prices, the largest factor driving price difference is nominal price stickiness.

Wolf (1999) studies a cross-section of prices for 42 goods across 211 US cities with data drawn from a variety of sources, mainly the *ACCRA Cost of Living Index*. He examines the dependence of cross-city price dispersion on distance, and then takes on a passel of other characteristics (e.g. competitive pressure measured by the number of stores, market size measured by population, per capita and median household income, the median house price as a proxy for rent, local taxes). Amazingly, all variables except the effect of distance have little influence on the price of goods across cities. As Wolf writes, “The most striking feature of the results is the absence of striking features.”

While the literature on goods market integration in the US appears to provide little in the way of ready-for-use figures on degree of integration, the results in the above-reviewed papers taken together suggest strongly that the US goods market is nowhere close to being perfectly integrated. Hence, its degree of integration, be it estimated, can be viewed as feasible upper bound of the degrees for other countries with large territories.

3. Methodology and data

3.1 Theoretical framework and econometric models

Here is a brief restatement of the methodology used for assessing the degree of market integration in Gluschenko (2003, 2004).

Consider a market for a tradable good consisting of a great number of spatially separated sub-markets (locations) $\{r\}$. Taking all variables as logarithms, let P_r be the price of the good in location r, I_r the per capita income, $Q_r = D(P_{\mathrm{r}}, I_r)$ the demand function (assuming I_r is the only determinant of demand apart from price), and $Q_r = S(P_{\mathrm{r}})$ the supply function. (Local quantities are negligibly small compared to their total across all locations.) Locations are linked by arbitrageurs (also supposed to be numerous) so that no monopolistic effects occur, even if the good is not produced in some locations.

It should be pointed out that the notion of market integration is inseparably linked with the notion of arbitrage. Under imperfect competition the very notion of market integration becomes vague. Indeed, might we regard, say, a monopolistic or oligopolistic (spatially separated) market as integrated or segmented? If arbitrage is impossible in some market, this market is definitely segmented; what is more, it is fragmented, being a set of unbound local markets rather than a single market. It is arbitrageurs that provide inter-location horizontal linkages, so making a spatially separated market to be competitive[2].

By moving the good to or from the location, arbitrageurs adjust the quantity supplied in it when the local price rises or falls due to changes in local demand (e.g. because of variations in per capita income) or production costs (e.g. because of increasing/decreasing returns). A market is deemed integrated when such an adjustment leads prices to equalize across locations so that the law of one price holds. Perfect integration implies that there are no impediments to the movement of the good between locations, and the market operates like a single perfectly competitive market. Thus the price of the good in any location is determined by the national market, not local demand. From the viewpoint of an individual location, the supply curve S is perfectly elastic. The presence of impediments to inter-location trade causes the market to be segmented. These impediments, trade barriers are quantified as arbitrage transaction costs C_{rs} needed to move a unit of the good between s and r. In the segmented market, prices differ across locations, resulting in a dependence of local prices on local demand.

From the above considerations, it follows that the dependence of local prices on local demand could be used to detect and measure market segmentation. However, data on quantities demanded are, as a rule, unavailable. Therefore, it is more convenient to derive a relationship between prices and incomes as a testable version. Taking a single location r, the equilibrium condition in its market:

$$D(P_r, I_r) - S(P_r) = 0 \tag{1}$$

yields $P_r = f(I_r)$. It is important to note that, while demand $D(P_r, I_r)$ is a local one, supply $S(P_r)$ is not that of local producers only, being formed jointly by producers from all locations through inter-location arbitrage. With some additional assumptions, $f(I_r)$ can be represented as a log-linear function:

$$P_r = \kappa + \beta I_r. \tag{2}$$

Thus, $\beta = dP_r/dI_r$. Assuming equilibrium to hold for each I_r, the derivative of the left-hand side of (1) with respect to I_r equals zero. From this we obtain:

$$dP_r/dI_r = -\varepsilon_I/(\varepsilon_D - \varepsilon_S), \tag{3}$$

where ε_I is the income elasticity of demand, and ε_D and ε_S are the price elasticities of demand and supply. It follows from (3) that $\beta \geq 0$. With finite ε_S, β is positive. However, $\beta = 0$ in a perfectly integrated market, i.e. β vanishes as supply approaches perfect elasticity ($\varepsilon_S \to \infty$).

Subtracting (2) for some location s from that for r, an equation in terms of percentage differentials, $P_{rs} \equiv P_r - P_s, I_{rs} \equiv I_r - I_s$, is arrived at (throughout the paper, r and s are arranged so that $P_{rs} \geq 0$):

$$P_{rs} = \beta I_{rs}. \tag{4}$$

Although (4) is a pairwise comparison, the location pair, r and s, is not dealt with in isolation. The rest of locations act "behind the scene," forming supplies in r and s, and so influencing the value of β.

Thus relationship (4) can be used as a cross-sectional test for market segmentation. A positive value of β indicates that local markets are not perfectly integrated. The magnitude of β (the elasticity of price dispersion *vis-à-vis* income dispersion) can be used as a measure of the degree of market segmentation/integration: a higher value for β means weaker integration (or higher segmentation). If $\beta = 0$ holds over a set $\{(r, s)\}$, implying the law of one price holds, then the relevant market can be deemed integrated.

On the other hand, the price differential equals arbitrage transaction costs $P_{rs} = C_{rs}$, so $\beta I_{rs} = C_{rs}$. In a large country, segmentation of markets by physical distance is inevitable. Under a weaker version of the law of one price, equality of prices takes into account transportation costs, T_{rs}. To control for transportation costs, price differentials should be cleaned from them, whereby $P_{rs} - T_{rs} = \beta I_{rs}$ or $P_{rs} = \beta I_{rs} + T_{rs}$. By assuming transportation costs to be log-linear function of distance, $T_{rs} = \alpha + \gamma L_{rs}$, the following equation is arrived at:

$$P_{rs} = \alpha + \beta I_{rs} + \gamma L_{rs}, \tag{5}$$

where L_{rs} is log distance separating locations r and s. If arbitrage transaction costs are nothing but the costs of shipping goods, i.e. $C_{rs} = T_{rs}$, then it will be $\beta = 0$ and the market is recognized as integrated. Taking into account individual deviations (deterministic and/or random) from the theoretical relationship (5), ε_{rs}, we obtain an econometric version of that equation:

$$P_{rs} = \alpha + \beta I_{rs} + \gamma L_{rs} + \varepsilon_{rs}. \tag{6}$$

This regression is estimated over a set of $N \times (N-1)/2$ location pairs; N is the number of locations.

Here we make a caveat about distribution and marketing services, a non-tradable component of tradable goods. Not only did we fail to find data on distribution costs in the US product market, our discussions with American economists suggest no such information exists. (We try to use apartment rents to proxy these cost (see Tables I and II); however, such a proxy seems too crude.) On the other hand, estimations in Gluschenko (2003, 2004) give grounds to believe that the role of distribution costs as a nuisance factor in assessing market integration is not as crucial as is customarily deemed in the literature. Indeed, omitting the distribution cost variable did not change the qualitative pattern of Russia's market integration; and quantitative changes were minor, if any. Of course, this may be not the case in the US market, so we propose two ways to deal with the problem. The first is to interpret β as the upper limit of the degree of segmentation in a given market, and not as the degree itself. The second is to deem differences in distribution costs as an additional indication of imperfect integration, i.e. to consider joint integration of the goods market and the market for distribution services (a wider notion of market integration).

As mentioned in Section 2, there is a specification among regressions run by Engel and Rogers (1996) that can be correlated to some extent with (6). Their dependent variable is the volatility of the price differential; the explanatory variables are distance, the US-Canada border dummy, and the volatility of the differential of real wages for manufacturing employees. As wages apparently are strongly correlated with personal

Coefficient (variable)	Estimate	Standard error	p-value
A: Dependent variable: *cost of the grocery basket*			
β^* (income)	0.0289	0.0155	0.064
γ (distance)	0.0027	0.0032	0.403
α_1 (city size)	0.0034	0.0019	0.081
α_2 (crime rate)	0.0023	0.0038	0.539
α_3 (rent)	0.0189	0.0135	0.161
F-statistic	10.75		0.000
B: Dependent variable: *average grocery price*			
β^* (income)	0.0353	0.0148	0.017
γ (distance)	0.0051	0.0029	0.083
α_1 (city size)	0.0008	0.0018	0.660
α_2 (crime rate)	0.0148	0.0036	0.000
α_3 (rent)	0.0361	0.0120	0.003
F-statistic	16.12		0.000

Table I.
Factors influencing market segmentation

	Contribution to the total price dispersion		Contribution to the price dispersion less its geographically determined part	
Factor	Grocery basket	Average price	Grocery basket	Average price
Unidentified factors	3.4	3.7	31.6	27.0
Distance	89.4	86.2	–	–
City size	4.3	1.2	40.2	8.6
Crime rate	0.4	3.7	3.4	26.6
Rent	2.6	5.2	24.8	37.8

Table II.
Contributions to the average price dispersion (percentage)

incomes, the latter variable may be considered as an analogue of I_{rs} in (6). Interpreting results obtained, Engel and Rogers assign the entire effect of wage dispersion to the difference in non-tradable marketing services. This seems to us questionable. Most probably, the wage dispersion variable captures a dependence of prices on local demand that is caused by imperfect goods market integration (maybe, however, along with the effect of the difference in distribution costs). When Engel and Rogers add the wage dispersion variable, this does not much affect the border coefficient, but markedly reduces the distance coefficient[3]. As might be supposed, this suggests that the border variable almost fully reflects the impact of impediments to trans-border trade, while the wage dispersion variable captures the effect of impediments to intra-country arbitrage within both the USA and Canada.

Model (6) yields an aggregate estimate of the effect of all trade barriers besides transportation costs. Therefore, we cannot explain reasons for one or another value of the degree of market segmentation. For example, if locations are regions within a country, do differences in regional size matter? Fortunately, benefiting from the fact that $P_{rs} = C_{rs}$, (6) can be modified so that it can estimate roles played by various factors in market segmentation. To do this, the same way is employed as used above to separate transportation costs from the total arbitrage transaction costs. After modification:

$$P_{rs} = \alpha + \beta^{*} I_{rs} + \gamma L_{rs} + \sum\nolimits_{k} \alpha_k X_{krs} + \varepsilon_{rs}, \tag{7}$$

where X_{krs} is a variable characterizing k-th factor for pair (r, s). The meaning of the coefficient on income differential in (7) differs from that in (6): β^{*} indicates the total effect of unidentified factors rather than the degree of market segmentation. It is reasonable to expect that $\beta^{*} < \beta$. If $\mathbf{X}_s$ and $\mathbf{L}$ exhaustively characterized all barriers to trade (i.e. covered all components of arbitrage transaction costs), we would have $\beta^{*} = 0$. Model (7) allows exploring "internal structure" of arbitrage transaction costs, i.e. identifying specific trade barriers and assessing their contribution to market segmentation. This essentially relates to the issue of trade costs that plays a central role in studying spatial (especially international) trade. For the most part, the literature considers how trade costs affect volumes of trade, as, e.g. in Hummels (2001) and Smeets (1990). Model (7) provides a way to look at them from a different point of view, considering the impact of trade costs on spatial differences in prices.

3.2 Data

The price data for the analysis are drawn from the *ACCRA Cost of Living Index* bulletin[4]. Each quarterly issue of the *Index* contains comparative average prices for 59 goods and services, as well as the composite cost-of-living index and six component indexes across about 300 US cities. Note that prices reported do not include sale taxes. To deal with tradable goods, we use the grocery items index as a price representative. This index is based on the cost of a basket of 27 grocery goods[5] relative to the national average cost. Thus:

$$P_{rs} = \ln(p_{(g)r}/p_{(g)s}) = \ln(\sum_{i=1}^{n} w_i p_{ir}) - \ln(\sum_{i=1}^{n} w_i p_{is}),$$

where $p_{(g)l}$ is the grocery items index in city l, i indexes individual goods from the grocery basket ($i = 1, \ldots, n$; $n = 27$), p_{il} is the price of i-th good in l, and w_i is the weight of i-th good in the grocery basket. For the values of weights see ACCRA (2000a, b). The weights are largely based on data from the US Bureau of Labor Statistics' *Consumer Expenditure Survey* – of 1992 in our case (ACCRA, 2000b). This variable is hereafter referred to as "the cost of the grocery basket."

Another version of the price variable, the geometric mean of prices for goods belonging to the grocery basket, is also applied, whereby:

$$P_{rs} = \ln((\prod_{i=1}^{n} p_{ir}/p_{is})^{1/n}) = \frac{1}{n}\sum_{i=1}^{n} \ln p_{ir} - \frac{1}{n}\sum_{i=1}^{n} \ln p_{is}.$$

This variable is referred to as "the average grocery price." (Note that both versions of the price variable can be interpreted as spatial price index numbers: the first is the Young index, and the second is the Jevons index.)

For the pilot analysis, we use the data for the first quarter of 2000 from ACCRA (2000a). The spatial sample covers 29 cities (i.e. 406 city pairs) located in different states[6]. The value of the income variable is computed from yearly per capita personal incomes by metropolitan statistical area. The data source is the website of the Bureau of Economic Analysis (BEA): www.bea.gov/bea/regional/reis, Series CA1-3, Per Capita

Personal Income, Metropolitan Statistical Areas, 2000. Distance is defined as the shortest highway distance between cities; distance values are taken from the *Map Quest* web site: www.mapquest.com.

We use three additional variables: city population, crime rate, and apartment rent. Population values are drawn from the BEA web site: www.bea.gov/bea/regional/reis, Series CA1-3, Population, Metropolitan Statistical Areas, 2000. Crime rates are those by state; the data source is US Census Bureau (2002), p. 184. Apartment rents are those by city for the first quarter of 2000; they are drawn from ACCRA (2000a).

4. Empirical results

Table III reports summary statistics, providing a pattern of price dispersion across US cities comprising our spatial sample. The statistics are computed over city pairs. Both the mean of the absolute price differential (which coincides with the average of P_{rs}, since the P_{rs} are set non-negative) and the standard deviation characterize the spatial variation of prices. The spread, which is the difference between the maximum and the minimum of the price differential, gives an idea of the range of price differences (since the minimum approaches zero, the spread almost coincides with the maximal price differential).

Price variability of the cost of the grocery basket appears to exceed that of the average grocery price, so we conclude that prices for goods with a greater share in the basket (i.e. greater weight) are more variable across space. In real, not logarithmic, terms, the mean price difference equals 6.1 per cent and 5.8 per cent, with standard deviations of 4.3 per cent and 4.0 per cent, respectively. The maximal differences in prices are equal to 23.8 per cent and 22.5 per cent. (Taking the entire spatial sample from ACCRA (2000a), except for New York City and Alaskan cities, the spread of the cost of the grocery basket equals 57.1 per cent with Victoria, TX, and Sacramento, CA, as the low and high ends; the cost of the basket is 77.6 per cent of the national average in the former, and 121.9 per cent in the latter.)

While this pattern is hardly compatible with the law of one price in its strict form, it is not inconceivable that we are merely observing a snapshot of purely random shocks distributed in space or that all price differences are due entirely to the combination of transportation costs and random shocks. This would imply that the law of one price holds statistically in either strict or weakened version, and hence, the market is integrated. Estimates of test equation (6) reveal whether that is the case.

The estimation results are presented in Table IV. The standard errors in this Table and in Tables V and I are the White heteroscedasticity-consistent errors.

The coefficient on income, β, (i.e. the degree of market segmentation) is statistically significant at the levels of less than 0.1 per cent for both versions of the dependent variable. Thus the US product market cannot be deemed as completely integrated. The values of β imply that a rise in the inter-city income difference by 10 per cent results in an increase in the grocery price difference of about 0.5 per cent.

Version of variable	Mean	Standard deviation	Spread
Cost of the grocery basket	0.059	0.042	0.213
Average grocery price	0.056	0.040	0.203

Table III. Summary statistics of dependent variables

The coefficient on distance, γ, has the expected positive sign in both regressions. It is statistically insignificant (at the 10 per cent level) in the regression of the cost of the grocery basket, but is significant at the 10 per cent level when the dependent variable is the average grocery price. A possible explanation is that the goods where transportation costs contribute markedly to prices have smaller weights in the basket. Therefore, in the average grocery price, where all goods are equipollent, the effect of distance is more pronounced. On the other hand, statistical insignificance of distance in the first regression may be due to the small size of our city sample.

It is interesting to see how integration of markets for individual goods differs from that of the aggregated market for groceries. We have selected three individual items from the grocery basket for this: beef, potatoes, and sugar. (This choice is motivated by the fact that there are results regarding these products for comparison in the next section.) Table VI presents summary statistics for price differentials of the three goods.

Table IV.
Integration of the US product market

Coefficient (variable)	Estimate	Standard error	*p*-value
Dependent variable: *cost of the grocery basket*			
β (income)	0.0552	0.0103	0.000
γ (distance)	0.0029	0.0032	0.360
F-statistic	14.48		0.000
Dependent variable: *average grocery price*			
β (income)	0.0471	0.0102	0.000
γ (distance)	0.0054	0.0030	0.067
F-statistic	11.53		0.000

Table V.
Integration of markets for individual goods

Coefficient (variable)	Estimate	Standard error	*p*-value
Beef			
β (income)	0.0714	0.0296	0.016
γ (distance)	0.0265	0.0095	0.005
F-statistic	6.62		0.002
Potatoes			
β (income)	0.0711	0.0306	0.021
γ (distance)	0.0231	0.0105	0.028
F-statistic	5.60		0.004
Sugar			
β (income)	0.0192	0.0148	0.193
γ (distance)	−0.0006	0.0043	0.887
F-statistic	0.85		0.428

Table VI.
Dispersion of prices for individual goods

Good	Mean	Standard deviation	Spread
Beef	0.192	0.137	0.658
Potatoes	0.162	0.131	0.720
Sugar	0.080	0.058	0.254

Comparing Table V with Table III, we can see that prices for the selected goods are more variable across cities that the aggregated prices for groceries. Of the former, only price for sugar approaches the aggregated prices from the viewpoint of spatial variability. In real (not logarithmic) terms, the mean price difference equals 21.2 per cent for beef, 17.6 per cent for potatoes, and 8.3 per cent for sugar. The standard deviations of price differences amount to 14.7 per cent, 14.0 per cent, and 6.0 per cent, correspondingly. Thus both mean and standard deviation of price differences for beef and potatoes are more than three times higher than those for groceries as a whole. The maximal price difference for these two goods comes up to about two times, being equal to 93.1 per cent for beef and 105.4 per cent for potatoes, while equalling 28.9 per cent in the case of sugar.

Table VI reports results of analysing integration in markets for individual goods. The results for beef and potatoes are similar to each other. The degree of market segmentation, β, is somewhat higher than that in the case of aggregated market for groceries, equalling 0.071 with significance at the 5 per cent level. Unlike the aggregated market, the effect of distance is much more pronounced. For beef, γ amounts to 0.027 and is statistically significant at the 1 per cent level; for potatoes, γ equals 0.023 with a 5 per cent significance. The case of market for sugar is quite different. Both β and γ are insignificant (at the 10 per cent level), γ having a wrong sign. The F-statistic also evidences that both variables are statistically insignificant. Since hypothesis $\beta = 0$ cannot be rejected, we infer that the US market for sugar (more exactly, its part covered by our spatial sample) is (near-)integrated. The second inference is that spatial differences in prices in this market are not due to transportation costs.

Thus the degree of market segmentation can widely vary across products. Hence, an aggregated market includes product sub-markets with different degrees of integration, up to perfect (or near-perfect) integration. Assessing integration of the aggregated market, we gain insight into an average (across products) degree of integration. It seems therefore that it makes sense to use aggregated markets only as benchmarks for measuring the feasible degree of market integration, since disaggregated markets for individual goods can have significant national features and considerably deviate from a typical regularity.

One more interesting issue is that of reasons for market segmentation. Unfortunately, there are limited possibilities to quantify factors that might explain it. No indicators characterize completeness and timeliness of information on the market situation or the institutional impediments to arbitrage. Data on some other potential components of arbitrage transaction costs in the US market have turned out to be unavailable for us. In the regressions below, we use only three factors: city size (population), crime rate (total number of reported offences per 100,000 population), and monthly apartment rent.

The size of city can put both upward and downward pressure on prices. The larger the city, the broader the market and lower the prices. Conversely, costs of retail trade may be higher in big cities. This makes it impossible to anticipate the sign of the coefficient on this variable. As for the crime rate, it is expected that higher crime leads to higher prices due to higher security costs (or payoffs to racketeers). Following Wolf (1999), we use apartment rent as a proxy for distribution costs (costs of retail trade), assuming that it is strongly correlated with outlet rents which, in turn, constitute a sizable part of distribution costs. It is reasonable to expect that the sign of the coefficient on this variable is positive. Estimates of model (7) for the aggregated market for groceries as a whole are presented in Table I.

As expected, the value of β^* decreases compared to β in both regressions. Hence, our additional factors do contribute to inter-city price dispersion. Note that all coefficients on the additional variables are positive (albeit some of them are statistically insignificant), indicating that the factors involved increase inter-city price differences. The value of γ changes only slightly relative to estimates of model (6) for the same dependent variables, remaining statistically insignificant (at the 10 per cent level) in the case of the cost of the grocery basket, and significant at the 10 per cent level in the case of the average grocery price. In other respects, however, the two versions of the regression, A and B in Table I, yield contradictory results. The city size is statistically significant at the level of 10 per cent in regression A (its positive coefficient indicates that the larger the city, the higher the prices), but insignificant at this level in regression B. Vice versa, the coefficients on crime rate and rent are insignificant (at the 10 per cent level) in the regression of the cost of the grocery basket, while they are significant at the 1 per cent level in the regression of the average grocery price. From this, we merely infer that the crime rate probably affects prices in US cities. We cannot draw a more definite conclusion, since the proxy of crime rate is state-specific rather than city-specific. An inference regarding rent seems vague. Be it a good proxy of distribution costs, it would turn out to be statistically significant in both versions of the regression. Most probably, insignificance of rent in version A indicates that this variable is not sufficiently adequate proxy for the supposed factor.

The estimates from Table I, which are elasticities, suggest that sensitivity of prices to changes in explanatory variables is rather low. Therefore, these values by themselves do not indicate the significance of a particular factor in causing inter-city price differences. Following Engel and Rogers (1996), the economic significance of an explanatory variable can be measured by the contribution of its average to the average of the dependent variable. Since it follows from (7) that $\bar{P} = \hat{\alpha} + \hat{\beta}^*\bar{I} + \hat{\gamma}\bar{L} + \hat{\alpha}_1\bar{X}_1 + \hat{\alpha}_2\bar{X}_2 + \hat{\alpha}_3\bar{X}_3$, the contribution of variable X_i to the average price dispersion may be calculated as $\hat{\alpha}_i\bar{X}_i/\bar{P}$. On the other hand, a portion in the total (average) price dispersion is due to the "natural," unavoidable market friction caused by the spatial separation of cities. That is why we also compute the contribution of the explanatory variables to price dispersion less its "natural" part, i.e. with the appropriate reduction for distance in average price dispersion: $\hat{\alpha}_i\bar{X}_i/(\bar{P} - (\hat{\alpha} + \hat{\gamma}\bar{L}))$. Table II reports the results.

The predominant contribution to price dispersion pertains to transportation costs proxied by distance and determines about 90 per cent of the inter-city price difference. About 2.5 per cent to 5 per cent is due to difference in (very crudely proxied) distribution costs. Evidence of the two regressions is discrepant as to the contribution of city size and crime. Taking the grocery basket, city size is responsible for about 4 per cent of dispersion of its cost, and crime is responsible for only 0.3 per cent, while the former is responsible for a bit more than 1 per cent of dispersion of the average grocery price, and the latter is responsible for almost 4 per cent. Other factors remained unexplained yield about 3-4 per cent of differences in prices. Unknown factors determine about 30 per cent of price dispersion cleaned of the effect of transportation costs. The difference in distribution costs contributes a quarter to almost 40 per cent to it. The difference in size of cities yields 40 per cent or 8 per cent, and crime is responsible for 3 per cent to more than a quarter.

5. Comparison with Russia

Some insight into possible difference of Russia's goods market integration from that of the US market can be gained from comparison of price dispersion in both markets. Figure 1 depicts time series of standard deviations of the log costs of the US grocery basket and the Russian staples basket; the costs are normalized to the national averages.

In contrast with the regression analysis reported above, standard deviations are computed over entire city samples as they appear in ACCRA (1992-2002). These samples vary across time both in the sample size, covering 294 to 330 cities (Canadian cities excluded), and in the set of cities. Changes in product weights occurred during the period under consideration.

The Russian staples basket represents 25 food goods for 1992 through 2000; see Gluschenko (2003) for a description. In June 2000, the Russian statistical agency, Goskomstat, introduced a new, 33-food basket, so the cost of the 25-food basket is unavailable after 2000. To obtain a time match with the US series, we geometrically average the Russian monthly data over each quarter (for the first quarter of 1992, over two months, February and March).

The standard deviations for Russia are computed over two spatial samples. The first comprises 74 of Russia's 89 regions (of that time) for which the price data are available. The second sample represents the European part of Russia excluding its northern territories; it is hereafter referred to simply as "European Russia." There are 51 regions in this sample.

Figure 1 suggests that price dispersion in the Russian market (represented by the staples baskets) became comparable with that in the US market (represented by the grocery basket) by the early 2000s. Curiously, while dispersion of prices in Russia rapidly falls, stabilizing at the end of 1999, it slowly rises in the USA. Maybe this is an

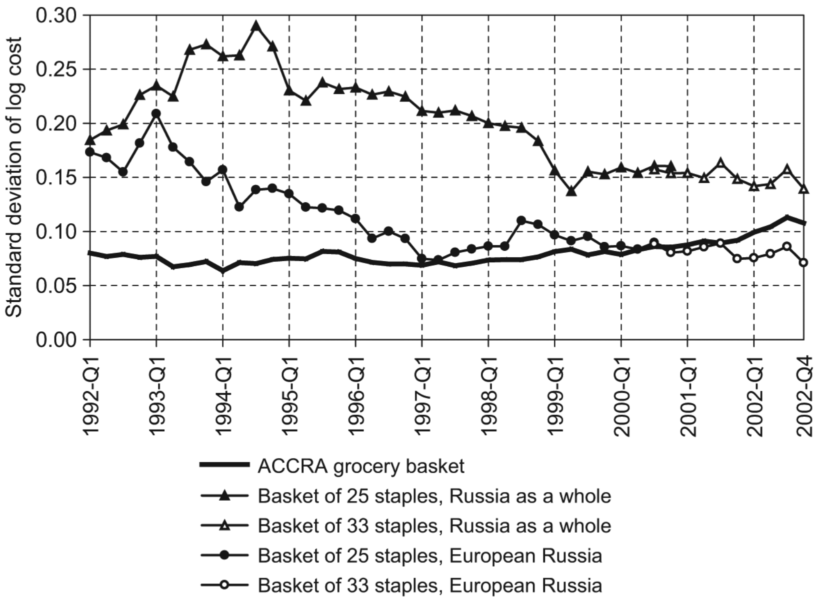

Figure 1.
Dispersion of the costs of US and Russian baskets

artefact caused by the variability of spatial sample over time. However, Parsley and Wei (2001), having uniformed the ACCRA spatial samples, find the mode of the price differential distribution to shift from a near-zero value in 1985 to a positive one in 1990, and the standard deviation to rise during 1989-1997. Therefore, it is not inconceivable that prices in the US market slowly diverged in that period (and indeed may offer an interesting topic for further research.) Overall, basing on the pattern of price dispersion, it can be expected that, in the recent years, market segmentation in European Russia approximates that of the US market, or, at least, they are of the same order of magnitude.

Taking account of the specificity of Russia's economic geography, it seems somewhat unreasonable to compare the entire Russian market with the US market. Comparison of European Russia would give a far more similar picture, since the average distance between US cities in our sample is about 1.1 thousand miles compared with 0.8 thousand miles between regional capitals in European Russia, while the figure for Russia as a whole amounts to circa 2.1 thousand miles. Besides, taking Russia as a whole, there are a few difficult-to-access regions which determine a great part of price dispersion in addition to that in European Russia. Therefore, hereinafter we use European Russia for comparisons with the USA.

Figure 2 compares the evolution of price dispersion in markets for selected individual goods in the USA and Russia. (The data for the latter are available only to the end of 2000.) Prices in both countries are normalized to the national averages.

As Figure 2 suggests, dispersion of prices for beef became close in the US and Russia from the beginning of 1996. Prices for potatoes were much more volatile in both countries. Nonetheless, dispersion of them can be deemed more or less similar from about the middle of 1995. As for sugar, dispersion of prices for it became close to that in the USA as early as from the end of 1993. Interestingly, sometimes prices turned out to be less dispersed in European Russia than in the USA.

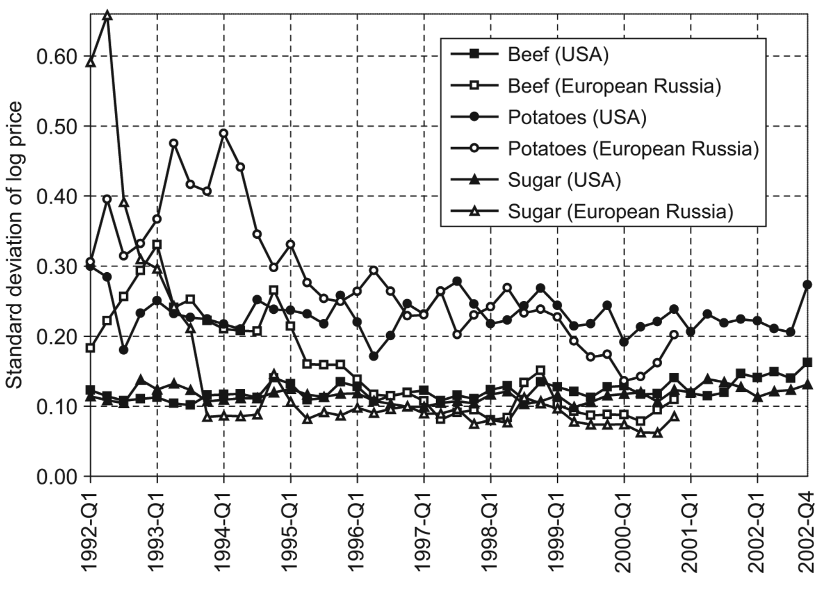

Figure 2.
Dispersion of prices for individual goods in the USA and Russia

Results of analysing market integration in the US and Russia are compared in Table VII. The estimates for the US are those from Tables IV and VI. The Russian goods basket is the basket of 25 staples. The values of β and γ for it in Table VII are averages of monthly estimates over 2000 from Gluschenko (2003). The coefficients for individual goods in Russia are also yearly averages of monthly estimates drawn from Gluschenko and Khimich (2007). (They also use prices for sunflower oil; however, the ACCRA product sample does not cover this good.)

Comparing results for the aggregated markets, the degree of market segmentation in European Russia in 2000 is about twice as high as in the USA despite almost the same dispersion of the basket costs in that year (see Figure 1). At the same time, the values of γ are close; as in the USA, this coefficient in Russia can be deemed statistically insignificant, since insignificant are nine of its 12 monthly estimates. Gluschenko (2003) reports estimates obtained with the use of yearly averaged costs of the basket of 25 staples. For 2000, $\beta = 0.093$ and $\gamma = 0.001$, the latter being statistically insignificant again. As is seen, the difference from the averages of monthly estimates in Table VII is minor.

Turning to markets for individual goods, we can see that results for beef are very close across two countries. Thus this market is integrated similarly in the USA and European Russia. Other two markets behave differently. The degree of segmentation in market for potatoes is more than 1.5 times smaller in Russia than in the USA (with 1.5 times stronger dependence on distance). Hence, the European Russian market for potatoes is more integrated than the US one. The market for sugar, vice versa, is more integrated in the USA. While it is (near-) perfectly integrated there, the degree of its segmentation in Russia is close to that in the market for beef. Near resemblance is observed in impact of distance on price differences. In both countries, distances do not matter in the market for sugar (for Russia, statistically insignificant are 11 of 12 monthly γs). Curiously, only three individual goods provide all possible diversity of comparison results: similarity between market integration in two countries, weaker integration in the USA than in other country, and stronger integration in the USA.

6. Conclusions

In this paper, we attempted to get a general idea of the degree of integration (or segmentation) of the US market, exploiting a methodology originally designed for analysing market integration in transitional economies. The results obtained allow us to conclude that this methodology does work when applied to a long-established market economy.

Product		USA	European Russia
Goods basket	β	0.055	0.099
	γ	0.003	0.003
Beef	β	0.071	0.070
	γ	0.027	0.020
Potatoes	β	0.071	0.040
	γ	0.023	0.036
Sugar	β	0.019	0.070
	γ	−0.001	−0.001

Table VII. Comparison of market integration in the USA and Russia

Using a sub-sample of a cross section of US cities for our pilot analysis, we found strong evidence of US market segmentation. Further, supposing that the US market is the most integrated among territorially large markets, its thoroughly estimated degree of integration may be deemed as the maximal feasible degree of integration and used as a benchmark against which integration of other markets (e.g. China, India, the European Union) may be measured. Here, we looked at Russia.

Patterns for selected markets for individual goods in the US proved to be different. The markets for beef and potatoes were found to be more segmented than the aggregated market for groceries, while the market for sugar turned out to be much less segmented compared with the aggregated market, so that the former could be deemed (near-) perfectly integrated.

Trying to explain reasons for market segmentation in the USA, we found transportation costs to be responsible for some 90 per cent of the average dispersion of prices across cities. As for other factors, their identification seems not so successful. Results obtained with the use of two different ways of measuring price dispersion yielded contradictory results, and did not allow making clear-cut conclusions. It can be merely inferred that market size, crime, and distribution costs are, most probably, positively related with prices, so increasing spatial price dispersion in the USA. The unreliability of these results may be due to insufficient sample size or/and too crude proxies used to quantify supposed segmentation factors.

Comparing our preliminary estimates of the degree of market integration in the USA with estimates for Russia, we note that integration of the European Russian market had become comparable by the order of magnitude with that of the US market by the early 2000s, i.e. market integration in Russia is presently rather strong. Estimates for markets for individual goods are consistent with this result. Of three such markets under consideration, the only market in European Russia is integrated weaker than the respective US market. On the other hand, we could expect something like that, based of the pattern of price dispersion in 2000 in both countries (Figures 1-2).

From both analysis of markets for individual goods in the USA and comparison of its results with respective results for Russia, we conclude that it makes sense to use only an aggregated market in the USA as a benchmark for measuring a feasible degree of market integration and comparing with other countries. It seems that the aggregated market only provides a typical pattern of market integration in a country, while disaggregated markets for individual goods can considerably deviate from the typical regularity due to some particular features of one or other market in the given country.

The finding that the degree of market integration in Russia is comparable to that in the USA is surprising. A more striking thing is that it took only eight years of transition from the centrally planned economy to market economy for market integration in Russia to approach that in the USA. We see a possible reason in that the Russian government did not intervene to creation of consumer market in the country (which had not in fact been a market in the Soviet Union), both wholesale and retail. Therefore, this market was built due to market self-organization only, which rapidly resulted in that the Russian consumer market became fairly efficient despite worse conditions than in the USA. In the 1990s, strong anti-integration forces in Russia had been regional protectionism and organized crime. However, regional protectionism greatly slackened and organized crime shifted its activity to other lines than consumer market by 2000s.

No great significance should be attached to the values of estimates regarding the US markets, though. They are preliminary, being based on a small spatial sample (albeit comparable in size with those used by other authors, e.g. Engel and Rogers (2001), etc.; see Section 2). Rather than rely on these crude estimates, it is sufficient here to note the orders of magnitude suggested and the qualitative pattern rather than the quantitative. Our further research will substantially widen the spatial sample and estimate integration of the US market across a number of points in time[7]. However, similarity of price dispersion in the USA and European Russia (recall that price dispersion in the US was estimated over the entire cross sections of cities in the ACCRA bulletins) in 2000 gives ground to believe that no fundamental changes will happen in the qualitative pattern of market integration in the US compared with that in Russia.

Notes

1. Berkowitz and DeJong (2001) later apply this methodology in analyzing Russia's market integration.
2. Probably, it might make sense to consider monopolistically competitive spatial markets. However, a relevant model would be mainly of theoretical interest. Data on close substitutes are very rare, since aiming to provide comparability of price data, statisticians in all countries record information on homogeneous goods (e.g. taking a certain variety as the representative good).
3. We experimented with deleting I_{rs} from (6), estimating this model with the use of the same data as in Gluschenko (2004). In doing so, changes in the distance coefficient were similar to those observed by Engel and Rogers (1996), even controlling for distribution costs.
4. ACCRA initially stood for the American Chamber of Commerce Researchers Association. Recently, the name has been changed to C2ER, the Council for Community and Economic Research, keeping the former name in the title of the bulletin. Although this institution is non-governmental, its data can be considered as almost official, since they are being included in the *Statistical Abstracts of the United States*.
5. This basket includes: T-bone steak, ground beef/hamburger, sausage, frying chicken, chunk light tuna, whole milk, eggs, margarine, grated parmesan cheese, potatoes, bananas, iceberg lettuce, white bread, cigarettes, vacuum-packed coffee, sugar, corn flakes, sweet peas, tomatoes, peaches, facial tissues, dishwashing powder, shortening, frozen orange juice, frozen corn, baby food, and soft drink. See, for example, ACCRA (2000a) for a detailed definition of goods.
6. The spatial sample covers: Mobile, AL; Jonesboro, AR; Colorado Springs, CO; Jacksonville, FL; Americus, GA; Boise, ID; Quincy, IL; Bloomington, IN; Waterloo-Cedar Falls, IA; Garden City, KS; Murray, KY; Lake Charles, LA; St Cloud, MN; Columbia, MO; Lincoln, NE; Las Cruces, NM; Binghamton, NY; Greenville, NC; Mansfield, OH; Oklahoma City, OK; Salem, OR; Philadelphia, PA; Columbia, SC; Vermillion, SD; Knoxville, TN; Amarillo, TX; Lynchburg, VA; Tacoma, WA; and Green Bay, WI. This selection is motivated by that such a sample would provide comparability with results of our future time-series and panel-data analyses, since continuous time series can be constructed from the ACCRA data for the listed cities only.
7. We still hope that it is possible to adequately take account of nontradable inputs (distribution costs) in the US market. We will be greatly indebted to anyone who could advise on ways to proxy them.

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