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Konstantin Gluschenko and Darya Kulighina

# Assessing a feasible degree of product market integration

## (A pilot analysis)

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SUOMEN PANKKI • FINLANDS BANK
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Konstantin Gluschenko** and Darya Kulighina

# Assessing a feasible degree of product market integration (A pilot analysis)


## Abstract

Perfect integration eludes the real world, so we suggest a realistic benchmark standard for judging the extent of market integration in various economies. We estimate the degree of integration in the US product market, widely acknowledged to be the most integrated among geographically large economies, so as to provide a reference for measuring Russian market integration. Prices for 27 grocery items across 29 cities of the United States in the first quarter of 2000 are used as empirical data. The estimated degree of integration turns out to be very close to values obtained for Russia for 2000. Apparently, market integration in Russia has in recent years moved toward conditions found in advanced market economies. The roles of other factors that could potentially cause segmentation of the US market are also analyzed.


JEL Classification: F14, F15, L81, R1
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# Assessing a feasible degree of product market integration (A pilot analysis)

## Tiivistelmä

Esittelemme tässä työssä realistisen tavan mitata maantieteellisesti erillisten markkinoiden integraatiota. Ensin arvioimme, kuinka integroituneita Yhdysvaltain markkinat ovat. Yhdysvallat on relevantti vertauskohde, koska se on suuri maa ja koska sen markkinoiden katsotaan olevan kaikkein integroituneimmat. Empiirisissä laskelmissa käytämme 27 tuotteen hintoja 29 yhdysvaltalaisessa kaupungissa vuoden 2000 ensimmäisellä neljänneksellä. Näin estimoitu integraation aste on hyvin lähellä Venäjän vastaavaa integroituneisuutta. Voidaan siis päätellä, että Venäjän markkinoiden integraatio on vuosien aikana lisääntynyt niin, että se vastaa kehittyneiden markkinatalousmaiden integraatiota. Tutkimme myös tekijöitä, jotka voivat aiheuttaa markkinoiden segmentaatiota Yhdysvalloissa.

Asiasanat: markkinoiden integraatio, hintojen hajonta, yhden hinnan laki, Yhdysvallat, Venäjä

# 1 Introduction

One way to judge the extent of market integration in Russia (or any spatially dispersed market, for that matter) is to compare it against a theoretical ideal, a perfect integration. Such an ideal benchmark (controlled for transportation costs), 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% change in the per capita income difference between regions induces a 0.05% to 0.1% change in the price difference). We now tackle the question that figure raises: Is this a lot or a little?

Under the strict standards of perfect integration, there is no way to deem the Russian economic space as "single." Indeed, Berkowitz and DeJong (2001, 2003) and Gluschenko (2003, 2004) find the Russian market far from integrated. As comparison to perfect integration would likely to overstate the shortcomings of Russia's product market, we suggest a realistic standard could provide more fruitful comparisons.

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.

Establishing the theoretical means for defining such a boundary presents a daunting task. While field studies of actual arbitrage (especially institutional aspects) would likely provide insight into this mechanism, it is sufficient for our purposes here to use an actual market as the standard. The reference market used 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.[1] We take it as our benchmark to measure integration of the Russian market.

Despite an excellent transportation system, a highly developed market infrastructure, and an also complete absence of local protectionism in US product markets (thanks to

[1] For example, Parsley and Wei (2002) write: "The goods market which is the most integrated is the United States." However, in an earlier paper, Parsley and Wei (2001) give grounds to believe that the Japanese market is more integrated than the US market. Notably, Japan is about the size of California in geographic terms.

the Commerce Clause of the US Constitution), two substantial factors constrain the efficiency of arbitrage in the US.

The first is imperfect information. Arbitrageurs need comprehensive and timely information on prices in different spatial segments of the market to operate effectively. 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 role played by institutions. The law of one price states that 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.[2]

To obtain a crude preliminary estimate of the degree of integration of the US product market, we use as empirical data 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 (excluding difficult-to-access regions) in 2000 are fairly comparable.

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 discussion of the empirical methodology, as well as descriptions of the econometric models and data. In section 4, empirical results are presented. We conclude in section 5.

[2] A simple thought experiment provides an example. Entrepreneur Bob observes that matches cost only half as much in one shop as in another. He decides to buy up all the matches in the first shop and sell them to another shop at a markup. Bob obviously has no problem in accomplishing the first phase of this enterprise; it is the second phase that is fraught with peril. A shop would hardly purchase goods from any passer-by. Nor would he succeed in selling the matches just near the second shop, having no sales permit, etc.

# 2 Literature on US market integration

We consider here several of the key papers directly relating to market integration in the United States, 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 tradables 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% to 15.1%, with a 9.0% 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 converge rapidly to the law of one price: the half-life of the price gap is roughly four or five quarters. Nonetheless, 17% of the time series for tradables turned out to be non-stationary. Cechetti, Mark and Sonora (2002) perform a similar analysis with the use of the consumer price index (CPI) for 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 EU 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 price data is analyzed with a GLS unit root test, a threshold autoregression (TAR) estimation and a smooth threshold autoregression (ESTAR) estimation. The analysis reveals 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 United States and Canada to estimate the role of the border between these countries.[3] Although Engel and Rogers do not treat

[3] Berkowitz and DeJong (2001) later apply this methodology in analyzing Russia's market integration.

market integration as such, they apply a regression specification similar to the one used in this study (see section 3.1). 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 United States 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 United States during 1989–1997 (and corroborating one of our findings in section 4.2).

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, 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 data in the reviewed papers above taken together suggest strongly that the US goods market is nowhere close to being perfectly integrated. Its degree of integration can, however, be viewed as feasible upper bound on the degrees for other countries with large territories.

# 3 Methodology and data

## 3.1 Theory 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, $Q_r = D(P_r, I_r)$ the demand function (assuming $I_r$ is the only determinant of demand apart from price), and $Q_r = S(P_r)$ 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. By moving the good to or from the location, arbitrageurs adjust the quantity supplied in it when the local price increases or decreases due to changes in local demand (e.g., because of variations in per capita income).

A market is deemed integrated when such an adjustment leads prices to equalize across locations such that the law of one price obtains. Perfect integration implies 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 at 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 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 in the quantities demanded here are, as a rule, unavailable. Therefore, it is more convenient to derive a relationship between prices and incomes as a testable version. The equilibrium condition

$$D(P_r, I_r) - S(P_r) = 0 \qquad (1)$$

yields $P_r = f(I_r)$. With some additional assumptions, $f(\cdot)$ can be represented as a log-linear function

$$P_r = \kappa + \beta I_r. \quad (2)$$

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

$$P_{rs} = \beta I_{rs}. \quad (3)$$

As (1) holds for each $I_r$, the derivative of its left-hand side with respect to $I_r$ equals zero. From this we obtain

$$dP_r/dI_r = -\varepsilon_I/(\varepsilon_D - \varepsilon_S), \quad (4)$$

where $\varepsilon_I$ is the income elasticity of demand, and $\varepsilon_D$ and $\varepsilon_S$ are the price elasticities of demand and supply. Hence, $\beta = dP_r/dI_r \geq 0$. With finite $\varepsilon_S$, $\beta$ is positive. However, $\beta = 0$ in a perfectly integrated market, i.e. $\beta$ vanishes as supply approaches perfect elasticity ($\varepsilon_S \to \infty$).

Thus, relationship (3) can be used as a cross-sectional test for market segmentation. A positive value of $\beta$ indicates that local markets are not perfectly integrated. The magnitude of $\beta$ (the elasticity of price dispersion vis-à-vis income dispersion) can be used as a measure of the degree of market segmentation: a higher value for $\beta$ 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, $T_{rs}$. Thus, that the degree of integration, $\beta$, is measured as arbitrage transaction costs minus transportation costs, 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:

$$P_{rs} = \alpha + \beta I_{rs} + \gamma L_{rs}, \quad (5)$$

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 random shocks, $\varepsilon_{rs}$, we obtain an econometric version of (5):

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

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. On the other hand, the noisiness of the distribution cost variable in market integration estimations could be taken to mean its role is not as crucial as is customarily deemed in the literature. Indeed, omitting this variable does not change the qualitative pattern of Russia’s market integration; and quantitative changes are minor, if any; see Gluschenko (2003, 2004). Of course, this may 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, and not as the degree itself. The second is to deem difference 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).

Benefiting from the fact that $P_{rs} = C_{rs}$, the latter equation can be modified so that it can estimate roles played by various factors in market segmentation. After modification,

$$P_{rs} = \alpha + \beta^* I_{rs} + \gamma L_{rs} + \sum_k \alpha_k X_{krs} + \varepsilon_{rs}, \quad (7)$$

where $X_{krs}$ is a variable characterizing $k$-th factor for pair ($r$, $s$). The meaning of the coefficient on income differential in this equation differs from that in (6): $\beta^*$ indicates the total effect of unidentified factors rather than degree of market segmentation. We reasonably expect that $\beta^* < \beta$.

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 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 demands 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.[4] 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 United States and Canada.

## 3.2 Data

The price data for the analysis are drawn from the *ACCRA Cost of Living Index* bulletin.[5] 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 components 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 relative to the national average cost. Thus,

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

where $p_{(g)l}$ is the grocery-items index in location $l$, $i$ indexes individual goods from the grocery basket ($i$=1,…,$n$; $n$=27), $p_{il}$ is the price of $i$-th good in $l$, $p_i$ is the (arithmetic)

[4] Although not reported in Gluschenko (2004), it was experimented with deleting $I_{rs}$ from (6) while analysing Russia's market integration. In doing so, changes in the distance coefficient were similar to those observed by Engel and Rogers, even controlling for distribution costs.

[5] ACCRA formerly stood for the American Chamber of Commerce Researchers Association. Nowadays, it is simply the institution's name, and not the abbreviation. Although ACCRA is a non-governmental institution, its data can be considered as almost official, since it is included in the *Statistical Abstracts of the United States*.

cross-section mean of prices for $i$-th good, and $\alpha_i$ is the weight of $i$-th good in the the grocery basket. Weights are largely based on data from the US Bureau of Labour Statistics' *Consumer Expenditure Survey* (1992 in our case; see ACCRA, 2000b). The goods are listed in Appendix; for detailed definitions and the values of the good weights, see ACCRA (2000a, b). 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."[6]

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. Appendix provides the list of these cities. 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).[7] Distance is defined as the shortest highway distance between cities; distance values are taken from the *Map Quest* website.[8]

We use two additional variables: city population and crime rate. Population values are drawn from the BEA website.[9] Crime rates are those by state; the data source is U.S. Census Bureau (2002), p. 184.

[6] Both versions of the price variable can be interpreted as (spatial) price index numbers. The first one is the Scrope index with the reference quantities being those in the national average market basket; the second version is the Jevons index (Diewert, 1987).

[7] www.bea.gov/bea/regional/reis, Series CA1-3, Per Capita Personal Income, Metropolitan Statistical Areas, 2000.

[8] www.mapquest.com.

[9] www.bea.gov/bea/regional/reis, Series CA1-3, Population, Metropolitan Statistical Areas, 2000.

# 4 Empirical results

## 4.1 Estimates

Table 1 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 (as the minimum approaches zero, the spread almost coincides with the maximal price differential).

Table 1 Summary statistics

| 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 |

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% and 5.8%, with standard deviations of 4.3% and 4.0%, respectively. The maximal differences in prices are equal to 23.8% and 22.5%.[10]

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 the test equation (6) reveal whether that is the case.

The estimation results are presented in Table 2. The standard errors in this table and in Table 3 below are the White heteroscedasticity-consistent errors.

[10] Taking the entire spatial sample from ACCRA (2000), except for New York City and Alaskan cities, the spread of the cost of the grocery basket equals 57.1% (with Victoria, Texas, and Sacramento, California, as the low and high ends; the cost of the basket is 77.6% of the national average in the former, and 121.9% in the latter).

Table 2 Integration of the US product market

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

The coefficient on income, β, (i.e. the degree of market segmentation) is highly significant at the levels of less than 0.1% 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% results in an increase in the grocery price difference of about 0.5%.

The coefficient on distance, γ, has the expected positive sign in both regressions. It is insignificant (at the 10% level) in the regression of the cost of the grocery basket, but is significant at the 10% 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 small 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, the insignificance of distance in the first regression may be due to the small size of our city sample.

Unfortunately, there are limited possibilities to quantify factors that might explain market segmentation. No indicators characterize completeness and timeliness of information on the market situation or the institutional impediments to arbitrage. Moreover, indicators that might reveal market segmentation turn out to be highly correlated with other explanatory variables. Only two factors stand out: city size (population) and the crime rate (total number of reported offences per 100,000 population).

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, in particular, due to higher rents. 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). Estimates of model (7) are presented in Table 3.

Table 3 Factors influencing market segmentation

| **Coefficient (variable)** | **Estimate** | **Standard error** | **p-value** |
|---|---|---|---|
| Dependent variable: ***The cost of the grocery basket*** | | | |
| $\beta^*$ (income) | 0.0310 | 0.0153 | 0.043 |
| $\gamma$ (distance) | 0.0027 | 0.0032 | 0.397 |
| $\alpha_1$ (size of city) | 0.0047 | 0.0018 | 0.008 |
| $\alpha_2$ (crime rate) | 0.0019 | 0.0038 | 0.616 |
| Dependent variable: ***Average grocery price*** | | | |
| $\beta^*$ (income) | 0.0399 | 0.0148 | 0.007 |
| $\gamma$ (distance) | 0.0050 | 0.0030 | 0.094 |
| $\alpha_1$ (size of city) | 0.0032 | 0.0017 | 0.060 |
| $\alpha_2$ (crime rate) | 0.0139 | 0.0036 | 0.000 |

As expected, Tables 2 and 3 show that the value of $\beta^*$ decreases compared to $\beta$. Hence, our additional factors contribute to inter-city price dispersion. The size of city is significant in both regressions (at the levels of 1% and 10%) with positive coefficients (i.e. the larger the city, the higher the prices). The coefficient on crime rate has the expected positive sign. However, this variable is significant only in 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).

The estimates from Table 3, 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 $\overline{P} = \hat{\alpha} + \hat{\beta}^* \overline{I} + \hat{\gamma}\overline{L} + \hat{\alpha}_1 \overline{X}_1 + \hat{\alpha}_2 \overline{X}_2$, the contribution of a variable, say $X_1$, to the average price dispersion may be calculated as $\hat{\alpha}_1 \overline{X}_1 / \overline{P}$. 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: $\hat{\alpha}_1 \overline{X}_1 / (\overline{P} - (\hat{\alpha} + \hat{\gamma}\overline{L}))$. Table 4 reports the results.

Table 4 Contribution of various factors to average price dispersion (percentage)

| Factor | Contribution to the total price dispersion | | Contribution to the price dispersion less the geographically determined one | |
|---|---|---|---|---|
| | Basket | Average price | Basket | Average price |
| Unidentified factors | 3.6 | 4.2 | 36.8 | 33.9 |
| Distance | 90.2 | 87.6 | – | – |
| Size of city | 5.9 | 4.8 | 60.2 | 38.3 |
| Crime rate | 0.3 | 3.5 | 3.0 | 27.8 |

The predominant contribution to price dispersion pertains to transportation costs proxied by distance and determines about 90% of the inter-city price difference. About 5% to 6% more is due to difference in size of cities. Evidence of the two regressions is discrepant as to the contribution of crime. Taking the grocery basket, crime is responsible for only 0.3% of dispersion of its cost, while it is responsible for 3.5% of dispersion of the average grocery price. Other unidentified factors yield about 4% of differences in prices. Unknown factors determine more than a third of price dispersion cleaned of the effect of transportation costs. The difference in size of cities yields 40% to 60%, and crime is responsible for 3% to 30%.

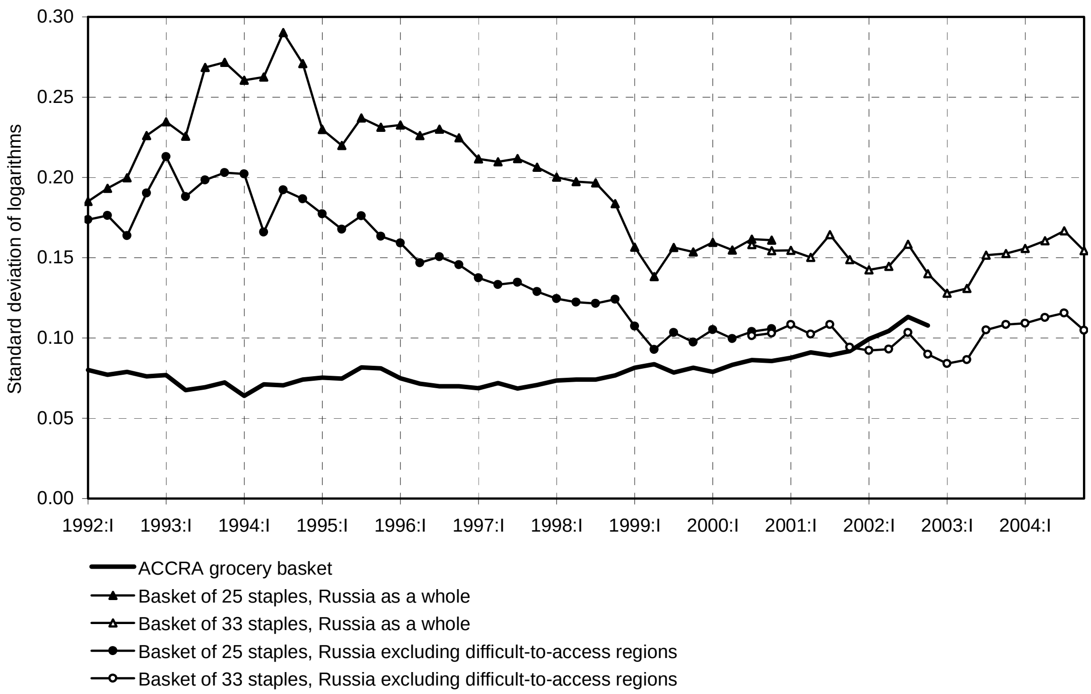
## 4.2 Comparison with Russia

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 latter is also normalized to the national average.

In contrast to the regression analysis reported above, standard deviations are computed over entire city samples as they appear in the ACCRA (1992–2002) bulletins. 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, Goskomstat introduced a 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).[11]

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




The standard deviations for Russia are computed over two spatial samples. The first comprises 74 of Russia's 89 regions for which the price data is available. In the second sample, five difficult-to-access regions (Murmansk Oblast, Magadan Oblast, Yakutia, Kamchatka, and Sakhalin) that cannot be involved in bilateral arbitrage are omitted. For the United States, we should similarly classify Alaska, Hawaii and the Virgin Islands as difficult to access. These territories, indeed, increase price dispersion across US cities, but only to a minor extent. For example, when Alaskan cities are excluded, the standard deviation in 2000:I decreases from 0.079 to 0.076. For this reason, we do not separate out Alaska, Hawaii, and Virgin Islands.

[11] In 1999-2003, there were regional sale taxes in Russia. However, they had a minor impact on cross-region price variability, if any. First, these taxes did not vary much across regions, as they had prescribed upper

Figure 1 suggests that price dispersion in the Russian market (represented by the staples baskets) became comparable with that of 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 United States. Maybe, this is an artifact 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. Certainly, 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 Russia, excluding difficult-to-access regions, approximates that of the US market, or, at least, they are of the same *order of magnitude*.

Comparing regression estimates, the degree of market segmentation in Russia as a whole in 2000 is about twice as high as in the United States. According to Gluschenko (2003), the value of β estimated over yearly averaged costs of the basket of 25 foods equals to 0.116 for 2000; averaging monthly values of β over 2000 yields 0.112. However, 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 Russia excluding difficult-to-access regions gives a far more similar picture. For this part of the Russian market, the respective values of β are 0.061 and 0.059.

Thus, the degrees of integration of the US and Russian (excluding difficult-to-access regions) markets are quite close. From the statistical viewpoint, they almost coincide: the 95% confidence intervals of estimates for the US market are [0.035, 0.075] when the cost of the grocery basket is used, and [0.027, 0.067] for the average grocery price, while it is [0.053, 0.070] for the yearly β in Russia.

No great significance should be attached to this striking result, since the US spatial sample used for the pilot analysis is so small. There are external grounds to believe that the Russian market is less integrated than the US. What may be concluded from the results here is that the degree of Russia's market integration has become *comparable* with that of the US market.

bound of 5%. Second, when the sale taxes were abolished, local retail prices did not change at all.

The coefficient on distance, $\gamma$, in Table 2 turns out to be one order of magnitude smaller than the estimate for Russia, excluding difficult-to-access regions (0.034 to 0.037). This is comparable by order of magnitude with estimates for the European part of Russia. This seems reasonable, since the average distance between US cities in our sample is about 1,500 kilometers compared to 1,100 kilometers between regional capitals in the European part of Russia. The figure for Russia, excluding difficult-to-access regions, is 2,600 kilometers.

# 5 Conclusions

In this paper, we attempted to get a general idea of the degree of integration (or segmentation) of the US market. Using a subsample 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.

Comparing our preliminary estimates of the degree of market integration in the United States with estimates for Russia, we note that integration of the Russian market excluding difficult-to-excess regions had become comparable with that of the US market by the early 2000s, i.e. market integration in Russia is presently quite strong.

These results are, of course, preliminary. They are based on a small spatial sample and some indicators are quite rough. 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.[12]

[12] We still hope that it is possible to take account of nontradable inputs (distribution costs) in the US market. We would be greatly indebted to anyone who could advise on ways to proxy them.

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# Appendix: Data details

## Product sample

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; soft drink.

See ACCRA (2000) for detailed goods definitions.

## Spatial sample (city and state)

Mobile, AL; Jonesboro, AR; Colorado Springs, CO; Jacksonville, FL; Americus, GA; Boise, ID; Quincy, IL; Bloomington, IN; Waterloo, 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; Green Bay, WI.

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