Economic Fragmentation in Russia:
The Influence of International Trade and Initial Conditions

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November 2004

Forthcoming in *Economics of Governance*

Abstract

Post-Soviet Russia has experienced a considerable degree of regional economic fractionalization. While previous evidence has assigned a causal role to openness to international trade in accounting for this phenomenon, we show here that evidence of this nature is less clear-cut upon conditioning on a set of regional-level pre-transition initial conditions, and focusing on international-trade activity measured at the regional rather than the national level. The variables used to quantify initial conditions include measures of standards of living, ethno-linguistic fractionalization, and most importantly, transportation infrastructure.

JEL Classification: P22; R1

For helpful comments, we thank Kai Konrad, two anonymous referees and participants in the Conference on Rationalist Approaches to War and Conflict sponsored by the Social Science Research Center Berlin, July 2004. We also thank Lauree Graham and Debbie Ziolkowski for assistance in preparing this manuscript.

I. Introduction

The implementation of market reforms in Russia has been accompanied by a distinct and persistent pattern of economic fragmentation. Following the federally initiated implementation of price-decontrol, trade-liberalization and large-scale-privatization measures in the early 1990s, many regional governments erected border controls and imposed regional import quotas in an effort to protect their inefficient regional and local industries from the rigors of increased competition. Regional and local governments also issued coupons and local monies and imposed export controls in order to limit the non-residential consumption of subsidized commodities (Mitchneck, 1995; Serova, 1998; Freinkman et al., 1999; and Ericson, 2001). These regionally and locally initiated protectionist policies violated federal laws mandating the free flow of goods, services and factors across regions. Beyond this direct evidence, there is a substantial body of statistical evidence that underscores the extent and persistence of economic fragmentation within Russia: pockets of economic isolation, manifested by inter-regional differences in commodity prices that fail to relate systematically with distance (thereby indicating seemingly unexploited arbitrage opportunities), are evident at least through the end of 1990s, which marks the terminal point of the data we consider here.[1]

What factors cause regions to withdraw from the domestic market? This question is important primarily because trade theory predicts (and there is a large body of empirical evidence supporting this prediction) that the overall economic wellbeing of a country falls when its regions engage in beggar-thy-neighbor policies with each other. This issue is also important because there may be a strong association between economic fragmentation and political disintegration within a country. In the particular case of Russia, for example, regions that have been lax in paying their taxes to the federal government have also been more likely to be isolated economically (Berkowitz and DeJong, 2003).

In previous work (Berkowitz and DeJong, 2003), we showed that the regional propensity towards internal economic integration within Russia has waxed and waned substantially over time, and that an aggregate measure of the extent of internal integration

[1] Early evidence of this sort is provided by Gardner and Brooks (1994) and DeMasi and Koen (1996); the persistence of this phenomenon is documented by Berkowitz and DeJong (1999, 2003).

has tended to co-vary negatively and significantly with aggregate international trade flows (exports plus imports as a fraction of total output, all measured at the national level). The pattern of these co-movements suggested a causal relationship wherein enhanced opportunities for international trade was serving to prompt regions to substitute international for domestic trading partners, thereby contributing towards internal economic fractionalization.[2]

Here, we revisit this issue using an enhanced data set that quantifies regional-level pre-transition initial conditions (including data on wealth, ethno-linguistic fragmentation, and transportation infrastructure), and that measures international trade flows at the regional rather than the national level.[3] Unconditionally, there is virtually no correlation between our measure of regional economic integration and international trade activity. Upon conditioning on the set of initial conditions we measure, we do find evidence of a negative trade-off between these variables, but the evidence is sensitive to the particular set of exclusion restrictions employed in the context of a two-stage least squares analysis. We focus on two sets of restrictions here. The first entails the use of only one restricted variable. This structure indicates no systematic relationship between regional economic integration and international trade activity, but this finding is tenuous due to the clear potential for problems arising from a weak-instrument problem.[4] The second set of restrictions yields a structure which indicates a clear negative relationship. However, while the exclusion restrictions in this case serve to mitigate the weak-instruments problem, and appear valid based on statistical grounds, they are difficult to support based on *a priori* considerations. Thus, evidence regarding this relationship is mixed.

In contrast, a clear culprit behind Russia's persistent pattern of regional economic fractionalization appears to be a deficient transport infrastructure. Specifically, regions

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[2] To the extent that economic fragmentation is also indicative of political disassociation, this finding is supportive of theories which hold that increased opportunities for regions within a country to trade with the rest of the world can undermine political integration by making these regions less dependent on their neighbors for fulfilling trading needs and providing resources for financing public goods. See Alesina et al. (2000) and Casella (2001) for elaborations of such theories.

[3] Data on initial conditions come from Goskomstat RSFSR (1990) and Goskomstat Rossii (2001); and data on international trade flows also come from Goskomstat Rossii (2003). Details on the data are provided in Section II.

[4] See, e.g., Stock, Wright and Yogo (2002) for an excellent discussion of problems associated with inferences based on weak instruments.

with relatively dense automobile road networks exhibit relatively strong propensities towards internal economic integration, and relatively low international trade activity. The opposite internal/external trade pattern prevails among regions with relatively dense railroad networks. Thus, the pattern of internal and external trade relationships observed among Russian regions seems most plausibly attributable to circumstance rather than choice.

One additional aspect of our results is notable, and serves to temper the circumstance versus choice observation somewhat: regions featuring relatively high degrees of ethnic diversity, or equivalently, relatively low proportions of Russians among their populations, also feature relatively low propensities towards regional integration.

In what follows, we first describe the method we use to quantify regional patterns of internal economic integration. Next, we characterize the variables we use to help explain these patterns; and then present the results of a regression analysis that serves as the basis of our characterization.

II. Measuring Regional Economic Integration[5]

The measure of economic integration we employ is based on an arbitrage argument: given regional market integration, goods will flow from regions in which prices are low to regions in which they are high so long as transport costs are not prohibitive. Thus if transport costs are increasing in distance, so too will be regional price differentials. More formally, let $Q_{ij}(t)$ denote the percentage price differential for some tradable good sold in regions i and j at some date t: $Q_{ij}(t) = abs(log(P_i(t)/ P_j(t)))$. Also, let d_{ij} represent the distance separating regions i and j, where inter-regional transport costs are increasing in d_{ij}. Lacking barriers to inter-regional trade, arbitrage opportunities exist at some date t when $Q_{ij}(t)$ is greater than or equal to transport costs. When $Q_{ij}(t)$ is less than transport costs, moving the good between these two regions is not profitable, and inter-regional trade does not occur.

To quantify the relationship between distance and transport costs, we follow Engel and Rogers (1996) in employing Krugman's (1991) transport cost model, in which

[5] See Berkowitz and DeJong (2003) for a more detailed discussion of the methodology outlined here, including comparisons with alternative methodologies.

$1 - 1/(1+ d_{ij})$ is the share of a good that depreciates when it is moved between regions i and j. Arbitrageurs can profitably buy goods in region j and resell these goods in region i when $P_i/ (1 + d_{ij}) \geq P_j$; the same arbitrageurs can profitably buy goods in region i and resell in region j when $P_j/ (1 + d_{ij}) \geq P_i$. Given market integration, goods will flow between regions i and j when the relative price (P_i/ P_j) fluctuates outside the band $[1/(1+ d_{ij}), (1+ d_{ij})]$. This band is increasing in $d_{ij;}$ thus given market integration, the variance of Q_{ij} should be increasing in inter-regional distance.

We measure movements in inter-regional price dispersion using a monthly price index that measures the cost of a weighted basket of basic food goods. The index spans January 1995 through December 1999, and was compiled by the Russian statistical agency Goskomstat (unpublished). The index includes observations from 72 Russian cities including Moscow and St. Petersburg, and capital cities in 70 additional regions. (There are 89 regions in Russia; the data we lack are from war-torn regions in the Caucasus, and from many of the Autonomous okrugs and krais. See the Appendix for a list of the regions included in our data set.)

Let t = 1, 2, …, M denote a particular month and year in which the price index is computed, and let $\sigma_{ij}(s)$ denote the standard deviation of $Q_{ij}(t)$ calculated over the twelve-month sub-period indexed by s. To measure movements in price dispersion, we calculate $\sigma_{ij}(s)$ for every possible (i,j) combination such that $i \neq j$, and for every possible twelve-month sub-period in the time period spanned by our data (we also considered shorter and longer sub-periods and obtained similar results). There are 60 months spanned by our price index, so there are 49 possible twelve-month sub-periods.

To measure market integration for region i in sub-period s, we use OLS to estimate

(1) $\sigma_{ij}(s) = \alpha_i(s) + \beta_i(s)\log(d_{ij}) + u_{ij}(s), \qquad i \neq j,$

where $\alpha_{ij}(s)$ is the estimated intercept, $\beta_i(s)$ is the coefficient for log distance from region i to all other regions, and $u_{ij}(s)$ is an error term. We deem region i to be integrated during sub-period s when $\beta_i(s)$ is estimated as positive and statistically significant.[6]

[6] We define significance at the 1% level in the results reported below; the patterns identified in this manner are robust to alternative choices. Standard errors used to evaluate significance are heteroscedasticity consistent (White, 1980).

Finally, letting π_i denote the proportion of sub-periods during which region i was deemed to be integrated using this methodology, the regression analysis presented in Section IV employs as a measure of regional economic integration the logged odds ratio $\ln(\pi_i/(1-\pi_i))$, referred to hereafter as LNODDS; the corresponding raw odds ratio is referred to hereafter as ODDS.

Several aspects of this measure warrant discussion. First, while as noted above Berkowitz and DeJong (2003) have shown that regional propensities towards integration have fluctuated significantly over time, we are constrained to work with a time-invariant measure of integration here since the remaining variables we employ are also time-invariant. Second, the level of π_i is clearly sensitive to the significance level chosen for judging the statistical significance of $\beta_i(s)$ in (1). We define significance at the 1% level here because higher levels generate instances in which π_i equals 1, thus producing infinite odds ratios. (However, increasing the significance level and excluding regions with infinite odds ratios yields results qualitatively similar to those reported below.) Third, an alternative to the continuous measure we employ is a discrete measure wherein a region is classified as 'non-integrated' if its value of π falls below a certain threshold and 'integrated' otherwise. The non-parametric portion of the data description presented in Section III is based on such a discretization (using 50% as a threshold value). Moreover, replacing the regression analysis presented in Table 2 with a probit analysis applied to such a measure again yields similar qualitative results. Finally, the logged odds measure has several attractive features: it is unbounded and continuous; it may be implemented directly in ordinary, two- and three-stage least squares analyses; and it yields coefficient estimates in such analyses that are interpretable as elasticity measures (since the additional variables we work with are all measured in log terms).

III. Data Description

Each variable in our data set is measured at the regional level. The two outcome variables include the odds ratios described above – ODDS – and TRADE. TRADE is measured as the average annual value of exports and imports in millions of dollars to non-CIS countries, measured as a fraction of regional income. Regional income is a real measure of the purchasing power of average annual income. Specifically, it is measured as the ratio of annual average money income (in rubles) to the ruble cost of a uniform basket of 25 basic food goods. Given the temporal proximity of ODDS and TRADE, and the potential for regions to treat internal and international trade as substitutable activities, these variables are potentially endogenous with respect to one another, and are treated as such in the regression analysis that follows.

In addition, we measure a set of strictly exogenous initial conditions related to regional wealth, transport infrastructure and ethnicity. The strict exogeneity of these variables arises from the fact that they are measured prior to the initiation of Russia's Big Bang reforms (at the latest, January of 1992), and because it is unlikely that any of these variables were formulated in anticipation of the subsequent behavior exhibited by ODDS and TRADE in the late 1990s. Beyond strict exogeneity, there are often *a priori* reasons to believe that these variables have potential causal relationships with respect to ODDS and TRADE, for reasons cited below. However, we note that, even given evidence of significant statistical relationships between these explanatory variables and ODDS and TRADE, caution must be taken in making definitive statements of this nature, because, e.g., the variables we measure may be merely serving as proxies for additional unmeasured regional characteristics

Regarding our measures of initial wealth, we note that under the Soviet system, social and political connections, in addition to monetary wealth, were important for obtaining goods and services due to the pervasiveness of fixed prices and rationing. Thus we use passenger automobiles per 1,000 people (AUTO) and apartment telephones per 100 city families (TELE) in 1990 to quantify initial regional wealth. Both goods were highly prized rationed durables in the Soviet system: beyond money, obtaining these durables required substantial political connections (especially in obtaining them from the state), and substantial social connections (especially in obtaining them from black market). *A priori* the relevance of these variables is somewhat mixed: on one hand, initial wealth may serve as a signal of the ability of a region to engage in either domestic or international trade; on another hand, a relatively high value of initial wealth may provide a region with an enhanced luxury of opting out of either type of trade relationship if they were so disposed.

We quantify regional transport infrastructure using kilometers of road for automobiles per 1000 square kilometers of territory (AROAD) and kilometers of railroad track per 10,000 square kilometers of territory (RROAD). Both variables are measured at the end of 1990. Since transport infrastructure is clearly important in influencing the ability of regions to participate in domestic and international trade, we would expect them to have a positive association with ODDS and TRADE. The source of AUTO, TELE, AROADS and RROADS is the Russian Statistical agency (Goskomstat Rossii, 2001).

Finally, we measure regional ethnic diversity using the following measure of ethnic fractionalization:

(2) $$\text{ETHNO} = 1 - \sum_{i=1}^{J} (g_{i,reg} / POP_{reg})^2, \quad i = 1,\dots,J$$

where $g_{i,reg}$ is the number people in ethnic group i in the region, POP_{reg} is the total population in the region and J is the total number of ethnic groups within the region (we suppress the reg subscript in ETHNO for simplicity; see Mauro, 1995, for a discussion of the use of ETHNO in a cross-country analysis). A more ethnically fragmented region has a higher ETHNO index. We compile the data for ETHNO from the All Union Census of 1989, which was collected by the Soviet State Committee on Statistics (Goskomstat RSFSR, 1990). It is notable that ETHNO is highly correlated with the share of the regional population that does not use Russian as its first language (the correlation between the logged versions of these measures is 0.961). Thus, ethnically cohesive regions are dominated by Russian speakers. Regarding *a priori* relevance, regions with relatively high ethnic diversity may exhibit a relatively low propensity towards internal integration due to a relative incompatibility of their own tastes with those of their domestic trading partners; and a relatively high propensity towards international trade due to a stronger compatibility of their tastes with international trading partners.

Table 1A provides summary statistics for the levels and logged values of the variables in our data set (logged variables are referred to with leading LN monikers – e.g., logged odds are referenced as LNODDS). Note the substantial variation in both outcome variables: LNODDS averages 0.47 (corresponding to an odds ratio of 1.6), and ranges from -3.30 (an odds ratio of 0.037, measured in the geographically isolated Northern Komi Republic) to 4.01 (an odds ratio of 55, measured in the centrally located

Tula Oblast). TRADE averages 29.73, and ranges from 0.62 (in the Karachay-Cherkess Republic) to 297.3 (in Moscow City).

Regarding initial conditions, it is striking just how few telephones and passenger automobiles were available at the end of 1990: on average, there were about 58 passenger cars owned per 1000 people and 30 telephones used per 100 city families. The cross-regional variance in ETHNO, AROADS and RROADS is much greater than for initial wealth. Regarding ETHNO, in 19 of the 72 regions, there is substantial homogeneity: ETHNO is no greater than $1/8^{th}$. However, in the regions Rostov, Karachay-Cherkess and Bashkortostan, ETHNO exceeds 70%. While the average density of automobile roads is roughly 88 km per 1000 km^2 of territory, there are 17 regions that have a relatively sparse road system (less than 25 km per 1000 km^2), and there are three regions that have a road density exceeding greater than 250 km per 1000 km^2. Because the overall automobile road systems and airports are underdeveloped by world standards, and rivers used for commercial transport are frozen for many months during the year, the railroad system is critical mode of commercial transport (see Fraser and Thompson, 1993). Remarkably, RROADS are even more inequitably distributed than AROADS. While the average density of railroad track is 160 km per 10,000 km^2, four regions in the Far East and Eastern Siberia (Magadan, Kamchatka, the Sakha Republic and Tyva Republic) and the Gorniy Altay Republic in West Siberia have essentially no railroad track, while Moscow and Kaliningrad have more than 500 km of track per 10,000 km^2.

Table 1B reports correlation patterns between logged values of these variables (logged, since the regression analysis that follows is based on logged values). Vis-à-vis LNODDS and LNTRADE, both measures of initial wealth exhibit positive but mild correlations. As expected, LNETHNO is negatively correlated with LNODDS (-0.264); however, it is virtually uncorrelated with LNTRADE. Regarding transport infrastructure, both LNAROADS and LNRROADS are strongly positively correlated with LNODDS (0.53 and 0.349, respectively), while surprisingly, both variables are weakly correlated with LNTRADE, LNAROADS negatively (-0.153), LNRROADS positively (0.148). Finally, the correlation between LNODDS and LNTRADE is mildly negative: -0.120.

Figure 1 presents the unconditional relationships between all logged variables via a scatterplot matrix. These plots of course underscore the correlation patterns reported in

Table 1B, but additionally, serve notice of potential outliers. Most notable are the five regions mentioned above with virtually non-existent railroad networks. To guard against potential problems arising from the presence of outliers, we take two steps: we complement the least-squares estimates presented below with estimates obtained using quantile regressions; and conduct our two-stage analysis both using the full sample and given the exclusion of apparent outlier regions (defined as regions with estimated residuals outside two-standard-deviation error bands). In all cases, outliers do not appear to be an issue, as results are similar qualitatively.

Before turning to our parametric analysis, we conclude this section by describing the results of a non-parametric exercise designed to contrast the unconditional distributions of the explanatory variables that prevail between regions with relatively low propensities towards regional integration, and those with relatively high propensities. Specifically, we began by assigning regions with values of π (the proportion of sample sub-periods during which the regions were defined as being integrated) below 50% into a 'non-integrated' category, and those with values above 50% into an 'integrated' category (alternative thresholds yield similar results). The former category includes 26 regions; the latter 46. For both classifications, we then used a kernel estimator to construct cdfs for each explanatory variable.[7] The resulting cdfs are illustrated in Figure 2. CDFs corresponding to 'non-integrated' regions are indicated by solid lines; when left-shifted relative to their dashed counterparts, this indicates that 'non-integrated' regions tend to have relatively low levels of the indicated variable.

Striking in Figure 2 is the dramatic difference in cdfs for AROADS and RROADS: 'non-integrated' regions clearly tend to have relatively low endowments of both variables. Indeed, these are the only variables for which the differences in cdfs across classifications are statistically significant (at the 5% and 10% levels, respectively, based upon the Kolmogorov-Smirnov test). There is a noticeable right-shift in the cdf of 'non-integrated' regions for ETHNO below 0.5, while for the remaining variables, the cdfs correspond closely. Although these comparisons are unconditional, they serve to foreshadow the results of the parametric analysis that follows: transport infrastructure is

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[7] Each cdf is plotted over 21 bins, and was constructed using a Gaussian kernel with bandwidth equal to twice the width of the corresponding bins. For details see, e.g., Silverman (1986).

of first-order importance in helping account for the pattern of regional fractionalization we observe within Russia, and ethnic diversity also plays a non-trivial role.

IV. Regression Analysis

The regression analysis we conduct is designed to assess the influence of regional initial conditions on openness to domestic and international trade; and whether regions have treated domestic and international trade as substitutes. As a first pass at the first question, we report results of regressing LNODDS (Table 2) and LNTRADE (Table 3) on logged values of the five initial conditions in our data set. (Note that since all variables are measured in logs, coefficient estimates represent elasticities.) Both tables report three specifications. Specification (1) is an OLS regression on all variables. Because this specification has 72 observations and five regressors, its estimated standard errors may be inefficient. To improve efficiency, in specification (2) we reduce (1) using a stepwise OLS procedure in which the regressor whose corresponding p-value is largest is sequentially eliminated one at a time, so long as this p-value exceeds 20%; we then report an F-test in order to check for the validity of the ensuing exclusion restrictions (this is a version of the general-to-specific estimation methodology advocated by Hendry, 2000). Finally, to evaluate the potential undue influence of regional outliers (recall, e.g., the set of regions with negligible railroad infrastructure), we report a third set of estimates (specification (3)) obtained using a stepwise least absolute deviations (LAD) estimation procedure.

Regarding the results obtained for LNODDS, each specification in Table 2 indicates that LNAROAD and LNRROAD are always statistically significant at at least the 5% level, and LNETHNO at at least the 10% level. In contrast, LNAUTO and LNTELE are each statistically insignificant in (1), and can be jointly excluded as well under the stepwise elimination procedure (the p-value for their joint exclusion is 0.485). Under specification (3), LNTELE is eliminated under the stepwise procedure, while LNAUTO is not eliminated but yet is not significant at the 10% level. Note that LNAROAD exhibits the expected strong positive relationship with LNODDS, while the relationship with LNRROAD and LNODDS is negative. (We will return to a discussion of this result during our summary of the relationship between LNTRADE and the initial conditions.) Finally, the quantitative significance of LNETHNO is notable; its corresponding elasticity measures range between -0.32 and -0.41.

Regarding the results obtained for LNTRADE in Table 3, the transport-infrastructure variables are always significant at at least the 5% level, LNTELE is statistically significant in only the stepwise OLS specification (2), and LNETHNO and LNAUTO are always statistically insignificant. Note that LNAROAD has a strong negative relationship (its elasticity measure is -0.959) and LNRROAD has a strong positive relationship (0.756) with LNTRADE. This is notable, particularly because this pattern is exactly the reverse of the pattern observed using LNODDS as the dependent variable. One interpretation of this result is that autoroad and railroad infrastructure work to induce regions into a substitution pattern between domestic and international trade: regions with relatively developed autoroad infrastructures have a comparative advantage in trading on the domestic market; and regions with relatively developed railroad infrastructures have a comparative advantage in trading on international markets. This interpretation would be more convincing given direct evidence that autoroad infrastructure is the primary means by which inter-regional trade is facilitated, and that railroad infrastructure is the primary means by which international trade is facilitated. Lacking such evidence, as we do here, this interpretation is primarily speculative.

In Table 4, we address both of the questions raised above jointly using a two-stage least squares (2SLS) analysis. We employ a two-stage procedure due to the possibility of simultaneity bias arising from the joint endogeneity of LNODDS and LNTRADE (confirmed by the application of the Hausman (1978) test). The structures in Table 4 treat LNODDS as the dependent second-stage variable, and LNTRADE as the variable to be instrumented (we also reversed the rolls of LNODDS and LNTRADE; results of this reversal are discussed below). The results of Tables 2 and 3 suggest that LNTELE is an attractive excludable instrument in this framework because it is the only variable that exhibits a strong statistical association with LNTRADE while appearing to be unrelated with LNODDS. Thus, in specifications (1) and (2) in Table (4) we estimate an exactly identified specification using LNTELE as the lone instrument excluded in the second-stage regression.[8] Specification (1) was estimated using the entire sample, and specification (2) was estimated given the elimination of outlier regions: i.e., those regions with corresponding residuals obtained under specification (1) that fell outside of the estimated two-standard-deviation residual error band. Under both specifications, we find that LNTRADE fails to exhibit a statistically significant relationship with LNODDS. However, it is evident that under both specifications, LNTELE is a weak instrument: F-statistics (and corresponding p-values) for the exclusion of LNTELE from the first-stage OLS regression are 1.62 (0.208) and 1.20 (0.277); also, partial R^2 statistics obtained in the first stage are low (0.039 and 0.034).[9]

In light of the well-known problems associated with 2SLS estimates obtained using weak instruments, conclusions based on the specifications (1) and (2) are decidedly tenuous (e.g., see Stock et al., 2002).

Table 4 reports two additional specifications, (3) and (4), under which LNRROAD is added as an additional variable excluded in the second stage. Once again, specification (3) was estimated using the entire sample, while (4) was estimated given the elimination of outliers. A statistical justification for this additional exclusion restriction is that while LNRROAD is strongly conditionally associated with LNODDS in the reduced-form regressions reported in Table 2, its t-statistic is always lower than unity when it is used a control (included instrument) in the two-stage specifications (1) and (2) in Table 4. In addition, this exclusion is plausible *a priori* if railroad infrastructure is unimportant relative to autoroad infrastructure in the conduct of internal trade. However, as noted, we have no direct evidence indicating this to be the case.

Given the joint exclusion of LNTELE and LNRROAD in the second stage, the weak-instrument problem that plagues specifications (1) and (2) seems to be eliminated:

[8] We eliminated LNAUTO from this portion of the analysis because it was not associated with either outcome variable according to the results reported in Tables 2 and 3. However, the results we report here hold if we retain LNAUTO either as an excluded instrument or a control variable.

[9] Chao and Swanon (2003) show that when an exact identification strategy fails because the excluded instrument is weak, one should consider using an additional plausible instrument, if the additional exclusion restriction increases the first-stage F-statistic for excluded instruments. This over-identification strategy is also warranted when the instruments employed are strong, because it enables a test for the validity of the exclusion restrictions. We have experimented with adding LNAUTO as an additional exclusion restriction in specifications (1) and (2) and found, however, that this lowers the first-stage F-statistic. The problem in this case is LNAUTO's lack of explanatory power noted above.

the first-stage F-statistics (and corresponding p-values) in specifications (3) and (4) are 9.89 and 9.77; and the first-stage partial R^2 statistics increase to 0.263 and 0.273. In addition, Hansen's J-test provides some validation for these over-identifying assumptions, failing to reject the null that LNTELE and LNRROAD are jointly uncorrelated with the second-stage residuals. Most importantly, in contrast with specifications (1) and (2), under specifications (3) and (4) there appears to be a strong negative and statistically significant relationship between domestic market integration and international trade: the elasticity measure estimated between these variables is approximately -0.4; and this estimate is significant at the 5% level. Note also that while the importance of LNAROAD continues to hold under this specification, this is not true of LNETHNO, which becomes insignificant at the 10% level.

Finally, in unreported regressions, we performed a similar 2SLS analysis under which the roles of LNODDS and LNTRADE were reversed, and found no evidence of a significant relationship running in the reverse direction. The results of Tables 2 and 3 suggest that LNETHNO is an attractive excludable instrument in this case, as it is the only variable that is strongly associated with LNODDS while being unassociated with LNTRADE. In this case, LNETHNO appears to be a strong instrument for identifying the impact of LNODDS on LNTRADE; nevertheless, this evidence indicates the absence of a statistically significant link running from LNODDS to LNTRADE.

V. Conclusion

We have sought a statistical account of the continuing evidence of market fragmentation observed within Russia. Our focus has been on the influence of regional initial conditions in contributing to this phenomenon, and on the issue of whether this phenomenon may be attributable in part to the treatment by regions of domestic and international trade as substitutable activities.

Unconditionally, there is virtually no correlation between our measure of regional economic integration and international trade activity. Conditioning on the set of initial conditions we measure, we do find evidence of a negative trade-off between these variables, but the evidence is sensitive to the particular set of exclusion restrictions employed in the context of a two-stage least squares analysis. In contrast, a clear culprit behind Russia's persistent pattern of regional economic fractionalization appears to be a deficient transport infrastructure. Specifically, regions with relatively dense automobile road networks exhibit relatively strong propensities towards internal economic integration, and relatively low international trade activity. The opposite internal/external trade pattern prevails among regions with relatively dense railroad networks. Thus, the pattern of internal and external trade relationships observed among Russian regions seems most plausibly attributable to circumstance rather than choice. Finally, it is also clear that regions which feature relatively high degrees of ethnic diversity, or equivalently, relatively low proportions of Russians among their populations, also feature relatively low propensities towards regional integration. Whether his finding reflects the presence of ethnic tensions or merely differences in tastes is impossible to discern, but the persistent explanatory power of this variable is striking.

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Table 1A: Descriptive Statistics

Variable	Average	Standard Deviation	Minimum	Maximum
LNODDS, 1995-1999	0.47	1.33	-3.30	4.01
ODDS	1.60	8.032	0.04	54.98
LNTRADE, 1997-1999	2.70	1.25	-0.48	5.62
TRADE	29.73	42.43	0.62	297.3
LNAUTO, 1990	4.02	0.27	3.23	4.64
AUTO	57.8	15.0	25.3	103.4
LNTELE, 1990	3.37	0.28	2.87	4.52
TELE	30.4	11.3	17.6	92
LNETHNO, 1989	-1.45	0.76	-2.97	-0.34
ETHNO	0.30	0.20	0.05	0.72
LNAROAD, 1990	4.02	1.20	0.74	5.73
AROAD	88.0	67.7	1.10	306.0
LNRROAD, 1990	4.53	1.49	0.00	6.37
RROAD	159.7	121.5	0.00	583.0

Table 1B: Correlation Patterns

	LN ODDS	LN TRADE	LN AUTO	LN TELE	LN ETHNO	LN AROAD	LN RROAD
LNODDS	1.000						
LNTRADE	-0.120	1.000					
LNAUTO	0.031	0.117	1.000				
LNTELE	0.114	0.072	0.069	1.000			
LNETHNO	-0.264	-0.064	0.340	0.042	1.000		
LNAROAD	0.530	-0.153	-0.060	0.155	-0.281	1.000	
LNRROAD	0.349	0.148	-0.080	0.045	0.386	0.826	1.000

Notes: Because several regions have no railroad infrastructure, we computed LNAROADS LNRROADS as the logged value of one plus AROAD and RROAD.

Table 2: Determinants of LNODDS

	(1) Unrestricted OLS	(2) Stepwise OLS	(3) Stepwise LAD
LNAUTO	0.634 (0.529)	X	0.629 (0.453)
LNTELE	0.051 (0.480)	X	X
LNETHNO	-0.408** (0.201)	-0.326* (0.188)	-0.318* (0.173)
LNAROAD	0.863** (0.199)	0.864** (0.194)	0.959** (0.179)
LNRROAD	-0.336** (0.165)	-0.329** (0.163)	-0.404** (0.153)
Adjusted R^2	0.300	0.305	
Pseudo R^2			0.230
F-statistic for excluded variables		0.73	0.05
P-value of F-statistic		0.485	0.819

Notes (apply to all subsequent tables): Standard errors accompanying point estimates are given in parentheses; * denotes significance at the 10% level; ** denotes significance at the 5% level. In all cases, a constant term has been estimated but is not reported. Excluded variables are derived using the step-wise general-to-specific algorithm with a 20% p value cutoff. X denotes an excluded variable.

Table 3: Determinants of LNTRADE

	(1) Unrestricted OLS	(2) Stepwise OLS	(3) Stepwise LAD
LNAUTO	0.612 (0.513)	X	X
LNTELE	0.738 (0.464)	0.774* (0.461)	X
LNETHNO	-0.044 (0.194)	X	X
LNAROAD	-0.959** (0.193)	-0.963** (0.192)	-0.809** (0.211)
LNRROAD	0.756** (0.160)	0.759** (0.153)	0.559** (0.169)
Adjusted R^2	0.252	0.258	
Pseudo R^2			0.132
F-statistic for excluded variables		0.73	1.26
P-value of F-statistic		0.486	0.290

Table 4: Does Trade Influence Domestic Economic Integration?

2SLS Analysis Dependent Variable is LNODDS				
	(1) Exactly identified	(2) Exactly identified and outliers removed	(3) Over-identified	(4) Over-identified and outliers removed
LNTRADE, INSTRUMENTED	0.110 (0.719)	-0.249 (0.443)	-0.385** (0.189)	-0.409** (0.178)
LNTELE	Excluded	Excluded	Excluded	Excluded
LNETHNO	-0.332* (0.182)	-0.349* (0.186)	-0.292 (0.209)	-0.293 (0.184)
LNAROAD	0.962 (0.665)	0.645* (0.379)	0.473** (0.124)	0.538** (0.102)
LNRROAD	-0.409 (0.542)	-0.117 (0.330)	Excluded	Excluded
Centered R^2	0.336	0.376	0.297	0.327
Hansen J-test: F-statistic	Not relevant	Not relevant	0.578	0.017
P-value			0.447	0.896
Number of outlier regions		4		3
Statistics for Excluded Instruments in First Stage OLS Regression				
F-statistic for excluded instrument(s)	1.62	1.20	9.89	9.77
P-value of F-statistic	0.208	0.277	0.000	0.000
Partial R^2	0.039	0.034	0.263	0.273

Note: Standard errors are heteroskedasticity consistent.

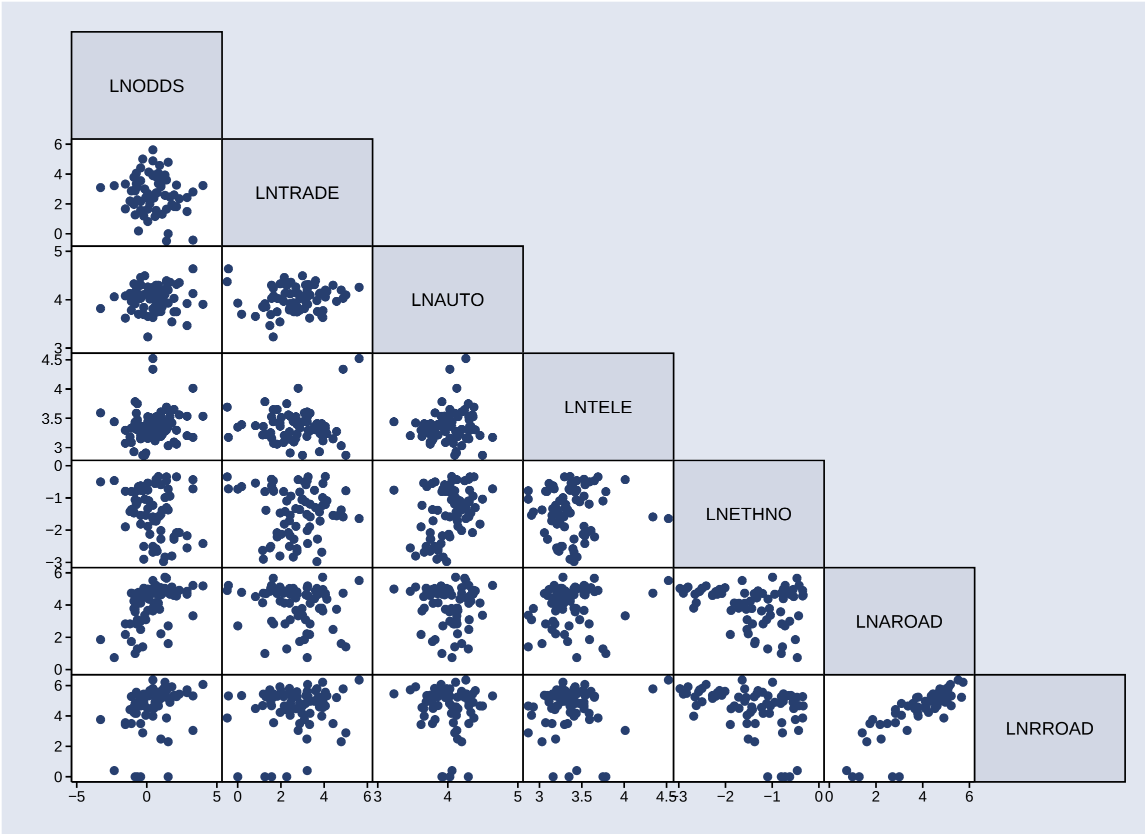

Figure 1: Scatter Plots for all Variables

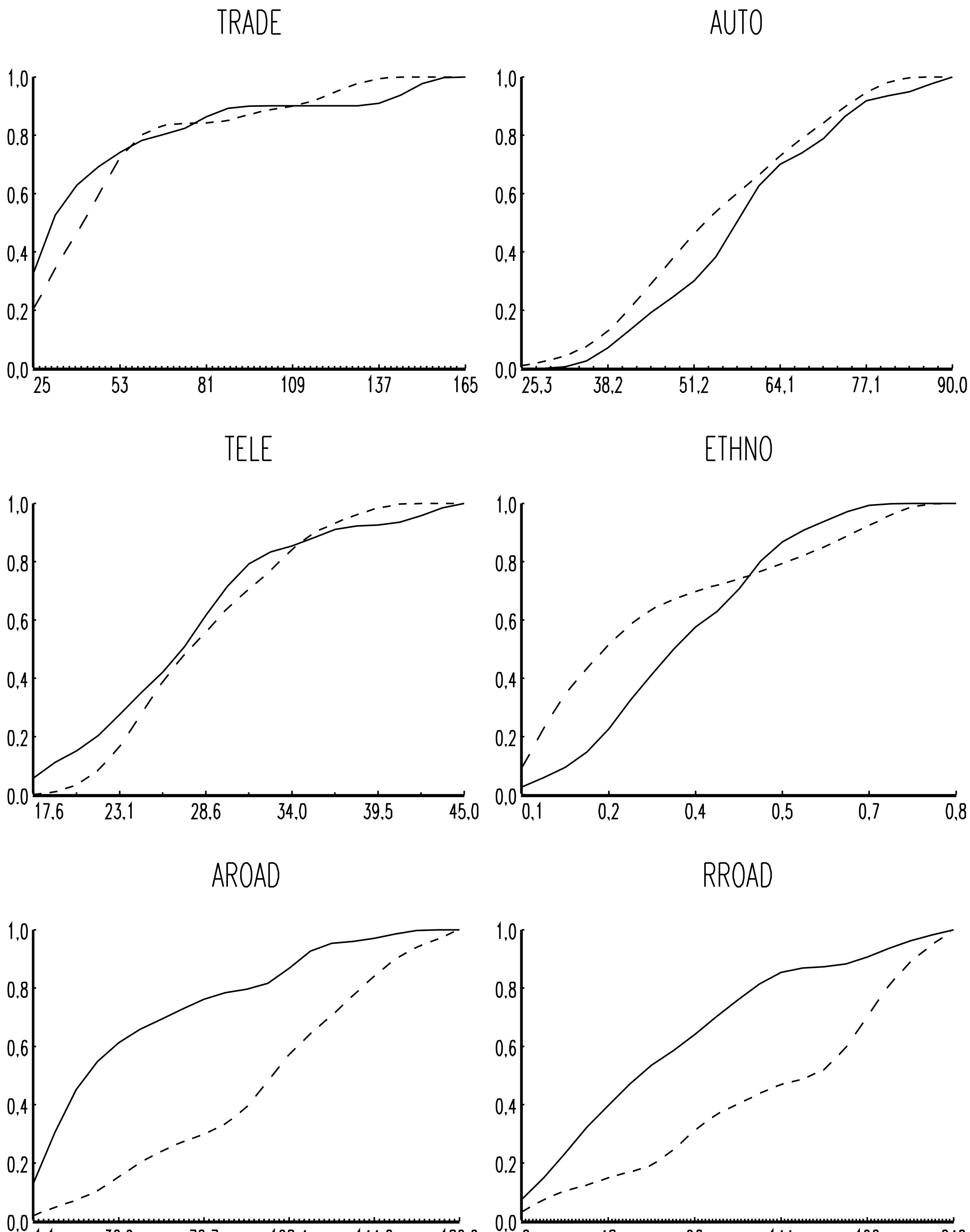

Figure 2: CDFs for Integrated Versus Non-Integrated Regions

Legend: Dashes correspond to Integrated Regions, solid lines to Non-Integrated Regions

Appendix: List of Regions

Arkhangelsk Oblast	Dagestan Republic
Vologda Oblast	Kabardin-Balkar Republic
Komi Republic	Karachaevo-Cherkes Republic
Murmansk Oblast	Krasnodar Kray
Karelian Republic	Rostov Oblast
Novgorod Oblast	Adygey Republic
Pskov Oblast	North Ossetin Republic
St.Petersburg	Stavropol Kray
Kaliningrad Oblast	Kurgan Oblast
Bryansk Oblast	Orenburg Oblast
Vladimir Oblast	Perm Oblast
Ivanovo Oblast	Sverdlovsk Oblast
Kaluga Oblast	Udmurt Republic
Kostroma Oblast	Chelyabinsk Oblast
Moscow	Bashkortostan Republic
Oryol Oblast	Altay Kray
Ryazan Oblast	Gorniy Altay Republic
Smolensk Oblast	Kemerovo Oblast
Tver Oblast	Novosibirsk Oblast
Tula Oblast	Omsk Oblast
Yaroslavl Oblast	Tomsk Oblast
Kirov Oblast	Tyumen Oblast
Mariy El Republic	Buryat Republic
Mordovian Republic	Irkutsk Oblast
Nizhniy Novgorod Oblast	Krasnoyarsk Kray
Chuvash Republic	Tyva Republic
Belgorod Oblast	Khakass Republic
Voronezh Oblast	Chita Oblast
Kursk Oblast	Amur Oblast
Lipetsk Oblast	Kamchatka Oblast
Tambov Oblast	Magadan Oblast
Volgograd Oblast	Primorskiy Kray
Kalmykiya Republic	Sakha Republic
Penza Oblast	Sakhalin Oblast
Samara Oblast	Khabarovsk Kray
Saratov Oblast	
Tatarstan Republic	
Ulyanovsk Oblast	