International Price Dispersion in State-Dependent Pricing Models

Data Appendix

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This document describes the micro-data used in Section 4 of the paper in more detail and also performs several robustness exercises. The data were collected in 12 cities [1] in six Eastern European countries by the Central Agricultural Market Information Bureau, an NGO created by an European Union project aimed at providing informational support to food exporters in Moldova, one of the countries in the sample. Our sample covers the years of 2000 to 2002.[2] Prices are collected on average once every two weeks (usually during weekends) in all years except for 2000, when prices are sampled weekly: a total of 83 time periods are available.

Goods in four good-categories are available: meat, fruit, vegetables, as well as a small number of other agricultural products (oil, honey, etc.). The primary purpose of the collecting agency is to provide local entrepreneurs with information about arbitrage opportunities in domestic and foreign markets: efforts are therefore made to ensure comparability of products across locations. The agency hires representatives in all 12 cities who sample prices several times during the day, from a number of vendors of a given product. An average price, across all vendors surveyed, is then reported. Goods are all homogeneous (beef ribs, beef fillet, apples, watermelon, shelled nuts, honey, tomatoes, etc.). In the case of fruits and vegetables, where quality differentials can easily lead to price differences, the agency distinguishes and reports separately the prices of both high- and low-quality products. Finally, most vendors set several prices for identical goods sold in a given day due to differences in the size, quality, etc. of the product. The agency treats the most and least expensive varieties of a good as separate items and records their prices separately. We follow this convention as well and treat high- and low-quality varieties of a given product as separate goods in our sample.

[1] see Table A1 for the list of cities and countries.

[2] An earlier version of this paper used two more years of data: 1998 and 1999, years characterized by the excessive nominal exchange rate volatility induced by the Russian financial crisis. We drop these years in this version of the paper because in times of crises real exchange rate movements are, to some extent, driven by factors our model abstains from. The relationship between relative price and nominal exchange rate volatility in this sample is not robust to different measures of relative price variability employed or across sub-periods, partly because goods prices have failed to respond immediately to the large nominal devaluations.

Not all prices are sampled in all periods: some goods, especially fruits and vegetables, are not sold in open-air markets during all months of the year, and, especially during the cold season, drop out of the sample. We therefore work only with those goods for which a panel of at least 6 cities is available in at least 75% of the time periods in our sample. A total of 58 goods make this cutoff. Table A1 presents the proportion of available observations by city and by good.

We calculate and report, in Table A2, several statistics that capture the extent to which the law of one price is violated in the data. We first focus on absolute LOP deviations. We calculate, in the spirit of Crucini, Telmer and Zachariadis (2005), for each city and good in the sample, the log-deviation of a city's price from the cross-sectional average: $d^c_{tg} = \log\left(\frac{p^c_{tg}}{\bar{p}_{tg}}\right)$, where p^c_{tg} is the price of good g in city c at time t, and $\bar{p}_{tg}$ the cross-sectional average of the price of this particular good in period t. The law of one price predicts that d^c_{tg} should be centered at 0 in the absence of frictions that prevent goods-market arbitrage. As Table 4 indicates, this proposition is grossly violated in our sample. We report, in the table, the median and interquartile range of the distribution of d^c_{tg} (across goods and time periods) for each city in the sample. St. Petersburg (Russia) is the most expensive city: prices here exceed the average price in the 12 cities by around 30% on average across goods and time-periods. St. Petersburg is followed closely by Moscow (Russia) and Bucharest (Romania), whose prices are 26% and 23% higher, on average, than those of other cities in the sample. Cities in Ukraine and Moldova are least expensive. Note also that these median statistics are large (in absolute value) relative to the interquartile range of the distribution of d, suggesting that some cities are consistently over- (under-) priced for all goods in our sample, in most time periods. Although large, absolute law of one price deviations are consistent with economic theory. In particular, prices are more expensive in (relatively) rich countries (Russia and Belarus)According to the Penn World Tables, 6.1, output per capita in the countries in our sample is 0.28 (Russia), 0.24 (Belarus) 0.14 (Ukraine), 0.14 (Romania), 0.06 (Moldova) relative to that of the United States. and cheaper in countries that are net exporters of agricultural products (Moldova and Ukraine).[3]

In the paper we show that relative price variability in our sample decreases with nominal exchange rate volatility. Here we ask whether these results are robust to the inclusion of a quadratic

[3]According to statistics published by the World Trade Organization, Moldova and Ukraine are net exporters of foodstuffs, with a ratio of exports to imports equal to 2.8 and 2.9, respectively. Belarus, Romania and Russia are net importers of food products (with a ratio of exports to imports equal to 0.48, 0.49 and 0.35, respectively).

NER volatility term in the regression. Tables A3 and A4 show that the relationship between NER volatility decreases relative price variability, but does so at a decreasing rate, consistent with the model's predicts that for sufficiently volatile nominal exchange rates firms adjust each period and allow no relative price fluctuations. The sole exception to this result is the behavior of the interquartile range of the level of relative prices.

References

[1] Crucini, Mario, Chris Telmer and Marios Zachariadis, 2005, "Understanding European Real Exchange Rates," American Economic Review, forthcoming

Table A1: Data Availability
(proportion available)

By City:

	city	country	
1	Chisinau	Moldova	0.97
2	Balti	Moldova	0.93
3	Cahul	Moldova	0.93
4	Causeni	Moldova	0.89
6	Tiraspol	Transdniester	0.82
7	Bucharest	Romania	0.91
8	St. Petersburg	Russia	0.80
9	Moscow	Russia	0.75
10	Kiev	Ukraine	0.81
11	Odessa	Ukraine	0.85
12	Cernovtsi	Ukraine	0.89
13	Minsk	Belarus	0.31

By good:

		grade 1	grade 2			grade 1	grade 2
	meat				**vegetables**		
1	chicken legs	0.77	0.77				
2	pork legs	0.87	0.88	16	tomatoes	0.85	0.85
3	pork w/ bones	0.87	0.87	17	sugar beet	0.87	0.87
4	beef ribs	0.85	0.85	18	potatoes	0.87	0.87
5	beef w/ bones	0.86	0.86	19	dry beans	0.76	0.76
6	beef legs	0.86	0.87	20	carrots	0.86	0.87
7	beef fillet	0.87	0.87	21	sweet pepper	0.71	0.71
8	mutton	0.70	0.69	22	garlic	0.86	0.86
9	chicken	0.76	0.76	23	onions	0.86	0.87
10	pork fillet	0.86	0.87	24	cabbage	0.87	0.87
11	pork ribs	0.85	0.86	25	cucumber	0.81	0.81
	fruit				**other**		
12	grapes	0.69	0.69	26	honey	0.87	0.87
13	apples	0.86	0.86	27	sugar	0.86	0.87
14	walnut	0.77	0.78	28	oil	0.87	0.87
15	walnut w/o shells	0.58	0.58	29	eggs	0.86	0.87

Table A2: Summary Statistics from Micro-Price data

Absolute PPP deviations

By city

		log-deviation from cross-sectional mean (pooled over goods/time-periods)	
		median	iqr
St. Petersburg	(Russia)	0.30	0.57
Moscow	(Russia)	0.26	0.40
Bucharest	(Romania)	0.23	0.37
Minsk	(Belarus)	0.13	0.45
Odessa	(Ukraine)	-0.01	0.34
Kiev	(Ukraine)	-0.02	0.30
Tiraspol	(Transdniester)	-0.18	0.37
Cernovtsi	(Ukraine)	-0.20	0.52
Chisinau	(Moldova)	-0.20	0.38
Balti	(Moldova)	-0.22	0.38
Cahul	(Moldova)	-0.29	0.34
Causeni	(Moldova)	-0.35	0.40

Relative PPP deviations

Time-Series standard deviation of bilateral relative prices
Average across goods/city-pairs

		Δq	q
By good category			
	meat	0.21	0.33
	vegetables	0.32	0.59
	fruit	0.31	0.59
	other	0.16	0.27
International pairs		0.26	0.46
Intranational pairs		0.24	0.37

NER volatility (std. dev. of log-changes) 0.042
(average across city-pairs separated by national borders)

Table A3: Time-series volatility of relative prices
Non-linear Terms

	1	2
	iqr(Δq)	**iqr(q)**
std(ΔNER)	-9.76	1.23
	(2.74)	(0.83)
std(ΔNER), squared	205.51	-13.26
	(76.62)	(6.53)
Effect of std(ΔNER) on RPV when std(ΔNER) is at its		
5th percentile	-9.76	1.23
	(2.74)	(0.83)
median	-6.26	0.93
	(1.64)	(0.69)
95th percentile	-0.31	-1.59
	(1.52)	(0.61)

Notes:
1. Random-effects model
2. Standard errors reported
3. Coefficient estimate and standard errors on log-distance and border multiplied by 1000
4. Regressions include meat/fruit/vegetable as well as city dummies

Table A4: Cross-goods volatility of relative prices
Non-linear Terms

	1	2
	iqr(ΔQ)	**iqr(Q)**
std(ΔNER)	-1.93	-4.34
	(1.07)	(1.11)
std(ΔNER), squared	43.41	150.67
	(57.03)	(57.56)
Effect of std(ΔNER) on RPV when std(ΔNER) is at its		
5th percentile	-1.93	-4.34
	(1.07)	(1.11)
median	-1.78	-3.80
	(0.89)	(0.94)
95th percentile	-0.96	-0.83
	(0.51)	(0.55)

Notes:
1. Random effects model
2. Standard errors reported
3.The last 3 rows report the derivative of RPV wrt. NER volatility for 3 different values of NER volatility
4. Regressions include city dummies