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Am Empirical Examination of Deviations from the Laws of One Price Using West German Data

Beverly J. Lapham

Department of Economics
Queen's University
94 University Avenue
Kingston, Ontario, Canada
K7L 3N6

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Abstract

Monthly West German producer, export, and import price indices are examined to investigate relationships among international prices. The data provides evidence of highly persistent time-varying deviations in the Law of One Price both across countries by a single producer and within a country by different international producers. The size and persistence of the deviations exhibits considerable variation across the industries studied. The time-varying deviations documented in this work appear to be much larger than what can be explained by variable tariffs and transport costs. Given the persistence of deviations, it is argued that theoretical models which seek to explain properties of international price data must be inherently dynamic.

I. INTRODUCTION

A number of studies have documented large and persistent departures from Purchasing Power Parity using various international price indices.[1] A portion of the deviations from Purchasing Power Parity in the data may be explained by discrepancies in the basket of goods measured by relative price indices due to, among other things, indexing differences and non-traded goods. This has led to examinations of the related theory of the Law of One Price applied to individual commodities sold in international markets.

There are at least two versions of the Law of One Price under the assumptions of perfect competition, no trade barriers, and no transport costs. One version predicts equal prices of a good manufactured by a single producer and sold in different countries when prices are converted to a common currency. For example, the Deutsche Mark prices of German produced automobiles sold in Germany and sold in the U.S. should be equal. Another version predicts equal prices of competing goods sold in the same country and manufactured by producers located in different countries. For example, the prices of U.S. produced automobiles and German produced automobiles sold in Germany should be similar.

Using disaggregated West German price data, this paper presents evidence of time-varying deviations from both versions of the Laws of One Price. More importantly, this work documents a high degree of persistence in these deviations. The degree and persistence of deviations is shown to vary considerably across industries. Kravis and Lipsey (1974,1977,1978), Giovannini(1989), Marston(1990), and others have also provided evidence of deviations using price indices from various

countries but have not focused on the serial correlation properties of these deviations. Given the persistence of deviations, it is argued that theoretical models which seek to explain the properties of international price data must be inherently dynamic.

The remainder of the paper is organized as follows. Section two discusses the data and the methodology employed to examine the dynamic properties of deviations from the Laws of One Price. Section three presents results and section four concludes.

II. THE DATA AND METHODOLOGY

The data consists of West German monthly producer price indices, export price indices, and import price indices for the years 1970-1981 in base year 1976.[2] Producer prices and import prices are reported at the primary wholesale level in Deutsche marks. Export prices are FOB and are also reported in Deutsche marks.

Movements of these price indices over the sample time period are compared. This necessitates a matching of the different price indices for each industry and, therefore, limits the analysis to two, three, and four digit industry classifications. Consistent series for producer and export prices were available for 33 two digit industries, 18 three digit, and 1 four digit industry. Consistent series for producer and import prices were available for 32 two digit industries, 29 three digit, and 24 four digit industries. The industries examined in this study are listed in the appendix.

Producer price indices reflect the pricing behavior of German producers selling in the German market. Export price indices reflect the

pricing behavior of German producers selling in other markets. Import price indices reflect the pricing behavior of producers located outside of Germany selling in the German market. Therefore, properties of the relationships between producer price indices and export price indices for each industry are investigated to examine deviations from the Law of One Price across countries. Properties of the relationships between producer price indices and import price indices for each industry are investigated to examine deviations from the Law of One Price across producers.

Let p_{jt} denote the price charged by German producers in the German market in industry j at time t. Then the producer price index for industry j at time t for base year o is

$$P_{jt} \equiv (p_{jt}/p_{jo})*100.$$

Let e_{jt} denote the price charged by German exporters in industry j at time t. Then the export price index for industry j at time t for base year o is

$$E_{jt} \equiv (e_{jt}/e_{jo})*100.$$

Let i_{jt} denote the price charged by importers in Germany in industry j at time t. Then the import price index for industry j at time t for base year o is

$$I_{jt} \equiv (i_{jt}/i_{jo})*100.$$

Finally, the relevant relative prices are given by

$$R_{jt} \equiv P_{jt}/E_{jt} \equiv (e_{jo}/p_{jo})(p_{jt}/e_{jt})$$

and

$$S_{jt} \equiv P_{jt}/I_{jt} \equiv (i_{jo}/p_{jo})(p_{jt}/i_{jt}).$$

Properties of P_{jt}, E_{jt}, and R_{jt} are examined to explore deviations across countries, whereas properties of P_{jt}, I_{jt}, and S_{jt} are examined to explore deviations across producers.

Deviations from the Laws of One Price consist of two components: a component which is constant over time and a time-varying component. Because price indices are analyzed in this study, only properties of the time-varying component can be documented. The results of this analysis suggest that this component of deviations from the Laws of One Price is not small, is highly serially correlated, and varies across industries.

Magnitude of Deviations from the Laws of One Price

Across Countries

Two criteria are employed to examine evidence of the magnitude of time-varying deviations from the Law of One Price across countries. If time-varying deviations from the Law of One Price across countries did not exist, the movements of the two price indices, P_{jt} and E_{jt} would be highly positively correlated. Denote the percentage change in each price series from one month to the next as $(P_{jt}\%)$ and $(E_{jt}\%)$. Then, if both series are variable and the correlation between $(P_{jt}\%)$ and $(E_{jt}\%)$ is low, this is evidence of deviations from the Law of One Price across countries.

Properties of the time series of relative producer and export price indices, R_{jt}, are also investigated. The range of variation in these relative price indices is examined by measuring the size of deviations in R_{jt} from its sample mean. Letting $\bar{R}_j$ denote the sample mean of R_{jt},

define

$$W_{jt} \equiv (R_{jt} - \bar{R}_j)/\bar{R}_j.$$

If there were no time-varying deviations from the Law of One Price across countries, W_{jt} would be small for all t, indicating a stable relationship between producer and export prices. Therefore, large absolute values for W_{jt} are evidence of deviations from the Law of One Price across countries. The range of W_{jt} is reported below as a measure of the variability of these relative prices.

Across Producers

By similar reasoning, deviations from the Law of One Price across producers is explored by examining the contemporaneous correlations of movements in producer and import price indices. Also the range of deviations in S_{jt} from its sample mean (V_{jt}) are reported.

Persistence of Deviations from the Laws of One Price

If the above criteria provide evidence of time-varying deviations from the Laws of One Price, the dynamic properties of those deviations require further investigation to determine if deviations are persistent. If time-varying deviations exist but are not persistent, then relative prices will exhibit low levels of serial correlation. Therefore, if serial correlation coefficients for relative prices are large and positive, this is evidence of persistence in deviations from the Laws of One Price.

III. RESULTS

III.1: Deviations Across Countries

Magnitude

The data is first examined for evidence of the magnitude of deviations in the Law of One Price across countries by examining the relationship between producer price movements and export price movements. Both of these price series are variable as indicated by their percent standard deviations reported in the appendix.

Figures 1.A and 1.B present the distribution across industries of the contemporaneous correlation coefficients for movements in the two prices series for different levels of disaggregation. Detailed correlations for each industry are presented in the appendix.

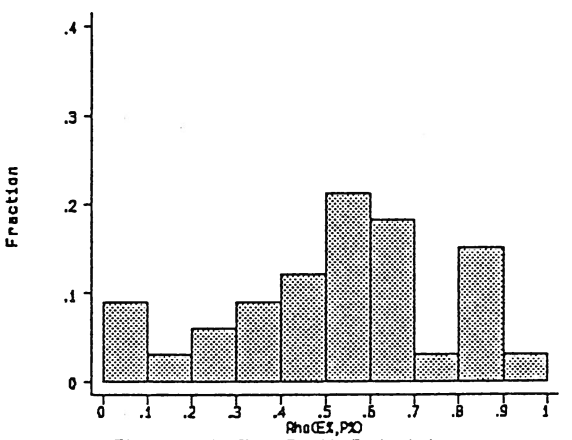

Figure 1.A: Two Digit Industries

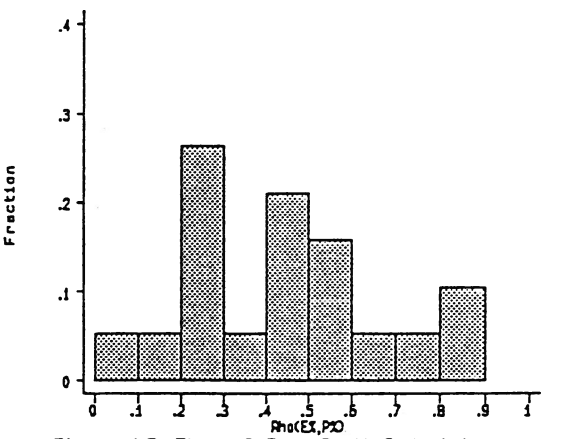

Figure 1.B: Three & Four Digit Industries

As discussed above, low contemporaneous correlation of movements in producer and export price indices provides evidence of deviations from the Law of One Price across countries. At both levels of disaggregation, over 50% of the industries exhibit coefficients less than .6 and approximately 80% have coefficients less than .8. Therefore, for a significant number of industries studied, producer and export price movements are not highly correlated. These results suggest that for many of these industries, the time-varying component of deviations from the Law of One Price across countries may be significant.

Figures 2.A and 2.B present the distribution across industries of the range of variation of relative prices from their sample mean. Detailed ranges of variation for each industry are presented in the appendix.

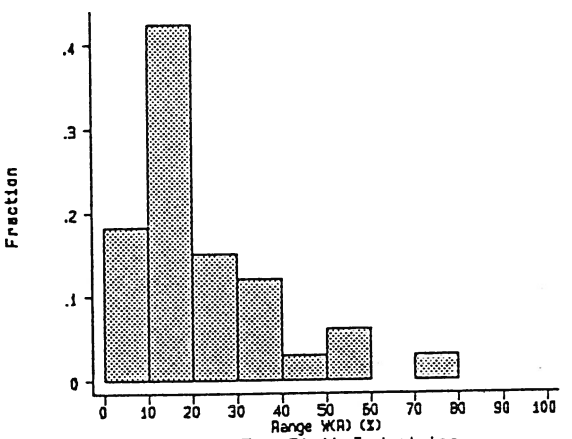

Figure 2.A: Two Digit Industries

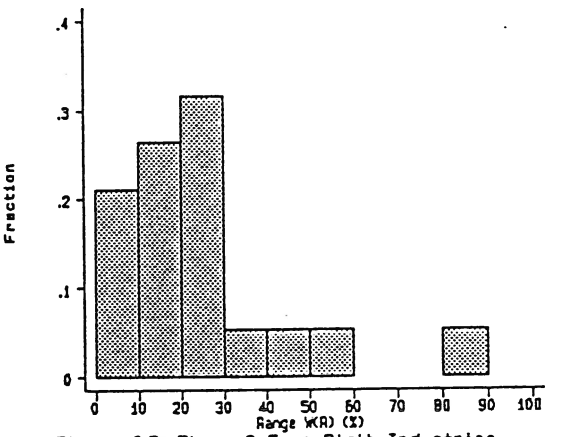

Figure 2.B: Three & Four Digit Industries

As discussed above, large deviations in the relative price between producer and export prices from their sample mean is evidence of time-varying deviations from the Law of One Price across countries. At both levels of disaggregation, approximately 80% of industries exhibit a range of deviation from sample mean greater than 10% and 40% of the industries have ranges greater than 20%. Therefore, for a significant number of industries studied, relative prices of producer and export goods vary over the sample time period. This is taken to be further evidence of time-varying deviations from the Law of One Price across countries.

Persistence

The serial correlation properties of relative prices is examined to determine persistence of the relationship between producer and export prices. If time-varying deviations exist, high serial correlations imply persistence of those deviations.

Figures 3.A - 3.D illustrate the distribution across industries of the serial correlation coefficients for these relative prices at one- and three-month lags. Detailed correlation coefficients are presented in the appendix.

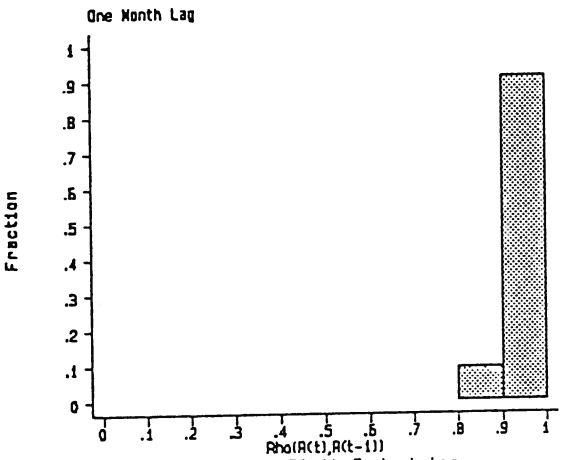

Figure 3.A: Two Digit Industries

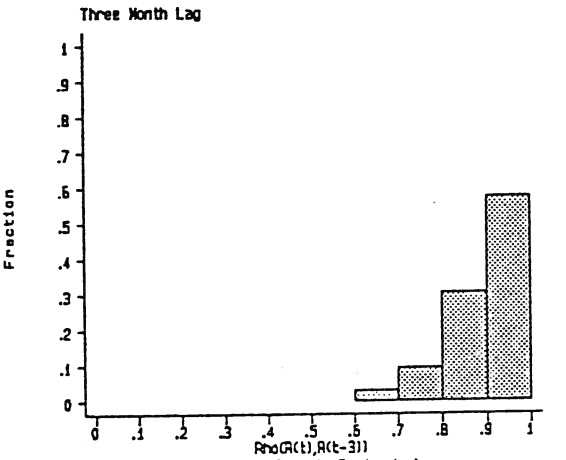

Figure 3.B: Two Digit Industries

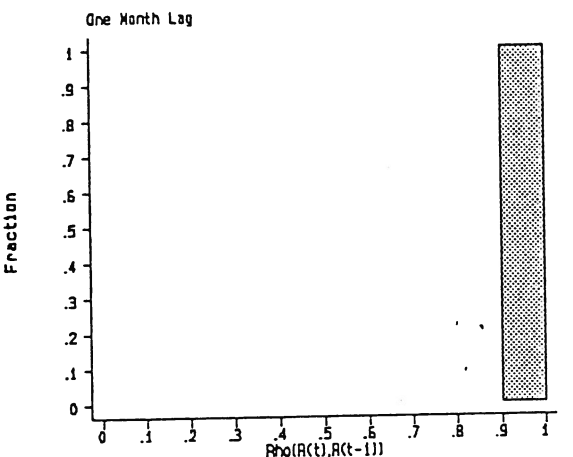

Figure 3.C: Three & Four Digit Industries

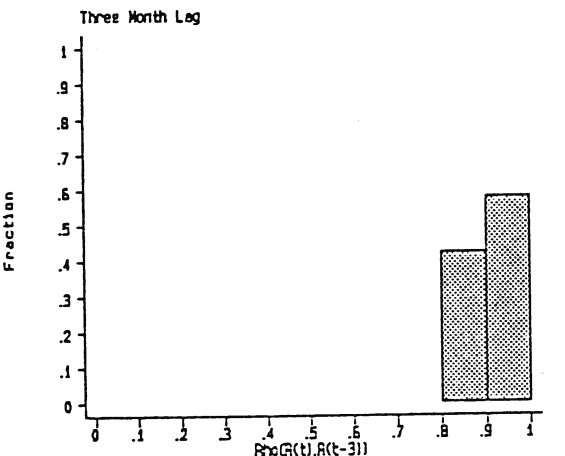

Figure 3.D: Three & Four Digit Industries

These figures indicate that the relative price series are highly positively correlated. If time-varying deviations across countries exist in an industry, this is evidence that those deviations are persistent.

III.2: Deviations Across Producers

Magnitude

The data is first examined for evidence of the magnitude of

deviations in the Law of One Price across different international producers selling in the same market by examining the relationship between producer price movements and import price movements.

Figures 4.A and 4.B present the distribution across industries of the contemporaneous correlation coefficients for movements in the two prices series for different levels of disaggregation. Detailed correlations for each industry are presented in the appendix.

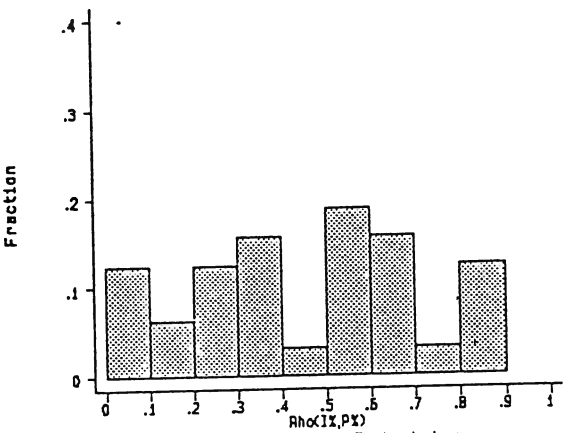

Figure 4.A: Two Digit Industries

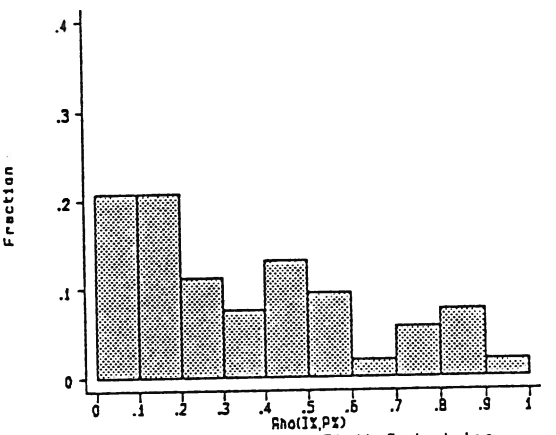

Figure 4.B: Three & Four Digit Industries

As discussed above, low contemporaneous correlation of movements in producer and import price indices provides evidence of deviations from the Law of One Price across producers. At both levels of disaggregation, approximately 70% of the industries exhibit coefficients less than .6 and approximately 90% have coefficients less than .8. Therefore, for a significant number of industries studied, producer and import price movements are not highly correlated. These results suggest that for many of these industries, the time-varying component of deviations from the

Law of One Price across producers may be significant.

Figures 5.A and 5.B present the distribution across industries of the range of variation of relative prices from their sample mean. Detailed ranges of variation for each industry are presented in the appendix.

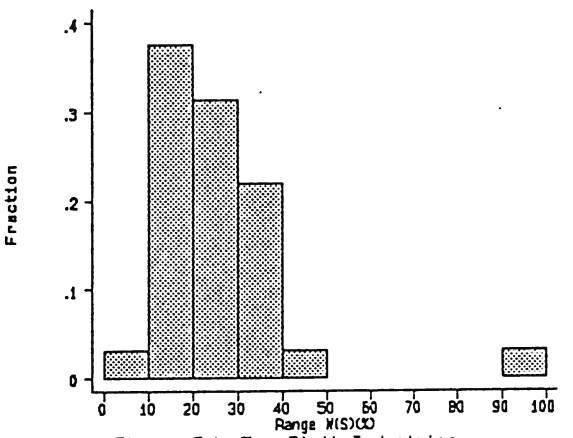

Figure 5.A: Two Digit Industries

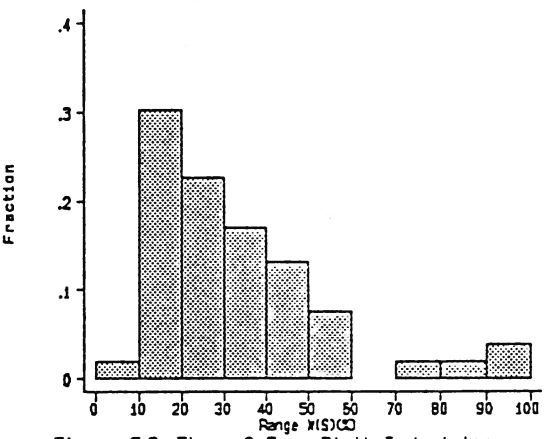

Figure 5.B: Three & Four Digit Industries

As discussed above, large deviations in the relative price between producer and import prices from their sample mean is evidence of time-varying deviations from the Law of One Price across producers. At both levels of disaggregation, nearly all of the industries exhibit a range of deviation from sample mean greater than 10% and approximately 60% of the industries have ranges greater than 20%. Therefore, for a significant number of industries studied, relative prices of producer and import goods vary over the sample time period. This is taken to be further evidence of time-varying deviations from the Law of One Price across producers.

Persistence

The serial correlation properties of relative prices is examined to determine persistence of the relationship between producer and import prices. If time-varying deviations exist, high serial correlations imply persistence of those deviations.

Figures 6.A - 6.D illustrate the distribution across industries of the serial correlation coefficients for these relative prices at one and four month lags. Detailed correlation coefficients are presented in the appendix.

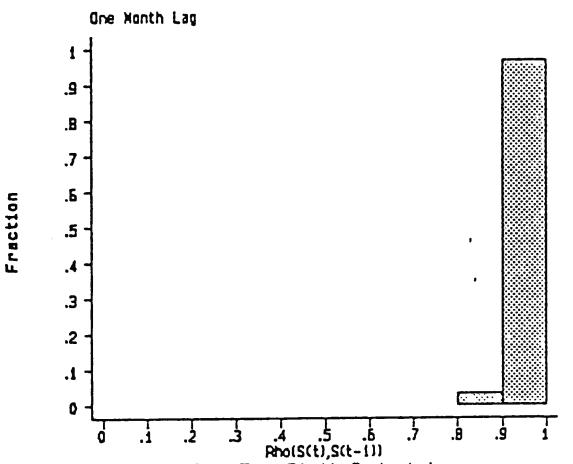

Figure 6.A: Two Digit Industries

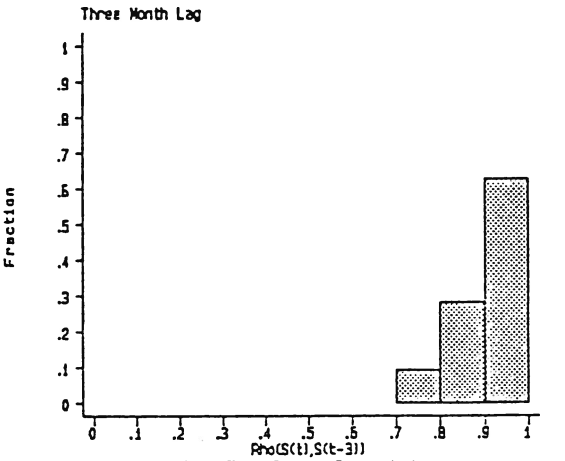

Figure 6.B: Two Digit Industries

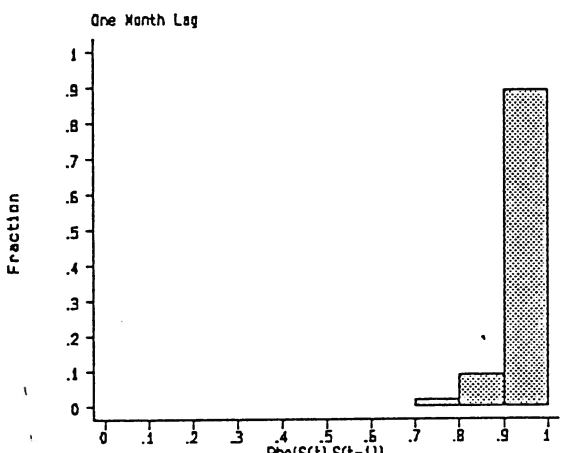

Figure 6.C: Three & Four Digit Industries

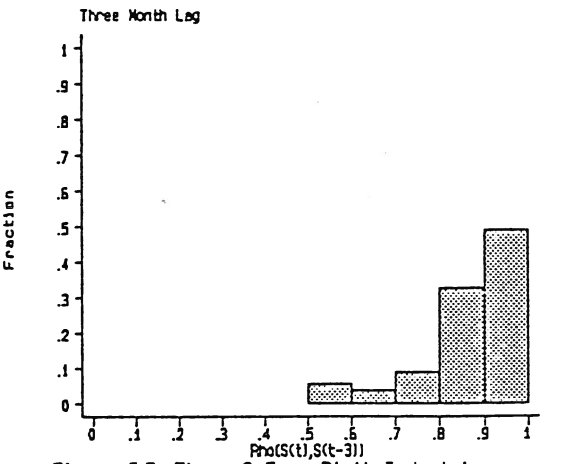

Figure 6.D: Three & Four Digit Industries

These figures indicate that the relative price series are highly positively correlated. If time-varying deviations across producers exist in an industry, this is evidence that those deviations are persistent.

IV. CONCLUSIONS

Monthly West German price indices were examined to explore the nature of relationships among producer, export, and import prices. The data provides evidence of highly persistent time-varying deviations in the Law of One Price both across countries by a single producer and within a country by different international producers. The size and persistence of the deviations exhibits considerable variation across industries. The magnitude of deviations suggested by this study understate actual deviations as the constant component of deviations cannot be documented using indices.

It should also be noted that tariffs and transport costs which were stable over the time period studied will affect the constant portion of deviations but not the time-varying component. The time-varying deviations documented in this work appear to be much larger than what can be explained by variable tariffs and transport costs.

Since the evidence presented here suggests highly persistent deviations, any theoretical model which seeks to explain deviations in the absence of transport costs and trade barriers, must be inherently dynamic to address this issue of persistence. Dynamic, stochastic, theoretical economies are explored in Lapham (1990a, 1990b) in which deviations result from the strategic pricing behavior of international oligopolists. Those models address the issue of persistence of deviations suggested by this paper.

NOTES

1. See, for example, Frenkel (1981), Huizinga (1987), Mussa (1986), and Roll (1979). Officer(1976) and Shapiro(1983) provide surveys of the theoretical and empirical literature examining Purchasing Power Parity.

2. The data used in this study was acquired from the Statisches Bundesamt, Wiesbaden, West Germany.

APPENDIX

This appendix presents detailed summary statistics for the data examined in this paper. Section one provides statistics for deviations across countries, Section two for deviations across producers, and Section three lists the industries studied.

I. DEVIATIONS FROM THE LAW OF ONE PRICE ACROSS COUNTRIES

In this section, statistical properties of the relationship between producer price indices and export price indices are reported.

The following notation is adopted.

$\bar{P}$ = Sample Mean of Producer Price Series

σ_P = Sample Standard Deviation of Producer Price Series

$\bar{E}$ =Sample Mean of Export Price Series

σ_E=Sample Standard Deviation of Export Price Series

$\rho(P\%, E\%)$ = Contemporaneous Correlation Coefficient of Percentage Changes in Producer Prices with Percentage Changes in Export Prices

$R_t = (P_t/E_t)$ = Ratio of Producer Prices to Export Prices at time t.

$\rho(R_t, R_{t+k})$ = Correlation Coefficient of Relative Prices

W_t = Percentage Deviation in R_t from its Sample Mean at time t.

Table A.1: Two Digit Industries Summary Statistics

Industry	$\sigma_P/\bar{P}$	$\sigma_E/\bar{E}$	$\rho(P\%, E\%)$	Range of W_t
22	.426	.566	.385	.765
27	.119	.172	.483	.306
28	.151	.209	.822	.379
29	.199	.127	.349	.261
30	.170	.134	.601	.167
31	.203	.189	.414	.137
32	.208	.204	.905	.032
33	.181	.201	.567	.100
36	.106	.120	.640	.065
37	.156	.161	.656	.052
38	.194	.218	.560	.102
39	.283	.259	.526	.164
40	.180	.186	.822	.128
41	.207	.231	.528	.265
42	.301	.226	.818	.349
43	.144	.244	.093	.555
44	.182	.282	.622	.389
45	.075	.101	.473	.188
46	.197	.209	.249	.134
50	.063	.026	.082	.213
52	.162	.150	.316	.109
53	.188	.280	.212	.428
54	.194	.188	.513	.068
55	.186	.196	.874	.104
56	.200	.164	.428	.216
57	.207	.209	.173	.138
58	.161	.146	.805	.086
61	.197	.231	.661	.215
62	.218	.205	.732	.125
63	.134	.106	.505	.113
64	.151	.162	.591	.065
68	.136	.165	.603	.152
69	.189	.089	-.010	.557

Table A.2: Two Digit Industries Serial Correlations of Relative Prices

Industry	$\rho(R_t, R_{t-k})$ at lag k = 1	2	3	4	5
22	.986	.968	.952	.936	.920
27	.976	.943	.903	.854	.806
28	.971	.939	.922	.904	.877
29	.996	.989	.983	.978	.973
30	.989	.980	.973	.968	.959
31	.956	.938	.921	.917	.882
32	.905	.828	.780	.755	.728
33	.969	.937	.905	.880	.851
36	.985	.970	.961	.951	.939
37	.923	.888	.832	.772	.713
38	.979	.962	.943	.922	.902
39	.895	.841	.808	.820	.776
40	.954	.895	.817	.735	.641
41	.980	.948	.899	.837	.766
42	.986	.975	.959	.946	.926
43	.972	.948	.926	.896	.869
44	.985	.968	.953	.936	.919
45	.921	.829	.754	.691	.628
46	.866	.812	.726	.666	.594
50	.977	.954	.928	.909	.893
52	.955	.913	.852	.786	.712
53	.994	.988	.981	.972	.962
54	.910	.840	.803	.768	.737
55	.968	.926	.874	.817	.761
56	.961	.940	.917	.886	.856
57	.847	.775	.665	.586	.494
58	.974	.960	.948	.931	.915
61	.951	.920	.886	.851	.809
62	.980	.956	.931	.907	.879
63	.988	.972	.952	.929	.902
64	.964	.932	.896	.871	.847
68	.971	.923	.880	.850	.836
69	.985	.968	.956	.942	.929

Table A.3: Three and Four Digit Industries Summary Statistics

Industry	$\sigma_P/\bar{P}$	$\sigma_E/\bar{E}$	$\rho(P\%, E\%)$	Range of W_t
211	.353	.306	.411	.230
2114	.408	.290	.205	.435
215	.227	.272	.229	.548
253	.203	.258	.394	.324
254	.226	.215	.471	.094
291	.222	.141	.457	.290
301	.162	.129	.500	.203
302	.181	.146	.526	.139
382	.191	.207	.803	.073
383	.154	.136	.258	.092
384	.188	.267	.139	.240
385	.196	.232	.747	.144
387	.215	.198	.609	.095
388	.220	.184	.551	.212
431	.212	.347	.032	.872
521	.178	.202	.258	.188
591	.169	.121	.278	.252
621	.213	.203	.812	.127
625	.222	.205	.495	.159

Table A.4: Three and Four Digit Industries Serial Correlations of Relative Prices

Industry	$\rho(R_t, R_{t-k})$ at lag k = 1	2	3	4	5
211	.951	.933	.917	.898	.889
2114	.963	.937	.913	.896	.891
215	.960	.917	.862	.806	.753
253	.992	.981	.967	.952	.936
254	.937	.883	.837	.793	.741
291	.997	.993	.990	.987	.985
301	.976	.950	.926	.904	.882
302	.983	.970	.960	.949	.942
382	.974	.946	.917	.896	.874
383	.952	.916	.890	.862	.832
384	.984	.969	.955	.940	.926
385	.990	.982	.977	.974	.970
387	.950	.909	.887	.864	.845
388	.991	.986	.976	.967	.960
431	.962	.924	.883	.839	.794
521	.959	.913	.854	.794	.741
591	.966	.928	.891	.850	.804
621	.965	.919	.873	.838	.807
625	.971	.940	.906	.875	.843

II. DEVIATIONS FROM THE LAW OF ONE PRICE ACROSS PRODUCERS

In this section, statistical properties of the relationship between producer price indices and import price indices are reported.

The following notation is adopted.

$\bar{I}$ =Sample Mean of Import Price Series

σ_I=Sample Standard Deviation of Import Price Series

$\rho(\Delta P, \Delta I)$ = Contemporaneous Correlation Coefficient of Percentage Changes in Producer Prices with Percentage Changes in Import Prices

$S_t = (P_t/I_t)$ = Ratio of Producer Prices to Import Prices at time t.

$\rho(S_t, S_{t+k})$ = Correlation Coefficient of Relative Prices

V_t = Percentage Deviation in S_t from its Sample Mean at time t.

Table A.5: Two Digit Industries Summary Statistics

Industry	$\sigma_P/\bar{P}$	$\sigma_I/\bar{I}$	ρ(P%, I%)	Range of V_t
22	.400	.602	.349	1.037
27	.104	.143	.609	.230
28	.154	.255	.817	.493
29	.188	.131	.429	.311
30	.157	.137	.352	.134
31	.182	.174	.066	.168
32	.195	.163	.556	.180
33	.170	.133	.152	.165
36	.098	.064	.227	.198
37	.149	.095	.266	.274
38	.180	.126	.528	.212
39	.269	.339	.522	.323
42	.289	.297	.895	.141
43	.131	.194	.394	.324
44	.168	.200	.837	.185
45	.070	.046	.301	.348
46	.181	.204	.292	.226
47	.142	.117	.044	.311
50	.062	.145	.012	.380
52	.149	.136	.148	.122
53	.184	.200	.669	.281
54	.179	.226	.532	.219
55	.176	.215	.823	.225
56	.189	.154	.683	.187
57	.198	.141	.211	.256
58	.152	.113	.628	.146
61	.194	.229	.773	.236
62	.207	.183	.595	.163
63	.124	.139	.662	.103
64	.141	.159	.336	.083
68	.129	.130	.588	.234
69	.155	.108	-.059	.309

Table A.6: Two Digit Industries Serial Correlations of Relative Prices

Industry	$\rho(S_t, S_{t-k})$ at lag k = 1	2	3	4	5
22	.986	.963	.940	.919	.897
27	.981	.964	.948	.928	.912
28	.982	.960	.944	.927	.902
29	.980	.953	.923	.892	.860
30	.961	.922	.873	.825	.782
31	.955	.914	.861	.793	.726
32	.994	.984	.972	.960	.946
33	.985	.967	.946	.927	.905
36	.992	.980	.967	.950	.933
37	.993	.983	.969	.956	.943
38	.995	.988	.981	.974	.967
39	.966	.918	.879	.848	.825
42	.908	.824	.750	.687	.606
43	.974	.954	.936	.918	.909
44	.967	.944	.916	.884	.852
45	.963	.923	.894	.858	.830
46	.887	.803	.740	.666	.607
47	.985	.955	.918	.881	.845
50	.986	.969	.950	.931	.913
52	.954	.892	.807	.723	.640
53	.989	.968	.936	.895	.847
54	.995	.991	.986	.980	.974
55	.980	.955	.927	.889	.854
56	.978	.957	.937	.913	.896
57	.989	.973	.955	.938	.922
58	.987	.972	.958	.943	.928
61	.956	.896	.825	.750	.676
62	.967	.930	.900	.876	.857
63	.979	.949	.910	.865	.821
64	.954	.879	.794	.707	.622
68	.969	.905	.838	.779	.730
69	.964	.925	.885	.844	.802

Table A.7: Three and Four Digit Industries Summary Statistics

Industry	$\sigma_P/\bar{P}$	$\sigma_I/\bar{I}$	ρ(P%, I%)	Range of V_t
2105	.174	.375	.143	.902
211	.332	.335	.156	.429
2114	.355	.334	.061	.369
2121	.635	.674	-.013	.945
2122	.458	.718	.157	.887
2217	.563	.617	.635	.731
2531	.179	.187	.486	.142
254	.211	.201	.320	.187
2541	.203	.257	.044	.426
255	.121	.150	-.071	.233
2716	.182	.174	.164	.183
281	.179	.286	.803	.509
2841	.186	.269	.302	.474
2843	.167	.139	.708	.359
291	.211	.136	.241	.322
301	.149	.133	.358	.161
302	.168	.152	.134	.241
3236	.152	.192	.073	.253
3261	.244	.158	.189	.506
3267	.169	.139	.438	.190
3272	.195	.105	.145	.408
3277	.137	.152	.277	.145
3301	.175	.141	.071	.164
3311	.160	.135	.057	.164
333	.162	.114	.127	.251
3701	.160	.084	.183	.344
371	.152	.187	.000	.367
372	.097	.040	-.034	.413
377	.099	.136	.257	.218
382	.179	.162	.400	.253
384	.175	.132	.279	.187

Table A.7 (Continued)

Industry	$\sigma_P/\bar{P}$	$\sigma_I/\bar{I}$	$\rho(\Delta P, \Delta I)$	Range of V_t
385	.179	.123	.342	.321
388	.213	.085	.413	.452
393	.177	.163	.451	.161
394	.135	.073	.173	.293
431	.193	.218	.451	.327
441	.165	.200	.830	.225
4412	.166	.196	.709	.269
4414	.174	.228	.777	.358
501	.035	.106	.010	.442
521	.162	.106	.222	.307
522	.142	.115	.113	.221
553	.178	.212	.868	.178
5531	.246	.268	.901	.176
5532	.184	.200	.803	.129
5533	.163	.218	.546	.299
5534	.187	.178	.570	.533
554	.175	.221	.555	.230
581	.127	.122	.541	.081
591	.152	.159	.005	.157
592	.278	.089	.252	.575
621	.202	.181	.510	.171
625	.210	.183	.471	.175

Table A.8: Three and Four Digit Industries Serial Correlations of Relative Prices

Industry	$\rho(S_t, S_{t-k})$ at lag k = 1	2	3	4	5
2105	.975	.947	.919	.889	.858
211	.930	.862	.804	.732	.684
2114	.857	.711	.576	.562	.547
2121	.944	.878	.785	.684	.583
2122	.969	.948	.935	.921	.919
2217	.951	.878	.810	.744	.691
2531	.953	.923	.895	.868	.840
254	.975	.935	.889	.839	.785
2541	.985	.963	.941	.918	.892
255	.953	.910	.866	.824	.780
2716	.883	.772	.677	.581	.523
281	.977	.954	.937	.917	.894
2841	.960	.935	.916	.906	.900
2843	.769	.610	.581	.512	.365
291	.983	.959	.931	.903	.875
301	.934	.850	.754	.654	.559
302	.967	.926	.877	.828	.776
3236	.979	.954	.930	.904	.877
3261	.993	.982	.969	.956	.942
3267	.963	.928	.893	.850	.817
3272	.993	.986	.980	.974	.967
3277	.855	.719	.599	.529	.481
3301	.977	.954	.928	.903	.875
3311	.961	.926	.882	.843	.795
333	.979	.951	.922	.894	.865
3701	.995	.987	.978	.969	.961
371	.977	.936	.894	.857	.822
372	.996	.991	.985	.978	.971
377	.971	.934	.897	.850	.800
382	.987	.969	.950	.929	.902
384	.984	.967	.951	.933	.916

Table A.8: (Continued)

Industry	$\rho(S_t, S_{t-k})$ at lag k = 1	2	3	4	5
385	.985	.966	.945	.924	.896
388	.998	.994	.991	.988	.987
393	.931	.848	.756	.688	.624
394	.981	.968	.958	.948	.944
431	.900	.823	.736	.664	.619
441	.974	.953	.926	.897	.867
4412	.984	.961	.937	.913	.885
4414	.967	.934	.891	.844	.794
501	.996	.991	.986	.981	.976
521	.976	.942	.909	.879	.852
522	.975	.934	.878	.821	.758
553	.986	.970	.951	.930	.911
5531	.946	.894	.836	.785	.764
5532	.960	.920	.874	.846	.818
5533	.962	.922	.889	.847	.801
5534	.986	.962	.927	.881	.828
554	.976	.956	.940	.923	.908
581	.913	.846	.789	.705	.627
591	.870	.735	.631	.513	.397
592	.998	.995	.991	.988	.985
621	.955	.911	.879	.851	.816
625	.960	.916	.878	.847	.824

III. INDUSTRIES STUDIED

Code	Description
211	Coal Mining
2114	Brown Coal and Briquettes
2121	Crude Mineral Oil
2122	Natural Gas
215	Potash
22	Petroleum Products
2217	Fuel Oil
253	Cement, Limestone, Plaster
2531	Cement
254	Coarse Ceramics
2541	Bricks
255	Concrete
27	Iron and Steel
2716	Processed Metal
28	Non-Ferrous Metal Products
281	Crude Metal and Precious Stones
2841	Aluminum and Aluminum Alloys
2843	Copper and Copper Alloys
29	Products of Non-Ferrous Metal Foundries
291	Iron, Steel and Case Iron
30	Refrigeration and Products of Steel Shaping
301	Refrigeration Products
302	Products of Steel Shaping

31	Steel Buildings and Rails
32	Machinery
3236	Construction Machinery
3261	Paper and Printing Machinery
3267	Sewing Machines
3277	Compression Machines
33	Road Vehicles
3311	Motor Vehicles
333	Parts for Motor Vehicles
36	Electrical Goods
37	Precision Instruments, Optical Goods and Clocks
3701	Precision Instruments and Optical Goods
371	Optical Goods
372	Photographic Equipment
377	Clocks
38	Products Made from Iron, Sheet Metal and Other Metal
382	Tools
383	Heating and Cooling Equipment
384	Products of Sheet Metal
385	Locks
387	Cutting Tools and Cutlery
388	Other Metal Goods
39	Musical Instruments, Sporting Goods, etc.
393	Toys
40	Chemical Products
41	Inorganic Chemicals
42	Organic Chemicals

43	Fertilizers and Pesticides
431	Fertilizers
44	Synthetic Rubber
4412	Condensation Rubber
45	Man-made Fibers
46	Dyes, Varnishes and Related Products
47	Pharmaceutical Products
50	Office Machinery and Data Processing Equipment
501	Office Machinery
52	Glass and Glassware
521	Flat Glass
522	Hollow Glass
53	Worked Wood
54	Wood Products
55	Wood Pulp, Paper and Paperboard
553	Unrefined Paper
5531	Newspaper
5532	Stationery
5533	Strong Paper
5534	Wrapping Paper
554	Cardboard
56	Paper and Paperboard Products
57	Printed Products
58	Plastic Products
581	Materials for Making Plastic
591	Tires
592	Soft Rubber

61	Leather
62	Leather Products and Footwear
621	Leather Products (not Including Footwear)
625	Footwear
63	Textiles
64	Clothing
65	Food and Beverages
69	Tobacco

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