Technical Appendix to accompany

Trade Openness Reduces Growth Volatility When Countries Are Well Diversified*

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In this Technical Appendix, we report additional summary statistics and a sequence of robustness checks for the above-referenced paper. In the interest of saving space, and noting that the results based on the 5-product and 10-product indicators typically very similar, we report only regressions based on the Herfindahl and 5-product indices. We discuss differences between the 5-product and 10-product estimators when they arise, and results based on the 10 product indicator are available upon request. In general, and unless otherwise indicated, results based on the Herfindahl index are reported in odd numbered columns, and results based on the 5 product index are reported in even numbered columns.

*The findings, interpretations, and conclusions expressed in this article are entirely those of the authors. They do not necessarily reflect the views of the European Central Bank, the International Monetary Fund or the World Bank.

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1 Summary statistics

Table 1 reports detailed summary statistics for the main explanatory variables of interest in the final five-year period.

Table 1: Summary statistics for key explanatory variables in the final five-year period

	Percentile	**N**	**Mean**	**Std Dev**	**Min**	**Max**	**Percentile**	**N**	**Mean**	**Std Dev**	**Min**	**Max**
	Product Herfindahl						Market Herfindahl					
10%	0.016	64	0.120	0.17	0.008	0.819	0.067	64	0.155	0.14	0.052	0.755
25%	0.029						0.083					
50%	0.051						0.112					
75%	0.127						0.175					
90%	0.312						0.236					
	5 product						5 market					
10%	0.204	64	0.464	0.22	0.132	0.974	0.487	64	0.630	0.12	0.409	0.966
25%	0.293						0.531					
50%	0.415						0.615					
75%	0.612						0.712					
90%	0.769						0.783					
	10 product						10 market					
10%	0.309	64	0.577	0.21	0.212	0.983	0.100	64	0.777	0.10	0.566	0.989
25%	0.395						0.250					
50%	0.581						0.500					
75%	0.755						0.750					
90%	0.828						0.900					
	PC product						PC market					
10%	-2.305	64	-0.882	1.29	-2.706	2.788	-1.997	64	-0.604	1.30	-2.765	3.256
25%	-1.885						-1.560					
50%	-1.082						-0.767					
75%	-0.139						0.120					
90%	0.951						0.704					
	Openness											
10%	0.684	64	0.841	0.11	0.618	1.133						
25%	0.791											
50%	0.857											
75%	0.898											
90%	0.950											

Table 2 provides average concentration index values for the last five-year period in the sample.

Table 2: Average concentration index values in final 5-year period[†]

Country	Product Herfindahl	5 Product	10 Product	Market Herfindahl	5 Market	10 Market
Algeria	0.444	0.958	0.983	0.119	0.695	0.894
Argentina	0.035	0.355	0.492	0.072	0.509	0.651
Australia	0.035	0.326	0.488	0.078	0.536	0.707
Bangladesh	0.088	0.616	0.788	0.154	0.683	0.837
Belgium	0.024	0.279	0.345	0.099	0.637	0.779
Bolivia	0.105	0.583	0.753	0.151	0.735	0.890
Botswana	0.632	0.935	0.969	0.643	0.966	0.989
Brazil	0.016	0.197	0.317	0.073	0.442	0.595
Burkina Faso	0.396	0.753	0.821	0.245	0.819	0.938
Canada	0.033	0.338	0.425	0.738	0.914	0.941
Chile	0.108	0.538	0.659	0.071	0.487	0.683
China	0.012	0.180	0.277	0.102	0.607	0.720
Colombia	0.068	0.474	0.578	0.206	0.653	0.759
Costa Rica	0.127	0.598	0.686	0.236	0.650	0.794
Denmark	0.013	0.204	0.279	0.071	0.504	0.711
Dominican Rep	0.051	0.398	0.579	0.205	0.764	0.878
Ecuador	0.246	0.769	0.825	0.209	0.694	0.836
El Salvador	0.069	0.485	0.613	0.153	0.783	0.917
France	0.016	0.230	0.304	0.065	0.512	0.687
Gambia, The	0.127	0.609	0.758	0.214	0.820	0.931
Ghana	0.202	0.681	0.828	0.096	0.588	0.780
Guatemala	0.042	0.392	0.559	0.175	0.720	0.846
Honduras	0.081	0.503	0.690	0.201	0.728	0.849
India	0.028	0.256	0.344	0.057	0.409	0.566
Indonesia	0.027	0.292	0.393	0.090	0.568	0.724
Iran	0.691	0.882	0.901	0.199	0.844	0.914
Ireland	0.057	0.447	0.616	0.112	0.658	0.834
Israel	0.142	0.508	0.596	0.162	0.584	0.721
Italy	0.008	0.132	0.212	0.058	0.484	0.618
Japan	0.032	0.294	0.397	0.103	0.573	0.726
Jordan	0.051	0.432	0.644	0.117	0.623	0.761
Kenya	0.080	0.518	0.623	0.069	0.507	0.672
Madagascar	0.112	0.637	0.789	0.225	0.777	0.887
Malawi	0.312	0.811	0.884	0.075	0.540	0.732
Malaysia	0.043	0.365	0.499	0.093	0.585	0.761
Mexico	0.029	0.303	0.433	0.755	0.919	0.944
Morocco	0.030	0.298	0.480	0.153	0.669	0.807
Netherlands	0.010	0.167	0.238	0.095	0.598	0.738
New Zealand	0.031	0.320	0.464	0.084	0.555	0.686
Nicaragua	0.055	0.443	0.647	0.160	0.716	0.879
Nigeria	0.819	0.974	0.983	0.168	0.666	0.823
Norway	0.256	0.699	0.759	0.097	0.603	0.812
Pakistan	0.050	0.396	0.583	0.084	0.492	0.644
Panama	0.052	0.382	0.482	0.255	0.690	0.812
Paraguay	0.170	0.682	0.815	0.155	0.707	0.848
Peru	0.077	0.528	0.664	0.105	0.537	0.694
Philippines	0.132	0.590	0.691	0.111	0.629	0.863
Portugal	0.019	0.231	0.347	0.115	0.669	0.839
Senegal	0.095	0.556	0.712	0.114	0.603	0.789
South Africa	0.031	0.351	0.466	0.052	0.444	0.589
Spain	0.029	0.265	0.332	0.083	0.590	0.725
Sri Lanka	0.041	0.351	0.503	0.163	0.635	0.755
Sweden	0.017	0.230	0.327	0.055	0.443	0.680
Syria	0.431	0.772	0.825	0.147	0.667	0.821
Thailand	0.016	0.212	0.309	0.075	0.516	0.682
Togo	0.109	0.637	0.752	0.092	0.594	0.742
Trinidad & Tobago	0.173	0.723	0.785	0.327	0.737	0.828
Tunisia	0.037	0.357	0.503	0.175	0.747	0.884
Turkey	0.015	0.198	0.309	0.055	0.445	0.620
United Kingdom	0.017	0.238	0.337	0.067	0.508	0.694
United States	0.011	0.177	0.255	0.086	0.521	0.671
Uruguay	0.040	0.349	0.469	0.088	0.527	0.703
Zambia	0.255	0.766	0.881	0.194	0.762	0.892
Zimbabwe	0.093	0.541	0.657	0.096	0.539	0.724

[†] Notes: 5-year period beginning 2001–2005, inclusive.

2 Subsample analysis

We restrict the sample from either end by deleting the final (2001–2005) (Table 3, columns *S1* and *S2*) and first (1976–1980) (Table 3, *S3* and *S4*) periods from the sample.

The first restriction, which deletes the most recent period, examines the importance of recent history in influencing the outcomes of the analysis. The second, which pares the earliest period of the sample, tests the robustness to the exclusion of the period of increased global trade integration in the late 1970s and early 1980s, which followed the end of the Tokyo Round and led up to the important Uruguay Round of the GATT.[1]

The results for specifications *S3* and *S4* show that excluding the first five-year period does not change the results in any noteworthy way. The coefficients of our variables of interest carry the expected signs and the interaction terms are highly significant. Instead, when we delete the last period the interaction term between the 5 product and trade openness is insignificant at the 10 percent level (column *S2*). Although these results do not change our main conclusions, they emphasize the importance of recent changes in the global pattern of trade liberalization and diversification since the turn of the 21st century, when the world economy experienced an extended period of economic calm.

An alternative restriction of the sample we experiment with is to limit it to only low and middle income economies (columns *S5* and *S6*) as well as only middle and high income economies (columns *S7* and *S8*). The restriction allows us to tease out whether the contribution of diversification and openness to growth stability is driven by patterns in the developed or developing world. As can be seen, our results do not change markedly when high income economies are excluded from the analysis, although the sample size falls substantially.

In contrast, when we exclude developing countries from the analysis, the interaction term is significant only in one of the three regressions (column *S7*; the third regression employing the 10 product indicator is not reported). Furthermore, while the variables of interest still carry the correct signs, the (statistical) significance of the relationship appears to be eroded. This suggests that much of the action driving our results indeed lies with low and middle income economies, for which export diversification matters more in shielding their economies from external shocks. A likely explanation is that developed economies have other means of insuring their economies against shocks, whereas developing countries depend more strongly on implicit insurance as represented by a more diversified structure in their exports.

[1] Restricting the sample further by eliminating the first two periods yields qualitatively similar results.

Table 3: System GMM regressions for growth volatility for selected subsamples[†]

	1976–2000		**1981–2005**		**Low/middle income**		**High/middle income**	
	(*S1*)	(*S2*)	(*S3*)	(*S4*)	(*S5*)	(*S6*)	(*S7*)	(*S8*)
Lagged	0.329	0.126	0.175	0.113	0.251	0.300	0.074	-0.006
volatility	(0.13)**	(0.17)	(0.12)	(0.16)	(0.13)**	(0.15)*	(0.14)	(0.15)
Product	-29.447	-18.496	-27.497	-21.480	-21.973	-25.074	-37.768	-5.390
concentration	(11.23)***	(11.93)	(10.01)***	(8.36)**	(8.91)**	(9.85)**	(12.00)***	(8.65)
Trade	-7.407	-13.547	-6.545	-12.377	-5.079	-16.994	-3.776	-2.959
openness	(3.78)**	(7.54)*	(3.52)*	(5.20)**	(3.75)	(7.10)**	(3.10)	(4.80)
Openness ×	34.604	21.805	33.358	26.128	25.274	29.756	40.959	6.141
concentration	(13.26)***	(14.34)	(11.76)***	(9.69)***	(10.48)**	(11.55)**	(12.84)***	(10.81)
Financial	-0.407	-0.536	-0.303	-0.390	-0.378	-0.155	-0.550	-0.581
openness	(0.27)	(0.30)*	(0.17)*	(0.18)**	(0.19)**	(0.21)	(0.17)***	(0.17)***
Capital flows	-0.281	-0.164	0.228	0.208	0.805	0.907	0.369	0.304
volatility	(0.41)	(0.46)	(0.37)	(0.44)	(0.47)*	(0.46)**	(0.32)	(0.38)
Foreign growth	2.938	2.146	2.037	1.556	2.732	2.863	1.076	1.266
volatility	(0.92)***	(1.09)**	(0.94)**	(0.98)	(1.02)***	(1.08)***	(0.87)	(1.10)
Terms of trade	-0.013	-0.016	-0.005	-0.004	0.020	0.018	0.046	0.011
volatility	(0.05)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.06)	(0.05)
Exchange rate	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000
volatility	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Inflation	0.017	0.016	0.026	0.025	0.012	0.006	0.018	0.017
volatility	(0.01)	(0.02)	(0.01)**	(0.01)*	(0.01)	(0.01)	(0.01)	(0.01)
Banking crisis	-1.119	-1.270	-2.395	-0.220	-0.970	2.857	-2.573	-5.687
	(5.64)	(6.60)	(5.85)	(6.14)	(5.55)	(5.95)	(3.85)	(3.70)
Wald χ^2	587.5***	463.1***	778.2***	806.9***	522.7***	779.3***	775.0***	830.3***
Hansen J	24.855	21.798	37.788	30.593	37.677	28.957	35.547	35.771
AR(2) z	0.470	0.267	0.421	0.154	0.881	0.814	0.935	1.028
N	238	238	283	283	207	207	231	231

[†] Notes: Heteroskedasticity and autocorrelation-robust (asymptotic) Windmeijer (2005)-corrected standard errors reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and a constant were included, but not reported.

3 Using external instruments to further address endogeneity concerns

We explore using external instruments as an alternative way of dealing with the issue of endogeneity in our setup. The literature has identified a reliable instrument for trade openness in the gravity-predicted trade flow variable of Frankel & Romer (1999). We employ this instrument for the analysis that follows. We begin our exploration by attempting to use the gravity predicted variable as an instrument in a cross-sectional setup; it is used to instrument both for the trade openness variable itself as well as for the interaction term. The specification is otherwise equivalent to the setup used above in our benchmark specification. The model is estimated for each of the five-year periods in our sample separately. We directly test for the endogeneity of the trade openness variable using the Durbin-Wu-Hausman test: of the six 5-year periods, the test fails to reject the null hypothesis of exogeneity for four of the five-year periods at the 5 percent level (rejections occur in the first and final 5-year period, and in the first the sample size of 18 makes it difficult to draw strong inference). Moreover, the Stock-Yogo tests suggest that the cross-sectional IVs suffer from weak instrument problems in our setup.

Although the results of the estimations are mostly qualitatively similar to the ones in our benchmark regressions above, we therefore prefer incorporating the Frankel-Romer instrument into the benchmark system GMM regressions as an additional external instrument; an added benefit, of course, is that we thereby avoid efficiency losses resulting from reducing the panel to a cross-sectional data set. Doing so does not alter our earlier findings in any substantial way (the findings, for specifications analogous to the main specifications, are reported in Table 4). The variables of interest generally retain their signs and both statistical and economic significance.

Table 4: System GMM regressions for growth volatility with additional external instruments[†]

	Product diversification	
	(*Herfindahl*)	(*5 Product*)
Lagged	0.157	0.108
volatility	(0.12)	(0.14)
Product	-19.482	-13.814
concentration	(9.14)**	(7.12)*
Trade	-0.040	-4.706
openness	(2.06)	(3.94)
Openness ×	22.750	16.734
concentration	(10.78)**	(8.50)**
Financial	-0.401	-0.421
openness	(0.16)**	(0.17)**
Terms of trade	0.000	0.005
volatility	(0.04)	(0.05)
Exchange rate	0.000	-0.000
volatility	(0.00)	(0.00)
Capital flows	0.440	0.290
volatility	(0.37)	(0.45)
Foreign growth	1.736	1.211
volatility	(0.90)*	(1.01)
Inflation	0.024	0.025
volatility	(0.01)**	(0.01)*
Banking crisis	-3.790	-2.271
	(5.51)	(4.93)
Wald χ^2	1034.5***	961.6***
Hansen J	38.064	35.640
AR(2) z	0.372	0.232
N	302	302

[†] Notes: Heteroskedasticity and autocorrelation-robust (asymptotic) Windmeijer (2005)-corrected standard errors reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and a constant were included, but not reported.

4 Nonlinearity in the interaction term

We test for nonlinearity in the interaction term by interacting the openness measure with both the linear and the quadratic indicator of export product concentration. In general, when an interaction term is included in a regression both variables that compose it are included as well. In this case, we do not include the quadratic index of export concentration as a regressor because this leads to a general loss of significance due to the high multicollinearity.

In Table 5, we report the results of the GMM estimates of the benchmark model augmented by the additional interaction variable given by the product between the openness measure and the quadratic indicator of export product concentration. The results show that the interaction variable between trade openness and export concentration squared is not significant. This suggests that that the interaction between export concentration and growth volatility is not nonlinear in the openness measure.

Table 5: System GMM regressions for growth volatility, openness, and concentration to test for potential non-linearity in the interaction term †

	(*NL1*)	(*NL2*)
Lagged volatility	0.259	0.154
	(0.111)**	(0.166)
Product concentration	-25.09	-15.18
	(10.35)**	(8.418)*
Openness × concentration	29.72	21.27
	(10.81)***	(12.83)*
Openness × concentration^2	1.515	-2.027
	(5.513)	(4.562)
Trade openness	-5.144	-9.769
	(3.065)*	(5.508)*
Financial openness	-0.281	-0.297
	(0.152)*	(0.187)
Capital flows volatility	0.202	0.180
	(0.347)	(0.366)
Foreign growth volatility	1.411	1.596
	(0.891)	(0.866)*
Terms of trade volatility	-0.0314	-0.0382
	(0.0308)	(0.0415)
Exchange rate volatility	0.00	0.00
	(0.00)	(0.00)
Inflation volatility	0.0270	0.0271
	(0.0125)**	(0.0149)*
Banking crisis	-3.076	1.788
	(4.902)	(6.047)
Wald χ^2	902.5***	1128.62***
Hansen J	44.12	40.59
AR(2) z	0.57	0.22
N	302	302

† Notes: Heteroskedasticity and autocorrelation-robust (asymptotic) Windmeijer (2005)-corrected standard errors reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and a constant were included, but not reported.

5 Using alternative measures of growth volatility

We estimate the benchmark model using 2 alternative definitions of our dependent variable. The 2 alternative measures of growth volatility are $\sum_t (g_t - \bar{g})^2$ and $\sum_t |g_t - \bar{g}|$.

In Table 6, the first two columns report the results of the GMM estimates of the benchmark model where, as dependent variable, the standard deviation of real GDP per capita growth has been substituted by $\sum_t (g_t - \bar{g})^2$. The last two columns of Table 6 report the results of the GMM estimates of the benchmark model where, as dependent variable, the standard deviation of real GDP per capita growth has been substituted by $\sum_t |g_t - \bar{g}|$. Odd-numbered columns refer to regressions using the product Herfindahl indicator, while even-numbered columns denote those using the 5-product indicator. We find that the results of the paper hold despite using alternative definitions of the dependent variable.

Table 6: System GMM regressions for growth volatility, openness, and concentration with alternative definitions of the dependent variable[†]

	(DV1)	*(DV2)*	*(DV3)*	*(DV4)*
Lagged volatility	0.129	0.0373	0.142	0.0543
	(0.0973)	(0.133)	(0.120)	(0.147)
Product concentration	-11.92	-6.539	-10.07	-8.103
	(3.657)***	(3.555)*	(4.131)**	(3.415)**
Openness x concentration	14.27	7.975	12.20	9.865
	(4.208)***	(4.117)*	(4.922)**	(3.970)**
Trade openness	-2.548	-4.021	-1.660	-4.441
	(1.267)**	(2.076)*	(1.195)	(2.115)**
Financial openness	-0.0953	-0.103	-0.114	-0.142
	(0.0716)	(0.0705)	(0.0679)*	(0.0699)**
Capital flows volatility	0.152	0.127	0.0962	0.0711
	(0.132)	(0.159)	(0.144)	(0.159)
Foreign growth volatility	1.046	0.392	0.696	0.502
	(0.456)**	(0.399)	(0.347)**	(0.377)
Terms of trade volatility	-0.00359	-0.000783	-0.00405	-0.000646
	(0.0156)	(0.0162)	(0.0154)	(0.0196)
Exchange rate volatility	0.00	0.00	-0.000	-0.000
	(0.00)	(0.00)	(0.000)	(0.000)
Inflation volatility	0.00839	0.00855	0.0104	0.0101
	(0.00460)*	(0.00547)	(0.00479)**	(0.00557)*
Banking crisis	-1.456	-0.0141	-0.819	0.246
	(2.651)	(2.478)	(2.382)	(2.303)
Wald χ^2	46.43***	28.45**	712.9***	602.7***
Hansen J	28.32	31.23	37.71	34.18
AR(2) z	0.41	-0.16	0.547	0.184
N	302	302	302	302

[†] Notes: Heteroskedasticity and autocorrelation-robust (asymptotic) Windmeijer (2005)-corrected standard errors reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and a constant were included, but not reported.

6 Controlling for the effect of openness on export concentration

We asses the total impact of openness and diversification on volatility taking into account the possible effect of openness on diversification by estimating a treatment effects model as in Rancière, Tornell & Westermann (2006) and Edwards (2004).

The treatment effects model allows to jointly estimate an outcome equation of growth volatility on controls—including an interaction term between openness and a dummy distinguishing diversified and non-diversified economies—and a Probit "selection" equation that controls for the (observable) determinants of diversification. The estimated treatment effects model is described by the equations below:

$$\begin{aligned} GDPVOL_{i,t} = \alpha + \beta_1 OPEN_{i,t} + \beta_2 CON_{i,t} + \beta_3 OPEN_{i,t} \times CON_{i,t} \\ + \gamma \mathbf{X}_{i,t} + \epsilon_{i,t}, \end{aligned} \tag{1}$$

$$CON_{it} = \left\{ \begin{array}{ll} = 1 & \text{if } CON^*_{it} > 0 \\ = 0 & \text{otherwise} \end{array} \right\} \tag{2}$$

$$CON^*_{i,t} = \mu + \delta \mathbf{Z}_{it} + \nu_{it}, \tag{3}$$

where i defines the country and t the time period.

Equation (1) is the outcome equation. The dependent variable, $GDPVOL_{i,t}$, is the standard deviation of real GDP per capita growth. Trade openness, $OPEN_{i,t}$, the export product concentration dummy, $CON_{i,t}$, and the interaction between these two previous variables, $OPEN_{i,t} \times CON_{i,t}$, are the main regressors of interest. $\mathbf{X}_{i,t}$ is a $(1 \times m)$ vector that contains the same control variables included in the benchmark model. The export product concentration dummy takes value equal to 1 when the considered concentration index takes values above the threshold determined in the paper[2] and 0 otherwise. $\epsilon_{i,t}$ is the error term.

It is assumed that a country is not sufficiently diversified if the latent variable CON^*_{it} is larger than 0. CON^*_{it} is the dependent variable of the Probit equation (3) and it is a function of the following covariates: trade openness, income per capita in the first period, private credit as a share of GDP, fuel export over merchandise export, manufacturing export over merchandise export and population. The regressors of the Probit equation are lagged one period to avoid endogeneity. ν_{it} is the disturbance term.

$\epsilon_{i,t}$ and ν_{it} are assumed to be jointly normally distributed with a zero mean and the following

[2]The thresholds computed in the paper are: 0.154 for the product Herfindahl index, 0.481 for the 5 product index and 0.575 for the 10 product index.

variance-covariance matrix Σ:

$$\Sigma = \begin{bmatrix} \sigma_{\varepsilon}^2 & \sigma_{\varepsilon\nu} \\ \sigma_{\nu\varepsilon} & 1 \end{bmatrix} \tag{4}$$

If the two equations are not independent, an OLS estimate of (1) produces inconsistent estimates. To overcome this problem, we estimate the model jointly using maximum likelihood.[3]

The model is estimated using annual data on the same sample of countries and the same time period used in the paper[4]. Volatilities are computed as rolling standard deviations over 5-year intervals.

Table 7 shows the results of the treatment effects model. The results of the outcome equation, reported in the upper part of Table 7, show that even taking into account the effect of trade openness on diversification the results of the paper mostly hold. The coefficient on the openness variable continues to be negative while the coefficients on the interaction terms are positive. The interaction terms are significant in two out of three regressions. Only in the case of the 10 product indicator can we not fully confirm the results of the benchmarke model (not reported).

The results of the treatment equation, reported in the lower part of Table 7, show that less open manufactures exporters with a higher access to credit for the private sector indeed exhibit less concentrated exports as suggested by the reviewer. Higher fuel exports over merchandise exports and a smaller population are associated with more concentrated exports.

[3]The two-step approach produces similar results.

[4]The data for income per capita in the first period, private credit share of GDP, fuel export over merchandise export, manufacturing export over merchandise export and population, which are the covariates used in the Probit equation, are from the World Development Indicators database

Table 7: Treatment effects model: growth volatility, openness and product concentration†

	(*Tr1*)	(*Tr2*)
Growth volatility		
Trade openness	-0.049	-0.566
	(0.637)	(0.773)
Openness × concentration	3.583	2.649
	(1.196)***	(1.084)**
Financial openness	-0.137	-0.138
	(0.0681)**	(0.078)*
Terms of trade volatility	0.055	0.038
	(0.030)*	(0.032)
Exchange rate volatility	0.012	0.008
	(0.016)	(0.017)
Capital flows volatility	0.596	0.557
	(0.173)***	(0.160)***
Foreign growth volatility	1.065	1.091
	(0.375)***	(0.387)***
Inflation volatility	0.009	0.011
	(0.010)	(0.012)
Banking crisis	1.055	1.051
	(0.317)***	(0.325)***
Product concentration	-2.192	-1.277
	(0.798)***	(0.716)*
Product concentration		
Lagged trade openness	2.318	2.544
	(0.596)***	(0.713)***
Lagged income per capita in the first period	-0.000	-0.000
	(0.000)	(0.000)**
Lagged private credit share of GDP	-1.582	-1.341
	(0.628)**	(0.485)***
Lagged fuel to merchandise exports	2.099	3.605
	(0.508)***	(1.123)***
Lagged manufacturing to merchandise exports	-2.641	-3.282
	(1.051)**	(0.851)***
Lagged population	-0.005	-0.006
	(0.004)	(0.004)
$\text{arctanh}(\rho)$	-0.087	-0.195
	(0.137)	(0.145)
$\ln(\sigma_\epsilon)$	0.368	0.377
	(0.067)***	(0.071)***
N	1027	1027

† Notes: Huber-White (robust) standard errors reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and constants were included, but not reported.

7 Product concentration measures at different levels of sectoral aggregation

We estimate the benchmark model substituting the product concentration measure with the corresponding measures computed at different levels of sectoral aggregation. This exercise provides results which are qualitatively similar to those obtained in the paper.

As an example, in Table 8, we report the results of the GMM estimates of the benchmark model using the product Herfindahl index. We use the 4-digit Herfindahl index, as in the paper, in specification *G2*, the 3-digit Herfindahl index in *G2a*, the 2-digit Herfindahl index in *G2b* and finally the 1-digit Herfindahl index in *G2c*. Our results are qualitatively robust to using concentration indices at varying levels of aggregation.

Table 8: System GMM regressions for growth volatility, openness, and product concentration, using as concentration indicator the product Herfindahl index computed at different levels of sectoral aggregation[†]

	(*G2*)	(*G2a*)	(*G2b*)	(*G2c*)
Lagged volatility	0.167	-0.001	-0.000	0.032
	(0.12)	(0.14)	(0.14)	(0.16)
Product concentration	-27.894	-27.173	-17.800	-23.976
	(9.77)***	(9.95)***	(9.62)*	(11.05)**
Trade openness	-5.160	-3.347	-1.025	-8.164
	(2.99)*	(3.30)	(3.67)	(5.80)
Openness × concentration	33.599	32.327	21.221	29.106
	(11.30)***	(11.34)***	(11.27)*	(13.71)**
Financial openness	-0.333	-0.398	-0.362	-0.331
	(0.17)*	(0.18)**	(0.17)**	(0.16)**
Terms of trade volatility	-0.008	0.036	0.038	0.008
	(0.04)	(0.05)	(0.05)	(0.06)
Exchange rate volatility	0.000	-0.000	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Capital flows volatility	0.289	0.195	0.228	0.380
	(0.36)	(0.37)	(0.36)	(0.38)
Foreign growth volatility	2.075	1.719	1.111	-0.050
	(0.96)**	(0.98)*	(0.98)	(0.94)
Inflation volatility	0.026	0.032	0.028	0.015
	(0.01)**	(0.02)**	(0.02)*	(0.02)
Banking crisis	-2.290	-3.080	-0.163	6.331
	(5.94)	(6.29)	(6.34)	(6.08)
Wald χ^2	926.2***	596.4***	654.5***	645.2***
Hansen J	37.46	34.23	31.60	37.39
AR(2) z	0.400	0.363	0.417	0.581
N	302	288	288	288

[†] Notes: Heteroskedasticity and autocorrelation-robust (asymptotic) Windmeijer (2005)-corrected standard errors reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and a constant were included, but not reported.

8 A Product-Destination Herfindahl Index

We estimate the benchmark model using as measure of concentration a product-destination Herfindahl index that measures concentration across destination-product pairs (based on UNCOMTRADE SITC Revision 2, 1 digit). As shown in Table 9, we find that our main results are confirmed by both GMM and random effects estimates.

Table 9: System GMM and random effects regressions for growth volatility, openness, and product concentration, using as concentration indicator the product destination Herfindahl index††

	(*GMM-ProdDest*)	(*RE-ProdDest*)
Lagged volatility	0.0833	
	(0.134)	
Product destination concentration	-47.28	-24.87
	(17.75)***	(11.82)**
Trade openness	-5.603	0.0807
	(3.533)	(1.400)
Openness × concentration	56.56	28.36
	(20.40)***	(14.11)**
Financial openness	-0.286	-0.197
	(0.170)*	(0.0780)**
Terms of trade volatility	-0.00665	0.0587
	(0.0534)	(0.0235)**
Exchange rate volatility	0.000	0.000
	(0.000)	(0.000)
Capital flows volatility	0.365	0.804
	(0.316)	(0.199)***
Foreign growth volatility	1.886	0.898
	(1.108)*	(0.364)**
Inflation volatility	0.0162	0.00588
	(0.0137)	(0.00729)
Banking crisis	-0.782	5.183
	(5.889)	(2.249)**
Wald χ^2	689.9***	
Hansen J	27.30	
AR(2) z	0.776	
R^2		0.259
F		3276.6***
N	288	350

† Notes: In the GMM regression, heteroskedasticity and autocorrelation-robust (asymptotic) Windmeijer (2005)-corrected standard errors are reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and a constant were included, but not reported.

† Notes: In the RE regression, Huber-White (robust) standard errors are reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and a constant were included, but not reported.

9 10-year averages

Table 10 shows that when we repeat the benchmark analysis on 10 year time intervals[5] the main results of the paper hold.

Table 10: System GMM and random effects regressions regressions for growth volatility, openness, and product concentration using 10-year averages†

	(*GMM-10yr*)	(*RE-10yr*)
Lagged growth volatility	0.231	0.197
	(0.10)**	(0.09)**
Product concentration	-20.199	-10.343
	(9.52)**	(2.99)***
Openness x concentration	26.655	12.253
	(12.70)**	(4.71)***
Trade openness	-0.941	-4.406
	(1.79)	(2.57)*
Financial openness	-0.391	-0.252
	(0.20)**	(0.19)
Terms of trade volatility	0.094	0.182
	(0.10)	(0.06)***
Exchange rate volatility	0.020	0.018
	(0.01)	(0.01)
Capital flows volatility	-0.457	-0.406
	(0.30)	(0.26)
Foreign growth volatility	1.571	0.876
	(0.68)**	(0.57)
Inflation volatility	0.020	0.013
	(0.01)**	(0.01)
Banking crisis	-2.449	1.571
	(2.01)	(1.61)
Wald χ^2	77.3***	50.6***
Hansen J	19.208	19.324
AR(2) z	0.444	0.436
N	126	126

† Notes: Heteroskedasticity and autocorrelation-robust (asymptotic) Windmeijer (2005)-corrected standard errors are reported in parentheses. * indicates significance at 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level. Period dummies and a constant were included, but not reported.

[5]Standard deviations are computed over 10 year periods while the remaining explanatory variables are computed as 10 year averages of the underlying annual data. Therefore, now we now have $T = 3$ and $N = 77$.

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