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Exposure to External Country Specific Shocks and Income Volatility

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EXPOSURE TO EXTERNAL COUNTRY SPECIFIC SHOCKS AND INCOME VOLATILITY

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ABSTRACT

Using a dataset of 138 countries over a period from 1966 to 2004, this paper analyses the relevance of country specific shocks for income volatility in open economies. We show that exposure to country specific shocks has a positive and significant impact on GDP volatility. In particular, we find that the degree to which the cycles of different trading partners are correlated is more important in explaining exporters' GDP volatility than the volatility of demand in individual export market. We also show that geographical diversification is a significant determinant of countries' exposure to country specific shocks.

Keywords: income volatility, geographical export diversification, external shocks.

JEL classification: C23, F43, O19

1.   Introduction

Trade provides countries with new growth opportunities but also exposes them to external shocks. With openness increasing significantly over the past decades - from a median across countries of 44 per cent in 1960 to 85 per cent in 2004 -[2], policy makers and economists have shown a continuing interest in the relationship between trade, and in particular patterns of specialization, and economic stability.[3]

Economic volatility has been shown to reduce economic growth (Ramey and Ramey, 1995; Martin and Rogers, 2000; Imbs, 2007) and the positive growth impact of trade may therefore be attenuated if it leads to significant exposure to external shocks. Risk-averse individuals dislike volatility and increased volatility may therefore have undesirable social consequences. Rodrik (1998) has shown that more open economies are characterized by higher government expenditure. He argues that higher government expenditure is meant to protect economic actors against increased volatility through exposure to external shocks.

Understanding the sources of volatility is an important issue for developing countries not only because income fluctuations are larger in those economies,[4] but also because their ability to hedge against fluctuations is particularly limited. Developing countries have shallow financial infrastructures and their compensatory fiscal and monetary policies are often underdeveloped which in turn makes it difficult for those countries to attenuate the impact of external shocks.

In the economic literature there has been a particular interest in the role of commodity diversification of trade in explaining economic fluctuations in developing countries. It has been argued that the structure of developing countries' exports makes those countries particularly vulnerable to external shocks. Michaely (1958) showed five decades ago that countries with lower GDP per capita tend to be characterized by a higher commodity concentration of exports and argued that as a result, shocks affecting individual export products can have significant effects on overall export performance and potentially on economic performance in developing countries. Using time series analysis for a sample of developing countries, Love (1986) found evidence of a positive relationship between product export concentration and export volatility, which indirectly affect income volatility. In a more recent study, Malik and Temple (2006) found a positive relationship between product concentration of exports and countries' terms of trade volatility. Terms of trade volatility, in turn, was found to be a significant determinant of income volatility. Focussing directly on the difference in income volatility between poor and rich countries, Koren and Tenreyro (2007) estimate that the sectoral composition of the economy (with poor countries specialised in fewer and more volatile sectors) explains roughly 50 percent of the differences in volatility.

The possible role of geographical concentration of exports and exposure to demand shocks in partner countries has been relatively under-researched in the literature examining economic volatility. The relative lack of interest in the role of country specific shocks can maybe be explained by the expectation that country specific shocks would either be reflected in price changes – and thus terms of trade changes – or be of no effect on exporters. In particular, country specific shocks that do not affect world prices were expected not to affect exporters, because they were expected to easily redirect production from one trading partner to the other.

Recent contributions to the theoretical trade literature (Melitz, 2003) emphasize the existence of fixed costs related to entry into new markets. In the presence of such fix costs, the re-direction of exports is

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[2] Openness is defined as imports plus exports over GDP.

[3]

costly and may take time. To whom countries export and how much, would in such a context matter when it comes to the need to adjust to country specific shocks.

In this paper we focus on the role of demand shocks in partner countries for economic volatility in exporting countries and we measure exposure to foreign demand shocks by GDP volatility in partner countries. Using panel data regressions for different country samples and employing different regression techniques we provide a comprehensive analysis of the effect of our variable on volatility in exporting countries. Brainard and Cooper (1968) suggested that the correlation between individual external shocks is a significant determinant of the potential for such shocks to negatively affect exporters[5]. Love (1979) showed that product diversification can indeed reduce instability of export earnings if the price movements of new export products are not strongly correlated with those already exported. Accordingly, we decompose trading partners' volatility of demand into two components: a variance and a covariance component. This allows us to distinguish between the risk countries face for trading with more or less volatile partners and the risk they face for choosing trading partners

Trade openness may expose economies to external shocks, but may also act as a buffer against domestic shocks. The overall impact of openness on volatility is therefore an empirical question. Easterly, Islam and Stiglitz (2001) and Calderon et al. (2005) find that higher trade openness leads to larger growth volatility. In contrast, Kose et al. (2002)do not find that trade openness have a robust effect on GDP volatility. Since terms of trade volatility is expected to affect countries income volatility through openness, a number of empirical studies have used the terms of trade variable interacted with openness (Rodrik, 2001; Calderon et al., 2005). However, the results on whether the impact of terms-of-trade volatility on income volatility is increasing with openness are ambiguous.

Only few studies have considered output volatility in partner countries as a potential determinant of domestic volatility. In the vector autoregression analysis mentioned above, Ahmed (2003) includes the volatility of the aggregate real GDP of the eight largest trading partners as a measure for external shocks. In a paper that uses a methodology closer to ours, Calderon et al.(2005) includes the standard deviation of the trade-weighted annual growth of the main trading partners. In a previous paper with Bacchetta (Bacchetta et al., 2009), we use the trade-weighted annual growth of all trading partners as a measure for external shocks. All these studies find a positive effect of output volatility in partner countries on exporters' GDP volatility.

This paper differs from existing literature in that while controlling for internal and other external shocks, it focuses on the role of trading partners' volatility, in particular, by ensuring in a number of ways that the possible endogeneity of this variable does not affect results. Additionally, using a database of 138 countries over a period of approximately four decades, we decompose this variable in its variance and covariance components and assess the robustness of the results under alternative specifications. Finally, we show that geographical concentration can be used as an instrument for exposure to output shocks in trading partners.

3. Stylized facts

Demand shocks in partner countries are likely to be linked to and even driven by income shocks in those countries. Increases in GDP are likely to increase demand for imports and decreases in GDP are likely to lower the demand for imports. GDP volatility in partner countries is therefore likely to be a good proxy for export demand volatility.

Countries' exposure to demand shocks in partner countries is likely to be higher, the higher the GDP volatility in those partner countries. But a country's degree of exposure is also likely to depend on whether GDP changes move in the same or in opposite directions in different partner countries. In the latter case demand changes in one country can balance out demand changes in other countries, reducing the exposure to partner country shocks in the exporting country.

The exposure to risk through economic integration with partner countries is therefore likely to depend on three factors: the geographical structure of exports, the volatility of markets that are served, and the correlation between the fluctuations in different partner countries.

All these factors are taken into account in the following measure of country i's "exposure to country-specific shocks" (ECSS):

$$ECSS_i = \sum_j (\frac{x_{i,j}}{Xi})^2 \operatorname{var} GDPgrowth_j + \sum_j \sum_z \frac{x_{i,j}}{X_i} \frac{x_{i,z}}{X_i} \operatorname{cov}(GDPgrowth_j, GDPgrowth_z) \qquad (1)$$

The ECSS is the variance of the weighted average of the annual growth of all trading partners which can be expressed as in equation (1), where the first term on the right-hand side reflects the risk associated with the variances of the growth rate of partner countries' GDP and the second term reflects the risk associated with the covariance of partner's GDP growth rate. Each variance and covariance is weighted by the importance of individual partner countries in country i's export basket.

Figure 1 reflects how ECSS evolved, on average over five years, for our sample of countries over the period 1966–2004. Interestingly, the two highest picks of the covariance component are in the 1970s and early 1980s, two periods marked by oil crises. Therefore, peaks in the covariance could indicate that shocks affect large numbers of countries in the same direction. This may generate a problem of endogeneity that we will control for by including time fixed effects or oil-shocks dummies.

Figure 1: Average level of exposure to country specific shocks, 1966–2004

Source: Authors' calculations using GDP data from World Development Indicators (World Bank) and trade data from Comtrade.

Figure 2: Singapore's exposure to country specific shocks in trading partners, 1966–2004
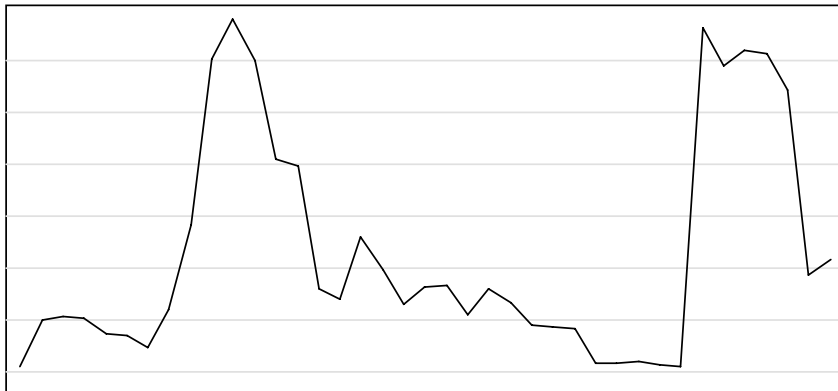

Figure 3: Chile's exposure to country specific shocks in trading partners, 1966–2004

4.   Methodology and data

The empirical analysis uses the following estimation equation:

$$GDPvol_{it} = \beta_0 + \beta_1 ECSS_{i,t} + \beta_2 CONTROL_{it} + \mu_i + \eta_t + u_{it}$$

(2)

where $GDPvol$ denotes the GDP volatility of the exporting country i at time t[8], $ECSS_{i,t}$ is the exposure to country specific shocks- our main variable, $CONTROL_{i,t}$ is the vector of control variables. μ_i and η_t represent country and time fixed effects and finally, $u_{i,t}$ the error term,

In appendix Table 2 we present the definition and sources of the data. Appendix Table 3 provides sample statistics for all variables and Appendix Table 4 presents the correlation matrix.

Most of existing economic literature on income volatility has used terms of trade (TOT) variation as a measure of external shocks. TOT fluctuations reflect changes in the prices of imports and exports and have been traditionally linked to product specific shocks. However, this variable may also be affected by country specific shocks. Demand shocks in large countries, for instance, may affect world prices of their main export/import goods. We therefore control for TOT fluctuations in our regressions. Some studies have introduced external shocks interacted with openness in the regressions. We also allow for this possibility and in some specifications, we interact openness with our ECSS variable and TOT volatility to assess whether openness makes economies more or less responsive to external shocks. The results for these regressions are presented in chapter 5 regression TB2

follow this approach because of the level of diversity among countries in our sample. Given the length of the time series dimension of our data, we would need to assume that dynamics are common across countries in our sample in order to follow a VAR approach. If dynamics differ across countries –as we think it is the case in our sample - we would end up underestimating (overestimating) the short-run (long-run) impact of exogenous variables by using the VAR approach (Pesaran and Smith, 1995).

5.   Results

Columns 1-5 of Table 1 report the results of the estimation of equation (2) for the panel of 5 year averages, overlapping periods, using the panel estimations with exporter error clustering. To control for global shocks we use two alternative approaches. In columns 1 and 3 we use two oil dummies, covering the period of the first and second oil shock. These dummies are defined for the 5-year period after 1973 and 1979 respectively. In columns 2, 4 and 5 we use time fixed effects. We prefer the first alternative in order to avoid overextending the parameter requirements on the data. Throughout this paper we perform all tests with the overlapping and the non-overlapping sample. The fnampl5vea1(ea

Table 1: Impact of ECSS on income volatility, 1966-2002

	5 years overlapping, cluster errors					5 years non overlapping, cluster errors				
	1	2	3	4	5	6	7	8	9	10
ECSS	0.162***	0.134**	0.101*	0.084#		0.254**	0.229**	0.148**	0.148**	
	[0.059]	[0.060]	[0.062]	[0.057]		[0.098]	[0.099]	[0.066]	[0.074]	
ECSS-variance					0.088***					0.079
					[0.028]					[0.064]
ECSS-covariance					0.351***					0.299**
					[0.110]					[0.136]
Government expenditure			0.07	0.05	0.075			0.022	0.01	0.022
			[0.047]	[0.051]	[0.048]			[0.038]	[0.039]	[0.038]
Financial Openness			-0.152	-0.082	-0.165*			-0.181*	-0.141	-0.195*
			[0.098]	[0.127]	[0.093]			[0.104]	[0.114]	[0.103]
Exchange Rate Volatility			0.004***	0.004***	0.004***			0.004***	0.004***	0.004***
			[0.001]	[0.001]	[0.001]			[0.001]	[0.001]	[0.001]
ToT volatility	0.004	0.006	0.019	0.021*	0.018	-0.004	0	0.017	0.02	0.018
	[0.008]	[0.008]	[0.012]	[0.013]	[0.012]	[0.010]	[0.010]	[0.013]	[0.014]	[0.013]
Military intervention	0.229	0.183	0.679**	0.627*	0.645**	0.347	0.311	0.671**	0.682**	0.626**
	[0.305]	[0.304]	[0.318]	[0.319]	[0.306]	[0.301]	[0.304]	[0.304]	[0.317]	[0.306]
Civil War	2.545***	2.469***	1.645***	1.680***	1.523***	3.642***	3.493***	1.395**	1.363**	1.400**
	[0.726]	[0.706]	[0.565]	[0.561]	[0.542]	[1.111]	[1.071]	[0.577]	[0.602]	[0.561]
Openness	0.781	1.413	0.188	0.532	0.212	1.097	1.867*	0.429	0.72	0.414
	[0.808]	[0.877]	[1.257]	[1.305]	[1.099]	[0.872]	[0.975]	[0.963]	[0.966]	[0.896]
GDP per capita	0	0	0	0	0	-0.000*	0	0	0	0
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Population	-0.000***	-0.000***	-0.000***	0	-0.000***	-0.000***	-0.000***	-0.000**	-0.000*	-0.000***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
oil73	0.161		0		0	-0.037		0		0
	[0.285]		[0.000]		[0.000]	[0.489]		[0.000]		[0.000]
oil79	0.769**		0.31		0.066	0.523		0.09		-0.028
	[0.301]		[0.254]		[0.266]	[0.322]		[0.352]		[0.348]
Year fixed effects	NO	YES	NO	YES	NO	NO	YES	NO	YES	NO
Country fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	2.720***	2.423***	0.897	0.81	0.754	2.371***	0.618	1.755	1.126	1.815
	[0.503]	[0.552]	[1.348]	[1.350]	[1.349]	[0.559]	[0.900]	[1.116]	[1.198]	[1.103]
Observations	3329	3329	1280	1280	1280	714	714	279	279	279
Number of countries	138	138	74	74	74	136	136	72	72	72
R-sq: overall	0.09	0.08	0.05	0.04	0.05	0.12	0.13	0.05	0.05	0.05
R-sq: within	0.1	0.12	0.14	0.16	0.16	0.18	0.2	0.15	0.16	0.15
R-sq: between	0.12	0.07	0.06	0.01	0.07	0.15	0.13	0.05	0.04	0.05
Rho	0.6	0.62	0.62	0.58	0.66	0.58	0.58	0.6	0.56	0.64

Note: ***, **, *, # denote level of significance at 1, 5, 10 and 15 % respectively.

Table 2: Estimations including regional-time dummies and for low-middle income countries

	5 years overlapping				5 years non overlapping			
	1	2	3	4	5	6	7	8
	Region time dummies	Region time and low middle income	Region time dummies	Region time and low middle income	Region time dummies	Region time and low middle income	Region time dummies	Region time and low middle income
ECSS	0.118*	0.110*			0.219**	0.213**		
	[0.063]	[0.062]			[0.107]	[0.107]		
ECSS-variance			0.026	0.022			-0.087	-0.098
			[0.043]	[0.045]			[0.059]	[0.064]
ECSS covariance			0.428***	0.436***			0.751***	0.776***
			[0.125]	[0.128]			[0.223]	[0.227]
ToT volatility	0.003	-0.001	0.001	-0.004	-0.003	-0.009	-0.003	-0.01

We use two additional approaches to control for a possible endogeneity problem in our panel regressions. First, we change the estimation method and use the generalized method of moments (GMM) for dynamic models of panel data developed by Arellano and Bond (1991). Second we instrument ECSS by the inverse of the number of trading partners. We expect that countries with a larger number of trading partners will be less exposed to external country specific risk because they find it easier to mitigate the impact of demand shocks in individual trading partners. This takes place through two channels: First, with a larger variety of partners, each individual partner matters less for overall exports, and exports become less volatile by the law of large numbers. Second, whenever a shock hits a particular partner, firms can more easily offset the shock by redirecting exports to another trading partner.

Table 3 shows the results of the GMM and the instrumental variable regressions, again for overlapping and non-overlapping samples. The GMM regressions confirm our previous results as ECSS is always significant in both the overlapping and the non-overlapping samples. When instrumenting ECSS with the inverse of number of trading partners the ECSS is significant at the one per cent level in the overlapping sample. It is significant at the five per cent level in the larger non-overlapping sample, but it loses significance when using a smaller sample. Our instrument, however, always has the expected sign and is significant at the one per cent level in the first stage regression. In other words, the results suggest that

Table 3: GMM and Instrumental variable estimations

	overlapping				non overlapping			
	Dynamic GMM	Dynamic GMM	Instrumental Variable (inverse N partners)	Instrumental Variable (inverse N partners)	Dynamic GMM	Dynamic GMM	Instrumental Variable (inverse N partners)	Instrumental Variable (inverse N partners)
ECSS	0.027*	0.034**	0.817***	0.829***	0.362***	0.174**	0.660**	0.284
	[0.014]	[0.015]	[0.259]	[0.235]	[0.053]	[0.080]	[0.294]	[0.309]
Government expenditd9	Tc-							

6.   Conclusions

This paper contributes to the literature examining the effect of external shocks on domestic volatility by focusing on the role of demand shocks in partner countries. Recent contributions to the theoretical trade literature emphasize the existence of fixed cost

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Appendix

Table A.1: Sample statistics for main

Table A.2: Description of main variables and their sources

VARIABLE	DESCRIPTION	SOURCE
GDP volatility	Standard deviation of the growth rate of GDP at constant prices	WDI
ToT volatility	Standard deviation of the terms of trade index.	New York University
ECSS (Exposure to Country Specific Shocks)	$$\sum_j (\frac{x_{i,j}}{Xi})^2 \operatorname{var} GDPgrowth_j + \sum_j \sum_z \frac{x_{i,j}}{X_i} \frac{x_{i,z}}{X_i} \operatorname{cov}(GDPgrowth_j, GDPgrowth_z)$$ Variance of the growth rate of the demand for exports	WDI and COMTRADE
ECSS-covariance	Covariance component of ECSS, $$\sum_j \sum_z \frac{x_{i,j}}{X_i} \frac{x_{i,z}}{X_i} \operatorname{cov}(GDPgrowth_j, GDPgrowth_z)$$	
ECSS-variance	Variance component of ECSS, $$\sum_j (\frac{x_{i,j}}{Xi})^2 \operatorname{var} GDPgrowth_j$$	
Openness	Exports plus imports divided by GDP. All variables are in current prices, mean over 5 years	WDI

Military
Intervention

Appendix Table 3: Sample statistics for all variables

variable	mean	p50	min	max	sd	Number of observations
GDP volatility	3.37	2.55	0.19	52.07	3.14	3281
ToT volatility	10.14	6.19	0.00	156.72	12.97	3281
ECSS	2.13	1.16	0.02	71.34	3.23	3281
ECSS-covariance	0.93	0.49	-13.27	24.58	1.55	3281
ECSS-variance	1.20	0.57	0.04	84.62	2.55	3281
Openness	0.64	0.56	0.08	3.69	0.36	3281
Military Intervention	0.25	0.00	0.00	1.00	0.43	3281

Appendix Table 4: Correlations between main variables, regression samples, five-year overlapping

	GDP volatility	ToT volatility	ECSS	ECSS-covariance	ECSS-variance	Openness	GDP per capita	Population	Government expenditure	Financial openness	Exchange rate volatility	Military Intervention	Civil War
GDP volatility	1												
ToT volatility	0.14	1.00											
ECSS	0.26	0.10	1.00										
ECSS-covariance	0.26	0.13	0.63	1.00									
ECSS-variance	0.17	0.05	0.88	0.19	1.00								
Openness	0.09	-0.11	0.01	0.01	0.00	1.00							
GDP per capita	-0.25	-0.24	-0.13	-0.02	-0.15	0.07	1.00						
Population	-0.08	-0.04	-0.03	-0.01	-0.04	-0.24	-0.02	1.00					
Government expenditure	0.17	0.02	0.16	0.04	0.18	0.21	-0.20	0.05	1.00				
Financial Openness	-0.18	-0.17	-0.04	-0.02	-0.03	0.22	0.58	-0.06	-0.10	1.00			
Exchange Rate Volatility	0.10	0.16	0.03	0.04	0.01	-0.14	-0.10	0.00	-0.02	-0.13	1.00		
Military Intervention	0.04	0.02	-0.01	0.00	-0.01	-0.20	0.02	0.27	0.12	-0.04	0.07	1.00	
Civil War	0.15	0.07	0.04	0.06	0.02	-0.147	-0.18	0.12	0.01	-0.16	0.03	0.07	1.00

Appendix Table 5b: Interacting external shocks with openness (5 years non overlapping)

	Non-overlapping sample				Regional-time & low income	Regional-time & low income
	Panel regression, cluster errors					
ECSS	-0.101	-0.12	-0.14	-0.156	-0.202**	-0.202**
	[0.081]	[0.079]	[0.130]	[0.132]	[0.094]	[0.094]
Openness*ECSS	0.517**	0.507**	0.521**	0.547**	0.613***	0.613***
	[0.202]	[0.199]	[0.223]	[0.236]	[0.230]	[0.230]
ToT volatility	-0.019	-0.016	-0.025	-0.021	-0.035	-0.035
	[0.023]	[0.023]	[0.036]	[0.036]	[0.028]	[0.028]
Openness*ToT volatility	0.025	0.025	0.07	0.068	0.042	0.042
	[0.042]	[0.042]	[0.059]	[0.059]	[0.045]	[0.045]
Openness	-0.361	0.463	-1.65	-1.468	-0.353	-0.353
	[0.861]	[0.931]	[1.108]	[1.172]	[1.368]	[1.368]
Government expenditure			0.021	0.012		
			[0.040]	[0.039]		
Financial openness			-0.152	-0.131		
			[0.108]	[0.114]		
Exchange rate volatility			0.004***	0.004***		
			[0.001]	[0.001]		
oil73	0.158		0		-0.39	
	[0.386]		[0.000]		[0.687]	
oil79	0.554*		-0.025		1.738**	
	[0.309]		[0.330]		[0.730]	
Year fixed effects	NO	S	N	Tc34.4117	80(	[0.i