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Abstract

This paper focuses on the welfare costs of exposure to shocks linked to trade openness, an issue that is of main interest for international economic policy. It addresses the question as to whether the current process of trade liberalisation has a net destabilising effect on partner countries, increasing their vulnerability.

Starting from a broader definition of vulnerability than simply vulnerability to poverty because of trade openness, this paper highlights, presenting both probit and 3SLS estimates, a robust and significant long term relationship (1960-2007), in a large sample of countries, between the "extreme volatility" of consumption (crisis and boom) - induced by trade openness - and the deviation of consumption growth from its expected path.

The novelty of this paper lies in its ability to match two strands of the literature (volatility and vulnerability). It improves the existing literature on aggregate volatility by adding a forward looking lens; a feasible notion of benchmark and a counterfactual, all essential elements of a vulnerability framework.

Keywords: trade openness, vulnerability, volatility, probit, 3SLS.

JEL: F40; F10; C82; E17; D60

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1. Introduction

After the Asian crisis, the issue of vulnerability, i.e. the welfare costs of risks, has been gaining ground in trade analysis too. The open question is the following: does trade openness[1] magnify the "risk exposure" of the open economy and/or increase uncertainty towards the future on certain domestic actors, with negative consequences on long term growth and welfare? This question has proven not to have a once-for-all answer (Montalbano, 2009). In dealing with the above topic, we should take into account two main constraints: i) the scattered nature of the empirical works on the effect of trade openness on developing countries' economic stability; ii) the limits of current vulnerability analyses, most of which are focussed on households, adopt a poverty line as a threshold, and are based on household surveys not designed to provide a full accounting of the actual impacts of shocks.

This paper aims at offering a substantive contribution to the debate on the effects of trade openness on developing countries' vulnerability. It presents empirical estimates grounded on a sound method of analysis and improves the existing literature on aggregate volatility by adding a forward looking lens; a feasible notion of benchmark and a counterfactual, all essential elements of a vulnerability framework.

The main result of this empirical test is to highlight a robust and significant statistical relationship between the "extreme volatility" of consumption - crisis and boom - and the likelihood and severity of the deviation of consumption growth from its expected path. This relation holds for a long time span (1960-2007) and a large sample of countries (147). The added value of this work is to highlight the relevance of this phenomenon, usually covered up in the standard analyses on trade, growth and poverty, and to demonstrate that phenomena of vulnerability to trade can co-exist with a positive trade and growth relationship.

2. Vulnerability to trade: what we know?

Provide a clear cut notion of vulnerability to trade openness is not straightforward. All individuals, households, communities and even countries face multiple risks, both natural and man-made, from different sources. However, a mere situation of risk exposure or a simple subjective feeling of vulnerability are not sufficient for policy targeting. Moreover, the link between vulnerability and trade openness remains ambiguous. If we take into account the redistributive nature of trade, it is certainly not possible to denounce any shock that may cause even a single individual to suffer a reduction in income. Furthermore, the simplest analysis of risk suggests that at low levels of trade (as typical in

[1] This work will not specifically address the long standing debate on the relative measures of trade liberalisation and openness. It builds on McCulloch et al. (2001) views that the relative openness of countries depends largely on the extent to which international trade determines local prices, regardless of whether this depends mainly on deliberate policies or not. For a comprehensive list of standard measures of trade openness, see McCulloch at al. (2001).

developing economies), further trade liberalisation would tend to reduce risk exposure because (larger) world markets with many players are likely to be more stable than (smaller) domestic ones (Winters, 2002). However, if world markets are more variable than domestic ones we can get the opposite effects. At the same time, if external shocks are different in nature, foreign exposure brings a "*new set*" of shocks that may raise uncertainty, lower expected utility (Calvo and Dercon 2003 and 2007; Ligon and Schechter 2003 and 2004) and harm people's standard ability to cope (Dercon, 2001). Finally, people can be unwilling or unable to undertake new potentially profitable activities induced by trade liberalisation because of increasing uncertainty. In this case, they will suffer the adverse effects of trade reforms without the compensating benefits of higher average earnings (Winters, 2000; Winters et al., 2004).

Trade literature on the issue is fuzzy (Montalbano, 2009). It does not deal adequately with the issue of the likely vulnerability hazard to trade openness. While most of the empirical studies establish a consistent and significant positive correlation between trade reforms, growth and poverty reduction (Edwards, 1993; Frankel and Romer, 1999; Dollar and Kraay, 2001, 2002, Cline, 2004; Winters, 2004) examples of countries that enjoy a good socio-economic performance and a fair degree of stability, but remain highly vulnerable to external shocks and uncertainty linked to trade openness are increasing nowadays. It is also likely that episodes of trade liberalisation have increased the risks faced by the poor and in some cases, also their vulnerability. Despite the attention paid to the idiosyncratic shocks on individual agents, the existence of sizable covariate shocks have been largely overstated. Macroeconomic crises, for instance, have proven to hurt the poor, or those close to the poverty line, even if they has not affected local populations disproportionately (Lustig, 2000). This because during macroeconomic crises, as with most covariate shocks, self-insurance, informal insurance, and market-based smoothing mechanisms such as credit are likely to be less effective, particularly for poor people. With covariate shocks, both the value of assets held by the poor and the incomes of their associates in informal insurance arrangements fall, precluding the use of either as a safety net (Jalan and Ravallion 1999, Lustig, 2000).

The debate on the topic is intense, focusing on the options and strategies to help developing countries capture the benefits of trade integration minimising the risks of negative shocks. While a lot of significant and informative works have been carried out in recent years to assess the potentially destabilising effects of trade openness in developing countries, these works remain scattered in a vast array of methods and empirical instruments and separated in different, often non-communicating, fields of investigation and did not achieve a common stand on the issue. Generally speaking, according to these empirical works, the role of trade openness on countries' economic stability is twofold: it is a key determinant of aggregate volatility which is the more widely used proxy of "uncertainty"[2] (Mendoza 1995; Gavin and Hausmann, 1996; Prasad and Gable, 1998; Rodrik 1998; Kose 2002; Kose and Yi 2001 and 2006, Wolf, 2004a; Kose et al, 2005) and it is

[2] Please note that for concentrated variables, the variance is the most widely accepted measure of the cost of risk.

a key transmission channel for crisis contagion (Milesi-Ferretti and Razin, 1998, 2000; Cavallo and Frankel , 2008), especially in regional contexts (Glick and Rose, 1999 and Easterly and Kraay, 1999; Forbes, 2001).

However, the empirical evidence is mixed. Regarding the trade and volatility link, some studies find that an increase in the degree of trade openness leads to higher output volatility, especially in developing countries (Easterly et al., 2001, Kose et al 2003; Loayza and Raddatz, 2007; Di Giovanni and Levchenko, 2006; Krishna and Levchenko, 2009); others find no significant relationship between an increased degree of trade interdependence and domestic macroeconomic volatility (Calderòn et al., 2005; Kose et al., 2006; Cavallo, 2007) or just a temporary one (Santos-Paulino, 2007). Concerning the analysis of the linkages between trade openness and economic crises, Cavallo and Frankel (2008), following closely the definition of Calvo et al. (2003), Frankel and Rose (1996) and Frankel and Wei (2004) find no evidence that trade openness makes countries vulnerable to sudden stops and currency crises. However, Eichengreen and Rose (1998), Glick and Rose (1999) and Forbes (2001) argue that - no matter who is the "first victim" of the speculative attack and what factors are behind it - there is a strong evidence that currency crises tend to spread regionally because of trade linkages.

The above empirical studies apply heterogeneous methods. Among the most recent exercises, Kose et al. (2003); Hnatkovska and Loayza (2004); Wolf (2004a); Calderòn et al. (2005) use panel data to measure the "external exposure" of a worldwide sample of countries by the sensitivity of first and second moments of economic growth (average rate and standard deviation) to openness and financial shocks. They also allow for the possibilities of non-linearities by assessing the dependence of the effects of trade and financial openness on the level of per capita income. On the same wake, Loayza and Raddatz (2007) apply semi-structural VAR to a panel of 90 countries with annual observations for the period 1974-2000 in order to isolate and standardise the shocks; estimate their impact on GDP and examine whether and to what extent this impact depends on the domestic conditions.[3] Santos-Paolino (2007) too applies the same Panel VAR approach for a selection of SIDS from the Caribbean[4]. Malik and Temple (2006), in their effort to explain differences in output volatility across developing countries, use instead a bayesian method to highlight explanatory variables that are robust across a wide range of specifications.[5] They show the pervasive role of geography in determining aggregate volatility: since remoteness is associated with a lack of export diversification, a significant phenomenon of high volatility of terms-of-trade and output of the more remote

[3] The Panel VAR methodology links the traditional VAR technique with panel-data methodology, which allows for individual (country) heterogeneity. The asymptotic properties and advantages of estimating VARs with panel data are discussed by Holtz-Eakin, Newey and Harvey (1988) and Gilchrist and Himmelberg (1998).

[4] The Small Islands Development States (SIDS) are States characterised by a "natural and/or endogenous inability to face external shocks" . A presumptive "special status" of SIDS (Small Island Development States) has been affirmed at the first Global Conference on Sustainable Development of Small Island Developing States in Barbados in April 1994.

[5] The use of a bayesian approach is justified by the fact that the number of candidate explanatory variables is large and theories about volatility are not mutually exclusive.

countries is apparent. This result is not sensitive to the regression specification, nor it is driven by the contrasting geographies of low income and high income countries. An interesting exercise to assess the effects of trade liberalisation on poverty in a context of volatile commodity markets has been proposed also by Valenzuela (2006), who attempts to use an innovative application of a stochastic framework in combination with Global CGE model and a micro-household simulation.[6] An extensive use of Probit models has been done, finally, to measure the probability of a sudden stop[7] (Cavallo and Frankel, 2007; Calvo et al., 2003; Frankel and Rose, 1996; Frankel and Wei, 2004; Glick and Rose, 1999).

It emerges from this brief review of the literature how current empirical analyses on the destabilising effects of trade openness remain basically ex post studies, mainly targeted to issues not directly linked to vulnerability. An additional effort is needed to build a sound methodology to assess vulnerability to trade openness. To this end, however, it is necessary to fulfil a number of pre-requisites and propose amendments to current literature. First of all, there is the need to move from ex post assessments, based on aggregate volatility or "crisis transmission", to an ex ante measure of the likelihood and magnitude of experiencing a reduction of well being induced by trade openness (or the process of opening up). Second, we ought to give an answer to the longstanding debate about the choice of a "*benchmark*" able to discern actual situation of vulnerability from normal variability (Alwang et al., 2001). Indeed, since everybody is, in principle, subject to a decline of well being in case of a negative shock occurs, without using a benchmark, the notion of vulnerability remains too imprecise for practical use. Hence, to get a true vulnerability measure, we should define a minimum social norm and a probability to fall below it. A minimum consumption level, usually linked to the poverty line, is normally applied by monetary vulnerability measures. Thirdly, since vulnerability is not directly observable, we should provide not only a factual analysis but a sound counterfactual too, i.e. a measure of the level of well being that would have prevailed in the absence of shocks. This is the most tricky issue to deal with vulnerability analysis since people are not able to estimate adequately the extent of the welfare cost loss of shocks (Tesliuc and Lindert, 2004). Finally, we should broaden our views on the vulnerability phenomenon as well as acknowledge the severe data limitations of existing household surveys which are not designed to provide a full accounting of the actual impacts of shocks and ignore a number of relevant policies' issues such, in a globalised world, "man-made" external shocks (Dercon, 2001).

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[6] The issue of CGE validation employing stochastic simulation is still under debate. Valenzuela et al. (2007) seek to validate the GTAP (Global Trade Analysis Project) model (Hertel 1997), by testing the model's capacity to replicate price volatility using shocks derived from a time-series model of wheat production. They conclude that the model performs relatively well for some regions of the world but it is still impossible to validate such models, as already noted by Gass (1983).The main weakness is related to the incomplete transmission of world price signals into the domestic markets of the major importing countries, an issue already highlighted by Winters (2000), who underlines a number of factors that can limit the extent of transmission between changes in border prices induced by external liberalisation and price changes actually experienced by producers and consumers at the local level.

[7] The expression "sudden stops" as synonymous of crisis was first used by Dornbusch, Goldfajn and Valdés (1995).

Acknowledging the above limits, we do present a sound and innovative empirical approach to vulnerability to trade analysis. The main innovations are: the use of a broader definition of vulnerability; the adoption of a suitable benchmark and a true counterfactual; the use of consumption volatility instead of income as a measure of risk[8].

3. Assessing "vulnerability to trade": a cross-country empirical test

While vulnerability to trade usually stands for vulnerability to poverty because of trade openness and embodies all the limits of standard poverty analyses (see Chaudhuri et al., 2002), we assume here, accordingly to Montalbano et al. (2006 and 2008); Guillaumont (2009); Naudé et al. (2009), a broader definition of vulnerability to trade as, overall, the likelihood that an economic system would undergo a negative outcome (below a certain norm or benchmark) because of a "perturbation". The above definition of vulnerability suits well to be applied to a broad range of welfare measures, benchmarks and shocks, enlarging our views on vulnerability from the simple notion of "expected poverty" as it has been traditionally locked in (Montalbano, 2009).

As already underlined, two issues are key in our approach to vulnerability: the choice of a suitable benchmark and an adequate proxy of "perturbation". To address the first one, we introduce in our analysis the notion of "consumption gap"; to address the latter that of "extreme volatility". "Consumption gap" is calculated as simply as the difference between the "expected level" of consumption growth and its observed level in presence of shock. If the observed level lies below the expected one (i.e the consumption gap is positive), the difference (i.e the gap level) measures the extent of the negative effect of shocks on consumption growth; if the observed level lies above (i.e. the consumption gap is negative) the difference measures the extent of the positive effect of shocks on consumption growth. The "expected level" of consumption growth is derived by extracting the smooth component from the observed consumption growth time series, using the Christiano-Fitzgerald (2003) band-pass filter[9]. Since this measure of "expected consumption" represents the path of consumption growth that each country would reach in the absence of shocks, it serves in our analysis as a suitable counterfactual. The adoption of this counterfactual permits us to overcome all the limits of simple specifications of vulnerability that risk to emphasise the impacts of shocks using shock dummies in consumption regressions (see Tesliuc and Lindert, 2001; Datt and Hoogeveen, 2000).

[8] Consumption variability can be considered a better measure of risk than income volatility since the consumption of an optimising household changes only in response to unexpected changes in income, thus highlighting the presence of true risks.

[9] Business cycle filters are used to decompose time series into a long-term trend, a short-term noise and a medium-term business cycle. There are virtually three kinds of time-series filters: the lowpass filter, which "passes" only the low frequencies; the highpass filter, which passes only the high frequencies; and the bandpass filter, which passes only the frequencies within a certain frequency band, i.e. they remove both short-term noise and long-term trends. The most common "bandpass filters" are the Baxter and King filter (BK) and the Christiano-Fitzgerald (2003) random Walk filter (CF). Indeed, the latter has proven to dominate in matching to the optimal bandpass filter even when the time series does not follow a random walk and, unlike the BK filter, has the advantage of not loosing observations. Moreover, our sample tests confirm that CF performs best when compared with other common time-series filters.

Regarding the issue of "perturbation", we are aware that collecting data on ex-post total volatility may overestimate risk (Dehn, 2000; Hnatkovska and Loyaza, 2004; Aizenman and Pinto, 2005). Hence, we adopt the Hnatkovska and Loyaza (2004) method to decompose total variability into two separate components: "normal" and "extreme" variability[10] on the assumption that only the larger or extreme fluctuations, positive and negative ("boom" and "crisis" volatility), are somewhat unpredictable and suitable to be considered as proxy of a true "perturbation" to economic growth. It follows that our vulnerability analysis is grounded on the notions of "boom" and "crisis" volatility, computed as the portion of the standard deviation of consumption growth that corresponds respectively to upward and downward deviations from a certain threshold (see examples of volatility decomposition in the appendix, fig. 1A)[11].

A glance to the raw data on consumption volatility, consumption growth and consumption gap for the full sample of countries during the entire period 1960-2007 and by decades[12], organised by income, level of openness and degree of fiscal policy pro-cyclicality[13], provides no clear evidence of a substantial phenomenon of vulnerability of specific categories of countries (Table 1). Actually, the richer and more open economies show a better path of consumption growth in the long run. The richer countries show a lower degree of volatility too, while, on the contrary, the countries characterised by high level of trade openness show higher volatility trends. The degree of fiscal policy pro-cyclicality seems do not affect the structural trends. Moreover, the consumption gaps are, on average, negative, highlighting that, generally speaking, the observed paths of consumption growth tend to be higher than its expected trends. Moving to simple cross-country correlations, as expected and largely confirmed by the empirical literature, it becomes more evident a negative correlation between volatility and consumption growth in the case of the poorer and less open countries in the sample (table 2). This relationships holds, on average, by decades. However, the phenomenon keeps to be uncorrelated with the economic policy behaviour, since the correlation between consumption volatility and growth is negative both in case of pro-cyclical and counter-cyclical policies. Surprisingly, however, consumption volatility is negatively correlated with our measure of "consumption gap" as well.

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[10] See Hnatkovska and Loyaza (2004) for details on the decomposition method.

[11] In this exercise, we adopt as threshold the standard deviation of consumption growth σ with respect to the average consumption growth μ: observations with consumption growth greater than $\mu+\sigma$ belong to "boom volatility"; observations with consumption growth lower than $\mu-\sigma$ to "crisis volatility".

[12] Following Dehn (2000), to minimise the bias of potentially sensitivity to outliers, we calculate our aggregate variable as averages and standard deviations over a ten-years time span (a decade) starting from the last available observation. The adoption of longer time spans would be inconsistent with the stylized fact of a vulnerability phenomenon that changes over time (Aizenman and Pinto, 2004). It is worth noting that changing the composition of the decade moving backwards annually would have slight effects on the final outcomes.

[13] Fiscal Policy Prociclicality is defined as the correlation between the annual rates of change of GDP and the annual rates of changes of general government final consumption expenditure over a given period.

Table 1 - Consumption growth, consumption gap and volatility by decades

Sample / Subsample		Average consumption growth						Average consumption gap						Volatility of consumption's rates of change					
		Full sample	Subperiods					Full sample	Subperiods					Full sample	Subperiods				
		60-07	60-67	68-77	78-87	88-97	98-07	60-07	60-67	68-77	78-87	88-97	98-07	60-07	60-67	68-77	78-87	88-97	98-07
Full Sample		2.3%	2.8%	3.0%	0.9%	1.6%	2.7%	-0.2%	0.0%	-0.3%	-0.1%	-0.4%	-0.2%	0.07	0.05	0.05	0.06	0.06	0.05
	N. Obs.	147	75	85	104	140	147	147	75	85	104	140	147	147	75	85	104	140	147
By Income:																			
High Income		3.0%	3.9%	3.8%	2.3%	2.0%	2.9%	-0.1%	0.1%	-0.1%	-0.1%	-0.1%	-0.1%	0.04	0.02	0.03	0.03	0.04	0.03
(OECD countries+Israel)	N. Obs.	40	25	27	29	39	40	40	25	27	29	39	40	40	25	27	29	39	40
Middle Income		2.7%	2.6%	4.1%	1.1%	1.9%	3.3%	-0.2%	-0.1%	-0.5%	-0.3%	-0.2%	-0.2%	0.07	0.06	0.05	0.07	0.07	0.05
(upper- and lower-middle income countries)	N. Obs.	71	31	36	48	67	71	71	31	36	48	67	71	71	31	36	48	67	71
Low Income		0.7%	1.6%	0.4%	-1.0%	0.5%	1.1%	-0.3%	0.0%	-0.1%	0.1%	-1.0%	-0.2%	0.09	0.05	0.08	0.07	0.09	0.07
(low income countries)	N. Obs.	36	19	22	27	34	36	36	19	22	27	34	36	36	19	22	27	34	36
By Trade Openness:																			
High Trade Openness		3.3%	3.5%	4.5%	1.8%	1.9%	3.7%	-0.3%	0.3%	-0.4%	-0.7%	-0.3%	-0.2%	0.08	0.05	0.04	0.08	0.08	0.06
(countries with trade volume/GDP >100%)	N. Obs.	50	17	18	31	49	50	50	17	18	31	49	50	50	17	18	31	49	50
Medium Trade Openness		1.6%	2.6%	2.1%	-0.2%	1.4%	2.1%	-0.2%	-0.1%	-0.2%	0.5%	-0.6%	-0.2%	0.07	0.05	0.06	0.06	0.07	0.06
(countries with trade volume/GDP >67% And <100%)	N. Obs.	49	25	30	32	46	49	49	25	30	32	46	49	49	25	30	32	46	49
Low Trade Openness		1.9%	2.5%	3.1%	1.1%	1.4%	2.2%	-0.1%	0.0%	-0.3%	-0.2%	-0.2%	0.0%	0.05	0.04	0.05	0.04	0.04	0.03
(countries with trade volume/GDP <67%)	N. Obs.	48	33	37	41	45	48	48	33	37	41	45	48	48	33	37	41	45	48
By Degree of Fiscal Policy Procyclicality:																			
Highly Procyclical Fiscal Policy		2.3%	3.4%	3.5%	0.7%	0.3%	3.5%	-0.1%	-0.2%	-0.3%	-0.2%	-0.3%	-0.2%	0.07	0.05	0.04	0.06	0.07	0.05
(corr[D%Y, D%GC] >43%)	N. Obs.	49	20	24	27	46	49	49	20	24	27	46	49	49	20	24	27	46	49
Medium Procyclical Fiscal Policy		2.3%	3.0%	3.1%	1.2%	2.3%	2.3%	-0.2%	-0.1%	-0.2%	-0.2%	-0.1%	-0.2%	0.06	0.05	0.04	0.05	0.06	0.04
(corr[D%Y, D%GC] 16%> And <43%)	N. Obs.	50	33	36	41	48	50	50	33	36	41	48	50	50	33	36	41	48	50
Counter-cyclical Fiscal Policy		2.2%	1.9%	2.5%	0.6%	2.1%	2.3%	-0.3%	0.3%	-0.3%	0.0%	-0.7%	-0.1%	0.07	0.04	0.06	0.07	0.07	0.06
(corr[D%Y, D%GC] <16%)	N. Obs.	48	22	25	36	46	48	48	22	25	36	46	48	48	22	25	36	46	48

Source: authors' estimations

Table 2 - Simple Correlations Cross-Sectional Analysis

Simple correlation between		Average per capita consumption growth and Standard deviation of per capita consumption growth						Consumption gap and Standard deviation of per capita consumption growth					
		Period						Period					
Sample / Subsample		Full sample	Subperiods					Full sample	Subperiods				
		60-07	60-67	68-77	78-87	88-97	98-07	60-07	60-67	68-77	78-87	88-97	98-07
Full Sample		0,01	0,11	-0,11	-0,10	0,02	-0,08	-0,53	-0,45	-0,35	-0,49	-0,49	-0,24
	N. Obs.	147	75	85	104	140	147	147	75	85	104	140	147
By Income:													
High Income		0,41	0,32	0,48	0,39	0,08	0,62	-0,30	-0,02	-0,61	-0,37	-0,27	-0,36
(OECD countries+Israel)	N. Obs.	40	25	27	29	39	40	40	25	27	29	39	40
Middle Income		0,22	0,18	0,21	-0,02	0,19	-0,12	-0,50	-0,53	-0,34	-0,66	-0,34	-0,14
(upper- and lower-middle income countries)	N. Obs.	71	31	36	48	67	71	71	31	36	48	67	71
Low Income		-0,25	0,46	0,01	-0,11	-0,25	-0,21	-0,59	-0,57	-0,60	-0,29	-0,69	-0,27
(low income countries)	N. Obs.	36	19	22	27	34	36	36	19	22	27	34	36
By Trade Openness:													
High Trade Openness		0,16	0,28	-0,22	-0,13	-0,07	-0,12	-0,61	-0,71	-0,09	-0,85	-0,43	-0,38
(countries with trade volume/GDP >100%)	N. Obs.	50	17	18	31	49	50	50	17	18	31	49	50
Medium Trade Openness		-0,31	0,46	-0,34	-0,26	0,15	-0,09	-0,36	-0,62	-0,58	-0,25	-0,58	-0,19
(countries with trade volume/GDP >67% And <100%)	N. Obs.	49	25	30	32	46	49	49	25	30	32	46	49
Low Trade Openness		-0,03	-0,25	0,22	0,04	0,00	-0,09	-0,48	-0,06	-0,35	-0,48	-0,57	0,12
(countries with trade volume/GDP <67%)	N. Obs.	48	33	37	41	45	48	48	33	37	41	45	48
By Degree of Fiscal Policy Procyclicality:													
Highly Procyclical Fiscal Policy		-0,04	-0,06	0,35	-0,23	-0,30	-0,09	-0,07	-0,14	-0,44	-0,42	-0,54	-0,26
(corr[Δ%GDP, Δ%Government Consumption Expenditure] >43%)	N. Obs.	49	20	24	27	46	49	49	20	24	27	46	49
Medium Procyclical Fiscal Policy		0,16	0,19	-0,30	-0,10	0,17	0,24	-0,77	-0,81	0,03	-0,40	-0,20	-0,47
(corr[Δ%GDP, Δ%Government Consumption Expenditure] >16% And <43%)	N. Obs.	50	33	36	41	48	50	50	33	36	41	48	50
Counter-cyclical Fiscal Policy		-0,06	0,26	-0,21	-0,03	0,38	-0,24	-0,79	-0,49	-0,68	-0,63	-0,59	-0,13
(corr[Δ%GDP, Δ%Government Consumption Expenditure] <16%)	N. Obs.	48	22	25	36	46	48	48	22	25	36	46	48

Source: authors' estimations

This implies that the more volatile countries show, ceteris paribus, lower consumption gaps. In this case, however, the ability to maintain a counter-cyclical fiscal policy seems to be much strongly negatively correlated with a positive consumption gap (Table 2).

Raw data and simple cross-country correlations actually give no insights about the key issues of the interdependence and causality among the observed variables as well as on the statistical and economic significance of the above relationships. In order to provide more robust estimates, we thus run a sound empirical test of vulnerability to trade openness. In this exercise, vulnerability to trade is defined as the probability that large or extreme fluctuations of consumption growth – above a certain cut off point in magnitude – (i.e. extreme volatility), induced by the volatility of trade variables, will cause a reduction of consumption growth below its expected path (i.e. a positive consumption gap). The intuition behind this empirical test is that vulnerable countries are supposed to be characterised, *ceteris paribus*, by a higher probability to be harmed by negative shocks on consumption (i.e. a positive consumption gap) as a result of covariate shocks in an open environment. This can be explained by the fact that trade openness brings a new set of shocks that can harm people's standard ability to cope (Dercon, 2001) or that it simply increases uncertainty, harming the capacity of people to undertake profitable activities by both increasing the riskiness of existing activities and/or haltering their optimal portfolio, changing the weight of foreign relative to domestic shocks (McCulloch et al., 2001; Winters, 2002; Winters et al., 2004). It goes beyond the scope of the present empirical work going into details to the different approaches to vulnerability analysis at the household level (see Montalbano, 2009). Similarly, we do not provide here any additional taxonomy about the most common covariate trade shocks as well as their transmission channels, at the country level (see Winters, 2000). Our aim here is to present a sound empirical method to look at the vulnerability issue of open economies, overcoming simple positive relationships between trade liberalisation and growth or volatility and growth, which are common in the literature. The novelty of this work concerns specifically its ability to match two strands of the literature (volatility and vulnerability) adding a forward looking approach to standard cross-country analyses on the destabilising effects of trade openness. It also addresses the key issue of the benchmark of the vulnerability measure - able to distinguish true situations of vulnerability from standard economic downturns - as well as the counterfactual in a feasible way.

To run our empirical test, we firstly apply a probit regression. It assesses the actual probability of registering a positive consumption gap induced by the "extreme volatility" of consumption (boom and crisis) linked to trade openness. Since there are strong reasons to believe there is a problem of endogeneity[14] and this presumption seems to be confirmed by our tests, we do apply a two steps probit model with instrumental variables (2SIVProbit) for both boom and crisis consumption volatility. The model controls also for unobserved time- and country-specific effects. The estimated probit regression is thus the following:

[14] Endogeneity induces a correlation between the explanatory variable and the true (unobserved) error term, which violates the OLS assumptions and leads to biased estimation.

$P(cg_{it}>0) = \beta_0 + \beta_1 boom\_vol_{it} + \beta_2\, crisis\_vol_{it} + \beta_3\, avcgr_{it} + \beta_4\, dd_i + \varepsilon_{it}$

where:

$cg_{it} = lncgr_{it}^* - lncgr_{it}$
$lncgr_{it}^*$ *is the natural log of the smooth component of consumption growth*
$lncgr_{it}$ *is the natural log of the observed consumption growth*
$crisis\_vol_{it}$ *and* $boom\_vol_{it}$ *are, respectively, the instrumented variables for boom and crisis components of the volatility of the rates of changes of per capita consumption. They are calculated as:*
$crisis\_vol_{it} = \gamma IV_{it} + u_{it}$;
$boom\_vol_{it} = \rho IV_{it} + w_{it}$;
where:
$IV_{it} = \lambda voltot_{it} + \psi voltop_{it} + \omega fpp_{it} + \nu dc_i$
and $voltot_{it}$ *is the volatility of the rates of change of terms of trade;* $voltop_{it}$ *is the volatility of the rates of change of trade openness;* fpp_{it} *is our measure of fiscal policy procyclicality*[15]; dc_i *are dummies for unobserved time-invariant countries' fixed effects.*
It holds that $E(crisis\_vol_{it} * \varepsilon_i) \neq 0$ *and* $E(boom\_vol_{it} * \varepsilon_i) \neq 0$ *but* $E(IV_{it} * \varepsilon_i) = 0$
$avcgr_{it}$ *is the average consumption growth of country i in period t.*
dd_t *is a dummy for unobserved time-varying fixed effects for each decade (it introduces a period specific intercept).*
ε_i *are the regression residuals that are assumed to be uncorrelated with zero mean and* $Var(\varepsilon_i) = \sigma^2$;
i = country
t = 1, 2, …, 5 decades (1960-67; 1968-77, 1978-87; 1988-97; 1998-2007)

The above probit regression has been applied to the full sample of 147 countries over the entire time span (1960-2007). Data source is World Bank, World Development Indicators.

Table 3 shows our IVProbit results. It highlights, overall, that countries that register phenomena of crisis consumption volatility (i.e. the downward side of extreme volatility), present, ceteris paribus, a robust and highly significant probability to get a positive consumption gap, while the opposite happens in the case of boom volatility (i.e. the upward side of extreme volatility). Moreover, the model shows, as largely expected, that the average level of consumption growth do matter: countries characterised by faster growth are, ceteris paribus, more likely to register a consumption path above its expected level. We tested also (model 2, table 3), the possibility of non linearity by allowing the above relationship to vary accordingly to the level of economic development. Indeed, the model shows that economic development matters: low income countries register, ceteris paribus, higher probability of positive consumption gaps even in a context of faster growth, while low and high income countries' average growth is strongly associated to a negative probability of a positive consumption gap. Furthermore, table 3 shows that time variant effects matter as well, and that period specific intercepts are significant and relevant for the more recent decades[16]. As above specified, our probit model does not include the observed values of "boom" and "crisis" volatility but their respective

[15] See footnote 11.

[16] The use of time varying fixed effects removes from the model the so-called "time series bias" (Baldwin and Taglioni, 2007), i.e. it permits to take into account of all the omitted terms and factors that vary across decades. The last decade does not appear in the model since it acts as the reference value for the entire set of time varying dummies.

instrumental variables. Instruments include the most common covariant trade shocks (volatility of terms of trade and volatility of trade openness); the role of policy (the fiscal policy pro-cyclicality) and control also for the unobserved time-invariant countries' fixed effects (by adding a set of countries' dummy variables). The F-tests prove the relevance of the instruments applied (we can reject the null hypothesis of irrelevance), while the Wald chi-square test prove their validity (we cannot reject the null hypothesis of exogeneity) i.e., they are uncorrelated with the error term in the structural equation.

Table 3 – Empirical results – 2S Probit with instrumental variables

	Dependent variable	
	1	2
Regressors	**Consumption Gap (0/1)**	**Consumption Gap (0/1)**
IV_boom_vol	-632.7339 ***	-687.1208 ***
	(12.06197)	*(11.97231)*
IV_crisis_vol	212.0118 ***	200.8983 ***
	(13.20615)	*(12.36154)*
avcgr	*-35.52298 ******	
	(6.233255)	
avcgr_high		-198.5096 ***
		(12.13665)
avcgr_middle		-36.68579 ***
		(7.072175)
avcgr_low		90.42322 ***
		(12.08923)
dd3	5.663635 ***	6.912225 ***
	(0.3237681)	*(0.3288467)*
dd4	4.200458 ***	4.813049 ***
	(0.2938246)	*(0.2914171)*
constant	2.726721 ***	4.023952 ***
	(0.2935767)	*(0.3105949)*
F - test boom_vol	F(80, 130) = 3.07	F(82, 128) = 4.30
	Prob > F = 0.0000	Prob > F = 0.0000
F - test crisis_vol	F(80, 130) = 3.31	F(82, 128) = 3.02
	Prob > F = 0.0000	Prob > F = 0.0000
Wald Test of exogeneity	$\chi^2(2) = 1.53$	$\chi^2(2) = 1.03$
	Prob > χ^2 = 0.4646	Prob > χ^2 = 0.5961
Number of Observations	211	211

Notes: Standard errors are reported below the corresponding coefficients.

*** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Source: Authors' estimation

Since the probit coefficients are expressed in terms of a standard deviation or z-metric, a transformation is usually required to transform them into something meaningful. We thus derive the associated probabilities of registering a positive consumption gap from the following standardised normal probability function:

$$P(cg = 1 \mid X = x) = \Phi(\beta 0 + \beta_1 boom\_vol_{it} + \beta_2 crisis\_vol_{it} + \beta_3\, avcgr_{it} + \beta_4\, dd_i)$$

Table 4 – Probability of negative shocks on consumption growth induced by trade openness (full sample of countries, period 1960-2007 and by decades)

Country	Subperiod					Country	Subperiod				
	1960-1967	1968-1977	1978-1987	1988-1997	1998-2007		1960-1967	1968-1977	1978-1987	1988-1997	1998-2007
Albania	na	na	na	0,0%	95,2%	Kuwait	na	na	na	na	0,0%
Algeria	0,0%	0,0%	100,0%	0,0%	0,0%	Kyrgyz Republic	na	na	na	0,0%	0,0%
Antigua and Barbuda	na	na	0,0%	0,0%	0,0%	Lao PDR	na	na	na	na	0,0%
Argentina	0,0%	97,5%	na	100,0%	100,0%	Latvia	na	na	100,0%	100,0%	0,0%
Armenia	na	na	na	100,0%	99,9%	Lebanon	na	na	na	100,0%	0,0%
Australia	53,3%	99,4%	100,0%	99,5%	70,7%	Lesotho	0,0%	0,0%	100,0%	0,0%	92,7%
Austria	39,9%	11,4%	100,0%	100,0%	12,5%	Lithuania	na	na	na	na	0,0%
Azerbaijan	na	na	na	99,5%	0,0%	Luxembourg	0,0%	46,6%	100,0%	99,9%	3,8%
Bangladesh	0,0%	0,0%	0,0%	100,0%	99,6%	Macao, China	na	na	100,0%	100,0%	0,0%
Barbados	na	na	na	0,0%	98,5%	Macedonia, FYR	na	na	na	0,0%	11,0%
Belarus	na	na	na	0,0%	17,3%	Madagascar	99,8%	0,1%	31,2%	44,6%	0,0%
Belgium	84,9%	6,1%	100,0%	100,0%	13,5%	Malawi	0,0%	0,0%	100,0%	0,0%	0,0%
Belize	na	na	0,0%	0,0%	95,6%	Malaysia	97,4%	7,5%	100,0%	100,0%	100,0%
Benin	40,7%	0,0%	100,0%	100,0%	100,0%	Maldives	na	na	na	na	66,6%
Bhutan	na	na	na	na	100,0%	Mali	na	0,1%	0,0%	100,0%	100,0%
Bolivia	na	0,0%	100,0%	100,0%	1,5%	Mauritania	0,0%	0,0%	0,0%	0,0%	0,0%
Botswana	na	na	0,0%	0,0%	3,6%	Mauritius	na	na	0,0%	0,0%	1,0%
Brazil	0,0%	46,3%	0,0%	97,3%	4,9%	Mexico	0,0%	83,5%	99,9%	100,0%	0,0%
Brunei Darussalam	na	na	na	0,0%	0,0%	Moldova	na	na	na	0,0%	0,0%
Bulgaria	na	na	100,0%	90,3%	0,0%	Morocco	0,0%	0,0%	100,0%	0,0%	0,0%
Burkina Faso	100,0%	3,5%	9,5%	0,0%	0,0%	Mozambique	na	na	0,0%	0,0%	100,0%
Cambodia	na	na	na	100,0%	0,0%	Namibia	na	na	0,0%	98,4%	60,0%
Cameroon	100,0%	0,0%	0,0%	100,0%	0,0%	Netherlands	0,0%	0,9%	100,0%	100,0%	0,0%
Canada	97,0%	49,0%	100,0%	100,0%	95,8%	New Zealand	99,8%	2,4%	100,0%	100,0%	46,1%
Cape Verde	na	na	na	0,0%	0,0%	Nicaragua	0,0%	0,9%	0,0%	0,0%	88,1%
Central African Republic	na	na	na	na	0,0%	Norway	2,4%	17,8%	48,4%	100,0%	15,3%
Chad	0,0%	0,0%	0,0%	0,0%	0,0%	Oman	na	na	na	0,1%	0,0%
Chile	0,0%	100,0%	100,0%	85,3%	0,0%	Pakistan	35,8%	0,0%	100,0%	0,0%	0,0%
China	0,6%	79,3%	54,7%	7,1%	0,0%	Panama	na	na	0,0%	84,7%	0,0%
Colombia	6,1%	89,5%	94,9%	0,0%	45,6%	Papua New Guinea	0,1%	1,0%	3,6%	0,0%	0,0%
Comoros	na	na	100,0%	0,0%	99,0%	Paraguay	0,0%	0,0%	0,0%	20,7%	0,0%
Congo, Dem. Rep.	0,0%	0,0%	0,0%	100,0%	0,0%	Peru	0,0%	0,0%	99,8%	91,1%	50,3%
Costa Rica	19,9%	0,0%	100,0%	0,0%	0,0%	Philippines	94,0%	90,1%	100,0%	100,0%	43,7%
Cote d'Ivoire	77,2%	29,4%	100,0%	82,7%	41,2%	Poland	na	na	na	83,3%	23,7%
Croatia	na	na	na	na	99,2%	Portugal	64,3%	0,0%	93,1%	73,2%	0,1%
Czech Republic	na	na	na	100,0%	11,6%	Romania	na	na	na	4,0%	0,0%
Denmark	0,1%	0,0%	100,0%	81,5%	2,3%	Russian Federation	na	na	na	31,2%	100,0%
Djibouti	na	na	na	17,4%	1,1%	Rwanda	0,0%	0,0%	18,9%	94,9%	84,9%
Dominica	na	na	0,0%	98,8%	0,0%	Saudi Arabia	na	na	na	na	99,9%
Dominican Republic	0,0%	0,0%	0,0%	100,0%	54,0%	Senegal	45,6%	0,2%	0,0%	100,0%	1,6%
Ecuador	0,0%	0,0%	100,0%	100,0%	100,0%	Serbia	na	na	na	na	0,0%
Egypt, Arab Rep.	na	0,0%	0,0%	99,6%	8,3%	Seychelles	na	na	0,0%	0,0%	0,0%
El Salvador	95,7%	0,0%	100,0%	0,0%	32,5%	Slovak Republic	na	na	na	0,0%	97,7%
Equatorial Guinea	na	na	na	na	0,0%	Slovenia	na	na	na	0,0%	3,4%
Eritrea	na	na	na	0,0%	0,0%	South Africa	1,4%	91,3%	93,0%	100,0%	0,1%
Estonia	na	na	na	100,0%	0,0%	Spain	0,0%	15,2%	68,6%	100,0%	2,3%
Ethiopia	na	na	0,0%	0,0%	0,0%	Sri Lanka	na	na	na	100,0%	1,5%
Finland	36,1%	0,0%	100,0%	100,0%	17,8%	St. Kitts and Nevis	na	na	0,0%	100,0%	0,0%
France	89,5%	38,1%	100,0%	100,0%	24,8%	St. Vincent and the Grenadines	na	na	0,0%	0,0%	0,0%
Gabon	0,0%	32,2%	0,0%	0,0%	0,0%	Sudan	21,5%	0,0%	0,0%	100,0%	0,0%
Gambia, The	na	0,0%	0,0%	100,0%	100,0%	Swaziland	na	na	47,2%	0,0%	100,0%
Georgia	na	na	na	0,0%	0,0%	Sweden	70,7%	100,0%	96,5%	100,0%	1,7%
Germany	na	100,0%	100,0%	100,0%	41,7%	Switzerland	0,7%	100,0%	100,0%	100,0%	99,3%
Ghana	0,0%	0,0%	0,0%	0,0%	0,0%	Syrian Arab Republic	na	na	0,0%	0,0%	0,0%
Greece	0,7%	98,2%	66,0%	48,7%	61,2%	Tajikistan	na	na	na	0,0%	23,5%
Guatemala	80,0%	50,2%	100,0%	100,0%	83,8%	Tanzania	na	na	na	0,0%	0,0%
Guinea-Bissau	na	0,0%	100,0%	0,0%	100,0%	Thailand	0,0%	10,4%	99,9%	100,0%	100,0%
Guinea	na	na	na	0,0%	0,0%	Togo	0,0%	0,0%	0,3%	0,0%	0,5%
Guyana	0,0%	0,0%	0,0%	100,0%	79,7%	Trinidad and Tobago	0,0%	0,0%	57,1%	0,0%	0,0%
Honduras	0,2%	0,0%	10,2%	100,0%	81,5%	Tunisia	0,0%	0,0%	0,2%	62,4%	91,2%
Hong Kong, China	0,0%	0,0%	0,0%	99,9%	1,5%	Turkey	na	na	na	na	0,1%
Hungary	na	20,0%	100,0%	23,0%	0,0%	Uganda	na	na	0,0%	0,0%	0,3%
Iceland	na	99,8%	1,5%	73,4%	0,0%	Ukraine	na	na	na	100,0%	0,0%
India	0,0%	0,0%	98,0%	99,8%	65,0%	United Arab Emirates	na	na	na	100,0%	0,0%
Indonesia	0,0%	0,0%	0,0%	100,0%	100,0%	United Kingdom	16,3%	0,0%	100,0%	71,8%	69,3%
Iran, Islamic Rep.	na	0,0%	64,3%	17,0%	0,0%	United States	89,7%	98,5%	100,0%	100,0%	54,9%
Ireland	100,0%	1,1%	100,0%	89,7%	0,8%	Uruguay	0,0%	0,0%	0,4%	6,0%	0,2%
Israel	na	na	na	100,0%	2,3%	Venezuela, RB	na	0,0%	71,6%	66,0%	0,0%
Italy	58,7%	2,3%	99,6%	100,0%	5,6%	Vietnam	na	na	na	94,0%	73,1%
Japan	97,1%	35,6%	100,0%	99,3%	99,8%	West Bank and Gaza	na	na	na	0,0%	47,0%
Jordan	na	na	0,0%	0,0%	0,0%	Yemen, Rep.	na	na	na	0,0%	0,0%
Kazakhstan	na	na	na	100,0%	0,1%	Zambia	0,0%	0,0%	0,0%	0,0%	0,0%
Kenya	100,0%	0,0%	0,0%	0,0%	8,9%	Zimbabwe	na	0,0%	0,0%	0,0%	0,0%
Korea, Rep.	0,0%	0,0%	100,0%	100,0%	100,0%	**Sample Average**	**28,4%**	**21,4%**	**51,8%**	**53,9%**	**29,5%**

Source: authors' estimations

Table 4 shows the associated probabilities of registering a positive consumption gap (i.e. the probability to register a lower path of consumption growth than the expected one) linked to crisis and boom consumption growth volatility for the full sample of countries and the five decades of the period 1960-2007. The main outcome of Table 4 is to highlight that a phenomenon of a positive probability to be worse off from the "expected path" of consumption growth is widespread and not limited to developing countries. The average probability level for the countries in the sample is around 30% (over 50% in the decades 1978-1987 and 1988-1997) but probabilities of 100% are not infrequent along the full sample of countries.

It is worth noting that our probit estimates do represent a good approximation of the stark reality of countries' performance in a long term perspective. We ran a test of model fitting to out-of-sample observations[17]. Fitting values appear to be never lower than 70% of total observations (59% with probability levels under 1%, see table 1A; 2A and Fig. 2A in the appendix for additional details). This is indeed a very good result, considering that our latent independent variable is actually a continuous variable that has been transformed into an observable binary dependent variable by a threshold model. Hence, it can be unfit to assess properly the observations that lie around our subjective threshold.

Probit estimates do not provide neither clues about the severity of the phenomenon nor an appropriate picture of the statistical relationships between instrumented and instrumental variables. To specify better the statistical links between the volatility of trade variables and the "extreme volatility" of consumption and its impact on the level of the observed consumption gap we thus provide a second estimation using a "three stages least square" (3SLS) regression[18].

Table 5 shows our 3SLS estimates. The coefficients of boom and crisis volatility are still robust and statistically significant and show the expected sign, i.e. while boom volatility is negatively associated with a positive consumption gap, crisis volatility is positively associated with it. The average level of consumption growth still matters: higher consumption growth rates are negatively correlated with positive consumption gaps (independently from the actual level of development, see model 2 of Table 5). The constant is, as expected, not statistically significant. This is consistent with the fact that the expected value of our dependent variable (the consumption gap) is, ceteris paribus, zero (i.e. since the gap is a variation from trend, the observed consumption growth, without shocks, is not supposed to be, on average, different from its potential level).

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[17] While our probit estimates include 211 observations, the fitting test has been applied to additional 71 observations.

[18] A 3SLS estimates systems of structural equations where some equations contain endogenous variables among the explanatory variables. Generally, these endogenous variables are the dependent variables of other equations in the system, though not always. The disturbance is correlated with the endogenous variables—violating the assumptions of OLS. Further, because some of the explanatory variables are the dependent variables of other equations in the system, the error terms among the equations are expected to be correlated. General references on the three-stage estimation are Davidson and MacKinnon (1993, 651–661) and Greene (2008, 381–383).

Table 5 – 3SLS - Empirical results

	Dependent variable	
	1	2
Regressors	**Consumption Gap**	
boom_vol	-0.522877 ***	-0.4842202 ***
	(0.1685018)	*(0.1393124)*
crisis_vol	0.4437139 *	0.3736087 *
	(0.2462467)	*(0.1939976)*
avcgr	-0.1121083 ***	
	(0.0259287)	
avcgr_high		-0.1202463 **
		(0.0524948)
avcgr_middle		-0.0916096 ***
		(0.0288874)
avcgr_low		-0.1494904 ***
		(0.0320556)
constant	0.0017169	*0.0021981*
	(0.0024852)	*(0.0023203)*
Regressors	**boom_vol**	
tot_vol	0.0799272 ***	0.080143 ***
	(0.0214689)	*(0.0214117)*
to_vol	0.0432199 ***	0.0439041 ***
	(0.015099)	*(0.0150462)*
fpp	-0.0064011 *	-0.0063058 *
	(0.0035602)	*(0.0035568)*
avcgr_Sids	0.5006334 ***	0.5016561 ***
	(0.1212333)	*(0.1212966)*
constant	0.0108283 ***	0.0107167 ***
	(0.0024175)	*(0.0024119)*
Regressors	**crisis_vol**	
tot_vol	0.0406126 **	0.0413293 **
	(0.0170087)	*(0.017552)*
to_vol	0.0236344 **	0.0229391 *
	(0.0116108)	*(0.0120941)*
fpp	-0.0007036	-0.0005591
	(0.0029911)	*(0.0030314)*
avcgr_Sids	0.430469 ***	0.4176732 ***
	(0.1028826)	*(0.1047693)*
constant	0.0137631 ***	0.0137627 ***
	(0.0020288)	*(0.0020387)*
Hansen-Sargan overid statist	$\chi^2(4) = 6.968$	$\chi^2(8) = 23.726$
	$\text{Prob} > \chi^2 = 0.1376$	$\text{Prob} > \chi^2 = 0.0025$
Number of Observations	272	272

Notes: Standard errors are reported below the corresponding coefficients.

*** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Source: Authors' estimation

All the coefficients of the instruments for the estimated boom and crisis consumption volatility are highly robust and statistically significant too, with the exception of the fiscal policy pro-cyclicality in the case of crisis volatility. This is to a certain extent surprisingly, but consistently with the results of our descriptive statistics. Conversely, being SIDS, as strongly emphasised by the literature[19], improves the probability of both crisis and boom volatility. This result can be highlighted to some extent as a positive net impact on vulnerability of endogenous resilience towards the exogenous responsiveness linked to the availability of coping mechanisms (see Montalbano, 2009) but it clearly needs further investigations. The estimates show overall that the volatility of terms of trade and trade openness have, ceteris paribus, an impact to consumption gaps via "boom" and "crisis" volatility. It is worth noting here that they impact positively both crisis and boom consumption growth volatility. Hence, the net effect on the probability of a positive consumption gap will depend strongly from the observed extreme volatility (crisis and boom). The Hansen-Sargan test shows that we cannot reject the null hypothesis of exogeneity, at least for one of the two models, thus confirming the validity of instruments applied[20].

The above probability are calculated ex post. Since vulnerability is intrinsically a forward looking approach, to get a feasible measure of vulnerability to trade openness we should calculate, for each country in the sample, whether and how a shock in the volatility of the rates of change of terms of trade and/or trade openness, through boom and crisis volatility of the consumption growth, affects, ceteris paribus, the probability of a positive consumption gap in a long term perspective[21]. To this aim, we adopt a transformation of the observed volatility of the rates of change of trade openness and terms-of-trade such as *ln(Vol_TOT-k)* and *ln(Vol_TRADE-k')* where *k* and *k'* are chosen so that the resulting skewness is zero and the output distributions are symmetric like the bell-shaped normal curve[22]. Thus, we can easily compute, for each country in the sample, the probability of a change of the probability to get a positive consumption gap due to an improvement of the volatility of the rates of change of trade openness and terms of trade. This probability is a measure of our countries' vulnerability hazard.

[19] Montalbano and Triulzi, 2009; UNU-Wider, 2008a; Briguglio 1995; Atkins and Mazzi, 1999; Easterly and Kraay, 2000; Winters and Martins, 2004; UN, 2006; Briguglio et al. 2007.

[20] As Davidson and MacKinnon (2004, p.532) indicate, a Hansen-Sargan test of the overidentifying restrictions is based on the 3SLS criterion function evaluated at the 3SLS point and interval parameter estimates. Under the null hypothesis, the statistic is distributed Chi-squared with (G*L - K) degrees of freedom, where G is the number of simultaneous equations. The procedure will take proper account of linear constraints on the parameter vector imposed during estimation.

[21] As above underlined, we keep adopting a ten years time span (a decade).

[22] According to Shapiro–Wilk test for normality we could reject the hypothesis that *Vol_TOT* and *Vol_TRADE* variables are normally distributed. However, we could not reject the hypotheses that *ln(Vol_TOT-0.0020728)* and *ln(Vol_TRADE-0.0141817)* are normally distributed.

Table 6 – Vulnerability to terms-of trade *(calculated as the probability of a positive shock in consumption growth under the hypothesis of a 50% improvement of volatility of terms-of trade coupled with the impact effect on consumption gap)*

Country	Δ Probability Consumption Gap > 0	Δ Consumption Gap	Shock Probability	Country	Δ Probability Consumption Gap > 0	Δ Consumption Gap	Shock Probability	Country	Δ Probability Consumption Gap > 0	Δ Consumption Gap	Shock Probability	Country	Δ Probability Consumption Gap > 0	Δ Consumption Gap	Shock Probability
Algeria	0,0%	53,0%	9,1%	El Salvador	66,0%	1944,3%	50,6%	Lesotho	7,3%	-15154,0%	46,8%	Senegal	43,8%	120,8%	31,3%
Argentina	0,0%	-1181,8%	33,5%	Equatorial Guinea	0,0%	-21,8%	7,0%	Macao, China	0,0%	85,9%	56,3%	Seychelles	0,0%	240,8%	28,7%
Australia	23,5%	-17,3%	31,5%	Ethiopia	0,0%	-157,6%	19,2%	Madagascar	0,0%	-39,3%	26,7%	South Africa	0,0%	211,9%	36,3%
Bangladesh	0,4%	-186,7%	38,7%	France	71,4%	-11,6%	56,4%	Malawi	0,0%	2903,0%	33,7%	Spain	19,2%	5,1%	49,5%
Barbados	-95,6%	-488,7%	46,5%	Gabon	0,0%	208,0%	14,1%	Malaysia	0,0%	-911,6%	51,9%	Sri Lanka	-1,4%	42,1%	48,2%
Belgium	85,6%	-350,7%	63,9%	Gambia, The	0,0%	-2306,0%	36,4%	Maldives	31,8%	-132,3%	34,5%	St. Kitts and Nevis	100,0%	-114,4%	43,6%
Belize	4,4%	-278,4%	23,9%	Germany	58,3%	-348,7%	39,9%	Mali	0,0%	-1090,2%	24,4%	St. Vincent and the Grenadines	0,0%	82,4%	22,4%
Benin	0,0%	521,1%	25,7%	Ghana	0,0%	-33,6%	19,3%	Mauritania	0,0%	50,1%	15,6%	Sudan	0,0%	-80,9%	18,2%
Bolivia	93,4%	84,3%	26,7%	Greece	18,3%	-49,2%	38,3%	Mauritius	-1,0%	-50,4%	23,5%	Swaziland	0,0%	532,1%	62,1%
Botswana	8,1%	11,8%	51,3%	Guatemala	16,2%	131,7%	54,4%	Mexico	0,0%	1122,6%	50,0%	Sweden	50,6%	108,2%	63,9%
Brazil	95,1%	-81,5%	40,3%	Guinea	0,0%	8,0%	14,0%	Morocco	1,6%	66,5%	34,2%	Syrian Arab Republic	0,0%	-54,0%	22,9%
Brunei Darussalam	0,0%	376,3%	15,4%	Guyana	16,6%	-183,6%	33,0%	Mozambique	0,0%	-820,0%	22,4%	Tanzania	0,0%	81,4%	34,4%
Burkina Faso	0,0%	-44,1%	23,6%	Honduras	16,4%	-152,3%	46,5%	Namibia	39,9%	-329,2%	27,2%	Thailand	0,0%	-888,0%	39,7%
Cambodia	0,0%	39,4%	40,7%	Hong Kong, China	75,8%	-135,9%	68,2%	Netherlands	29,6%	867,7%	56,5%	Togo	99,5%	-961,2%	26,1%
Cameroon	0,0%	181,9%	15,3%	Hungary	0,0%	51,2%	66,2%	New Zealand	34,0%	39,9%	42,3%	Trinidad and Tobago	0,0%	-14,5%	26,9%
Canada	4,2%	-91,7%	40,4%	India	-50,2%	-82,0%	20,3%	Nicaragua	11,2%	-110,1%	37,9%	Tunisia	-16,8%	-52,3%	58,7%
Cape Verde	0,0%	20,3%	29,2%	Indonesia	0,0%	-268,1%	12,5%	Norway	10,5%	-60,2%	15,2%	Turkey	-0,1%	-176,4%	43,0%
Central African Republic	99,7%	-75,6%	28,7%	Iran, Islamic Rep.	0,0%	61,1%	20,0%	Oman	0,0%	57,0%	15,6%	Uganda	1,4%	-55,8%	26,2%
Chile	0,0%	-28,7%	17,5%	Ireland	-0,7%	-13,1%	43,2%	Pakistan	0,0%	311,2%	23,7%	United Arab Emirates	0,0%	518,9%	21,7%
China	0,0%	17,4%	43,9%	Israel	80,3%	-32,9%	51,4%	Panama	0,0%	81,2%	46,4%	United Kingdom	27,6%	-68,7%	62,7%
Colombia	54,4%	-642,9%	28,5%	Italy	93,4%	185,3%	42,8%	Papua New Guinea	0,0%	6769,0%	25,3%	United States	40,5%	-55,9%	48,5%
Congo, Dem. Rep.	0,0%	48,8%	12,7%	Japan	0,2%	-450,2%	33,6%	Paraguay	0,0%	-449,9%	38,8%	Uruguay	4,2%	1309,7%	32,2%
Costa Rica	37,1%	62,5%	49,4%	Jordan	0,0%	630,2%	43,5%	Peru	40,6%	-169,1%	20,1%	Venezuela, RB	0,0%	-56,9%	10,6%
Cote d'Ivoire	58,8%	-257,7%	19,2%	Kenya	89,3%	-126,2%	38,3%	Philippines	52,2%	24,4%	27,5%	Vietnam	-64,1%	72,9%	59,2%
Denmark	84,8%	215,9%	56,1%	Korea, Rep.	0,0%	-587,2%	41,9%	Poland	-15,9%	-35,3%	44,5%	Yemen, Rep.	0,0%	-212,2%	20,0%
Dominican Republic	-54,0%	-192,9%	61,2%	Kuwait	0,0%	238,2%	15,3%	Portugal	5,8%	-632,4%	43,4%	Zambia	0,0%	-60,0%	10,9%
Ecuador	0,0%	-353,8%	22,0%	Lao PDR	0,0%	-232,3%	22,3%	Rwanda	14,7%	-185,5%	15,1%	Zimbabwe	3,4%	90,0%	41,6%
Egypt, Arab Rep.	43,2%	-28,6%	26,8%	Lebanon	85,7%	-9,3%	47,7%	Saudi Arabia	0,1%	-707,7%	18,5%				

Source: authors' estimations

Table 7 – Vulnerability to trade openness *(calculated as the probability of a positive shock in consumption growth induced by a 100% improvement in the volatility of trade openness coupled with the impact effect on consumption gap)*

Country	Δ Probability Consumption Gap > 0	Δ Consumption Gap	Shock Probability	Country	Δ Probability Consumption Gap > 0	Δ Consumption Gap	Shock Probability	Country	Δ Probability Consumption Gap > 0	Δ Consumption Gap	Shock Probability	Country	Δ Probability Consumption Gap > 0	Δ Consumption Gap	Shock Probability
Algeria	0,0%	91,3%	4,8%	El Salvador	64,7%	233,2%	37,4%	Lesotho	7,3%	-1481,4%	5,2%	Senegal	59,6%	198,4%	76,7%
Argentina	0,0%	-424,0%	0,2%	Equatorial Guinea	0,0%	-12,9%	2,6%	Macao, China	0,0%	52,9%	26,8%	Seychelles	0,0%	215,2%	5,9%
Australia	23,2%	-18,1%	23,1%	Ethiopia	0,0%	-162,4%	13,2%	Madagascar	0,0%	-66,1%	0,3%	South Africa	-0,1%	120,5%	12,9%
Bangladesh	0,4%	-178,6%	16,9%	France	69,0%	-23,2%	31,0%	Malawi	0,0%	307,7%	0,7%	Spain	13,0%	-2,4%	36,5%
Barbados	-96,6%	-477,4%	49,8%	Gabon	0,0%	279,9%	31,9%	Malaysia	0,0%	-742,4%	27,6%	Sri Lanka	-1,5%	21,0%	20,5%
Belgium	83,6%	-615,0%	33,6%	Gambia, The	0,0%	-1110,5%	2,0%	Maldives	30,9%	-128,3%	15,9%	St. Kitts and Nevis	100,0%	-114,7%	43,3%
Belize	4,4%	-295,5%	19,5%	Germany	58,2%	-666,8%	32,5%	Mali	0,0%	-848,1%	3,5%	St. Vincent and the Grenadines	0,0%	138,3%	57,3%
Benin	0,0%	390,4%	91,6%	Ghana	0,0%	-37,9%	2,0%	Mauritania	0,0%	37,4%	0,4%	Sudan	0,0%	-81,3%	2,5%
Bolivia	90,7%	63,2%	9,1%	Greece	12,9%	-54,7%	12,4%	Mauritius	-1,0%	-47,7%	32,8%	Swaziland	0,0%	731,5%	10,8%
Botswana	5,5%	6,2%	61,0%	Guatemala	16,2%	-62,3%	2,2%	Mexico	0,0%	977,1%	32,4%	Sweden	34,9%	70,1%	40,9%
Brazil	94,8%	-94,6%	4,6%	Guinea	0,0%	18,3%	4,4%	Morocco	0,6%	50,8%	16,9%	Syrian Arab Republic	0,0%	-56,6%	4,3%
Brunei Darussalam	0,0%	-29058,9%	57,7%	Guyana	17,5%	-186,9%	54,5%	Mozambique	0,0%	-766,0%	4,5%	Tanzania	0,0%	39,2%	16,0%
Burkina Faso	0,0%	-44,9%	7,1%	Honduras	14,1%	-143,5%	9,0%	Namibia	39,9%	-346,4%	24,0%	Thailand	0,0%	-752,3%	11,9%
Cambodia	0,0%	27,0%	9,2%	Hong Kong, China	46,8%	-126,9%	20,1%	Netherlands	11,0%	387,7%	29,4%	Togo	99,5%	-881,1%	11,8%
Cameroon	0,0%	277,1%	23,3%	Hungary	0,0%	33,8%	10,5%	New Zealand	25,2%	7,3%	18,4%	Trinidad and Tobago	0,0%	-14,8%	10,9%
Canada	4,2%	-91,8%	41,1%	India	-47,4%	-80,9%	12,3%	Nicaragua	10,5%	-106,8%	6,9%	Tunisia	-18,3%	-57,4%	30,7%
Cape Verde	0,0%	11,7%	3,8%	Indonesia	0,0%	-247,0%	0,2%	Norway	29,0%	-52,5%	40,8%	Turkey	-0,1%	-160,7%	10,6%
Central African Republic	50,6%	-91,5%	0,2%	Iran, Islamic Rep.	0,0%	55,1%	2,5%	Oman	0,0%	504,1%	51,2%	Uganda	0,7%	-57,3%	8,2%
Chile	0,0%	-0,9%	71,8%	Ireland	-0,7%	-25,1%	12,5%	Pakistan	0,0%	300,5%	7,6%	United Arab Emirates	0,0%	542,2%	14,9%
China	0,0%	8,8%	9,9%	Israel	64,0%	-45,9%	19,6%	Panama	0,0%	62,7%	12,0%	United Kingdom	26,3%	-72,7%	35,4%
Colombia	54,4%	-585,5%	13,3%	Italy	92,4%	118,1%	26,3%	Papua New Guinea	0,0%	30228,7%	44,7%	United States	39,0%	-59,4%	25,8%
Congo, Dem. Rep.	0,0%	27,2%	0,1%	Japan	0,2%	-418,6%	23,6%	Paraguay	0,0%	-861,9%	4,2%	Uruguay	-0,1%	12766,4%	7,0%
Costa Rica	17,5%	30,0%	21,0%	Jordan	0,0%	548,5%	15,7%	Peru	46,4%	-200,4%	24,5%	Venezuela, RB	0,0%	-50,1%	4,8%
Cote d'Ivoire	58,8%	-296,2%	28,3%	Kenya	85,9%	-116,4%	13,7%	Philippines	52,9%	41,8%	25,2%	Vietnam	-66,3%	50,0%	58,1%
Denmark	70,6%	93,5%	27,5%	Korea, Rep.	0,0%	-475,8%	7,0%	Poland	-19,3%	-41,7%	14,4%	Yemen, Rep.	0,0%	-172,1%	26,9%
Dominican Republic	-54,0%	-178,9%	2,5%	Kuwait	0,0%	435,2%	31,8%	Portugal	3,0%	-743,6%	41,0%	Zambia	0,0%	-45,4%	9,7%
Ecuador	0,0%	-351,4%	6,3%	Lao PDR	0,0%	-155,8%	1,2%	Rwanda	15,0%	-199,5%	12,3%	Zimbabwe	0,0%	-56,4%	0,0%
Egypt, Arab Rep.	31,5%	-36,0%	6,7%	Lebanon	63,4%	-26,2%	10,0%	Saudi Arabia	0,1%	-927,1%	7,7%				

Source: authors' estimations

Tables 6 and 7 show the results in terms of countries' vulnerability due to a large increase of the volatility of the rates of change of terms of trade (50% improvement , Table 6) and a in the volatility of the rates of change of trade openness (100% improvement, Table 7), both with respect to the last decade. As already underlined, our notion of vulnerability to trade is much more complex than that usually applied in this kind of cross-country exercises. It can be assessed as the compound outcome of three separate elements: the probability to register in the future extreme fluctuations of aggregate trade variables (the shock probability column); the predicted variation in terms of consumption gap (using 3SLS estimates) and the probability of this variation (using IVprobit estimates). As a result, we get heterogeneous country profiles in terms of vulnerability.

For instance, in table 6, countries that register the higher probabilities of extreme fluctuations of terms-of-trade (more than 60%) – i.e. Belgium, Dominican Republic, Hong Kong, Hungary and United Kingdom – register, generally speaking, a reduction of their consumption gap (hence, a reduction of their vulnerability), while a number of countries (see, for instance, Bolivia, Costa Rica, Denmark, Guatemala, Italy, Morocco, Netherlands, New Zealand, Philippines, Senegal, Spain, South Africa, Uruguay, Zimbabwe) that register a lower probability of extreme fluctuations, present instead higher probabilities to register a positive consumption gap and, in some cases, strong impacts in terms of welfare. It means, in other words, they show higher probabilities to run off their respective rails of consumption growth – and in some cases with very large gaps from their own potential consumption growth - in case of an improvement of terms-of-trade fluctuations, even if the probability of such improvement is not as high as in the first group of countries. As our analysis clearly shows, give an appropriate answer to the question of who are the more vulnerable countries to trade openness is not straightforward. In our opinion, however, while people normally think they should belong to the first group, in our opinion it is the second group of countries that should be primarily under suspect. Similar results hold in the case of an increase of trade openness volatility (see Table 7).

4. Conclusions

This paper offers a substantive contribution to current debate on the effects of trade openness on developing countries' vulnerability. It presents empirical estimates grounded on a sound method of analysis and improves the existing literature on aggregate volatility by adding a forward looking lens as well as a feasible notion of benchmark and a counterfactual, which are essential in a vulnerability framework.

The main result of this cross country empirical test is to highlight, presenting both probit and 3SLS estimates, a robust and significant relationship in a large sample of countries between the "extreme volatility" of consumption (crisis and boom) - induced by trade openness - and the deviation of consumption growth from its expected path. This phenomenon remains covered up by simple data analyses and largely overlooked by current empirical literature on trade and growth.

The empirical results are mixed. However, it is apparent that some open economies have difficulties to catch up their own potential, in terms of consumption growth; this applies both to developing and developed countries. At the same time, our estimates show that

trade volatility does not imply necessarily a vulnerability phenomenon, that vulnerability to trade is a compound outcome and that national factors do matter.

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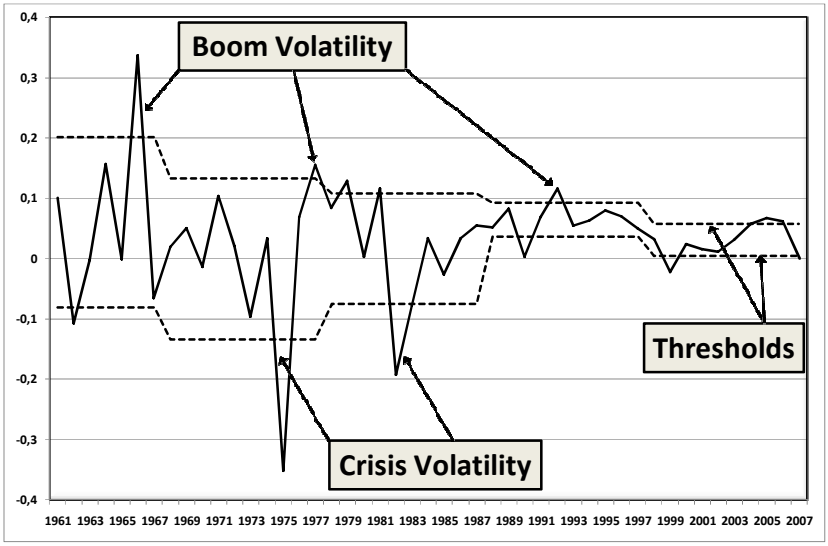
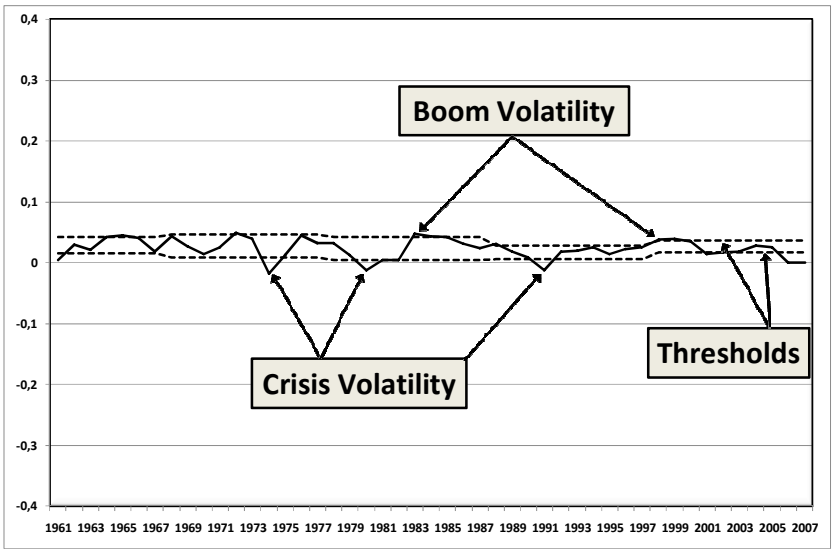
APPENDIX A

Fig. 1A – Examples of volatility decomposition: the cases of Chile and USA

Chile



USA



Source: Authors' elaboration from Hnatkovska and Loyaza (2004)

Tab 1A – Assessed and Observed probabilities of a positive consumption gap

Country	Subperiod									
	1960-1967		1968-1977		1978-1987		1988-1997		1998-2007	
	Assessed	Observed	Assessed	Observed	Assessed	Observed	Assessed	Observed	Assessed	Observed
Albania	nd	nd	nd	nd	nd	nd	0,0%	1	93,3%	0
Algeria	0,0%	0	0,0%	0	100,0%	1	0,0%	0	0,0%	0
Antigua and Barbuda	nd	nd	nd	nd	0,0%	0	0,0%	1	0,0%	0
Argentina	0,0%	0	99,1%	1	nd	nd	100,0%	1	100,0%	0
Armenia	nd	nd	nd	nd	nd	nd	100,0%	0	100,0%	1
Australia	0,0%	1	35,3%	0	100,0%	1	94,2%	1	0,2%	0
Austria	0,0%	1	0,0%	0	100,0%	1	100,0%	0	1,0%	0
Azerbaijan	nd	nd	nd	nd	nd	nd	90,1%	1	0,0%	1
Bangladesh	0,0%	1	0,0%	1	0,0%	0	100,0%	0	100,0%	0
Barbados	nd	nd	nd	nd	nd	nd	0,0%	0	0,8%	1
Belarus	nd	nd	nd	nd	nd	nd	0,0%	0	23,7%	1
Belgium	2,9%	1	0,0%	0	100,0%	0	100,0%	1	0,7%	0
Belize	nd	nd	nd	nd	0,0%	0	0,0%	0	99,1%	1
Benin	100,0%	1	0,0%	0	100,0%	1	100,0%	0	100,0%	1
Bhutan	nd	nd	nd	nd	nd	nd	nd	nd	100,0%	1
Bolivia	nd	nd	0,0%	0	100,0%	1	100,0%	1	9,0%	0
Botsw ana	nd	nd	nd	nd	0,4%	1	0,0%	0	99,6%	1
Brazil	0,0%	0	32,9%	0	0,1%	1	99,8%	0	17,1%	1
Brunei Darussalam	nd	nd	nd	nd	nd	nd	0,0%	0	0,0%	1
Bulgaria	nd	nd	nd	nd	100,0%	0	88,0%	1	0,0%	0
Burkina Faso	100,0%	0	12,6%	0	29,4%	1	0,0%	0	0,0%	0
Cambodia	nd	nd	nd	nd	nd	nd	100,0%	1	65,5%	0
Cameroon	100,0%	1	0,0%	0	0,0%	0	100,0%	1	0,0%	0
Canada	23,1%	1	0,0%	1	100,0%	0	100,0%	0	17,7%	0
Cape Verde	nd	nd	nd	nd	nd	nd	0,0%	0	0,0%	0
Central African Republic	nd	nd	nd	nd	nd	nd	nd	nd	0,0%	0
Chad	0,0%	0	0,0%	0	0,0%	1	0,0%	0	0,0%	0
Chile	0,0%	0	100,0%	0	100,0%	0	98,6%	1	0,1%	0
China	0,1%	1	94,8%	1	95,6%	0	24,2%	1	0,0%	0
Colombia	9,1%	1	98,7%	1	100,0%	0	0,0%	0	63,7%	1
Comoros	nd	nd	nd	nd	100,0%	1	0,0%	0	100,0%	1
Congo, Dem. Rep.	0,0%	0	0,0%	1	0,0%	0	85,3%	0	0,0%	0
Costa Rica	24,1%	1	0,0%	0	100,0%	1	0,4%	1	0,2%	0
Cote d'Ivoire	100,0%	1	100,0%	0	100,0%	0	82,2%	1	18,5%	0
Croatia	nd	nd	nd	nd	nd	nd	nd	nd	99,9%	1
Czech Republic	nd	nd	nd	nd	nd	nd	100,0%	1	0,0%	1
Denmark	0,0%	0	0,0%	0	99,8%	1	53,2%	1	0,0%	0
Djibouti	nd	nd	nd	nd	nd	nd	47,2%	1	2,9%	0
Dominica	nd	nd	nd	nd	0,0%	0	99,9%	1	0,0%	0
Dominican Republic	0,0%	0	0,0%	0	0,0%	0	100,0%	1	50,6%	0
Ecuador	0,0%	1	0,0%	1	100,0%	0	100,0%	0	100,0%	0
Egypt, Arab Rep.	nd	nd	0,0%	1	0,0%	1	100,0%	0	28,2%	0
El Salvador	98,9%	1	0,0%	0	100,0%	1	0,0%	0	67,3%	0
Equatorial Guinea	nd	nd	nd	nd	nd	nd	nd	nd	0,0%	1
Eritrea	nd	nd	nd	nd	nd	nd	0,0%	0	0,0%	1
Estonia	nd	nd	nd	nd	nd	nd	99,4%	0	0,0%	1
Ethiopia	nd	nd	nd	nd	0,0%	0	0,0%	0	24,3%	1
Finland	0,0%	0	0,0%	1	81,8%	1	100,0%	0	0,0%	1
France	0,0%	0	0,0%	1	100,0%	0	100,0%	1	0,1%	0
Gabon	0,0%	0	15,4%	1	0,0%	0	0,0%	0	0,0%	0
Gambia, The	nd	nd	0,0%	1	0,0%	0	100,0%	1	100,0%	0

Country	Subperiod									
	1960-1967		1968-1977		1978-1987		1988-1997		1998-2007	
	Assessed	Observed	Assessed	Observed	Assessed	Observed	Assessed	Observed	Assessed	Observed
Gabon	61,4%	0	98,1%	1	0,0%	0	0,0%	0	1,6%	0
Gambia, The	nd	nd	55,4%	1	0,8%	0	86,6%	1	99,8%	0
Georgia	nd	nd	nd	nd	nd	nd	0,3%	0	92,7%	0
Germany	nd	nd	66,3%	0	50,3%	0	36,4%	1	32,1%	0
Ghana	0,2%	0	27,9%	1	58,7%	0	5,1%	0	35,3%	1
Greece	32,3%	1	71,8%	0	23,1%	1	27,0%	0	38,2%	1
Guatemala	41,0%	0	40,4%	0	47,2%	0	43,7%	1	32,0%	0
Guinea-Bissau	nd	nd	83,8%	1	100,0%	1	1,8%	0	100,0%	1
Guinea	nd	nd	nd	nd	nd	nd	26,8%	0	13,5%	0
Guyana	0,0%	0	47,9%	0	0,1%	0	100,0%	1	72,5%	1
Honduras	25,2%	1	37,0%	0	20,1%	1	36,9%	0	58,8%	0
Hong Kong, China	21,3%	1	68,9%	0	9,1%	0	58,1%	0	49,7%	0
Hungary	nd	nd	39,6%	1	30,1%	0	28,5%	1	16,9%	0
Iceland	nd	nd	98,4%	0	44,9%	0	43,1%	1	62,4%	0
India	25,8%	1	21,9%	0	36,3%	1	39,3%	0	48,8%	0
Indonesia	39,9%	1	7,9%	1	0,0%	0	90,8%	0	90,4%	1
Iran, Islamic Rep.	nd	nd	5,4%	0	55,7%	1	27,3%	0	9,5%	0
Ireland	57,0%	1	41,4%	0	69,2%	0	30,8%	0	39,8%	0
Israel	nd	nd	nd	nd	nd	nd	69,8%	1	35,5%	0
Italy	58,2%	0	37,7%	1	32,3%	0	56,7%	1	24,9%	0
Japan	59,7%	0	56,2%	1	41,4%	0	31,4%	0	45,5%	1
Jordan	nd	nd	nd	nd	11,4%	0	8,8%	0	0,3%	0
Kazakhstan	nd	nd	nd	nd	nd	nd	95,9%	0	68,2%	1
Kenya	81,5%	0	0,0%	1	33,1%	0	7,3%	1	40,0%	0
Korea, Rep.	5,0%	1	2,0%	0	81,0%	0	52,6%	0	96,2%	1
Kuwait	nd	nd	nd	nd	nd	nd	nd	nd	6,4%	0
Kyrgyz Republic	nd	nd	nd	nd	nd	nd	0,1%	1	6,3%	0
Lao PDR	nd	nd	nd	nd	nd	nd	nd	nd	49,9%	1
Latvia	nd	nd	nd	nd	36,3%	1	100,0%	0	8,8%	0
Lebanon	nd	nd	nd	nd	nd	nd	70,3%	0	24,3%	1
Lesotho	23,7%	1	40,7%	1	90,0%	1	17,2%	0	96,1%	1
Lithuania	nd	nd	nd	nd	nd	nd	nd	nd	35,4%	0
Luxembourg	25,1%	1	36,3%	0	40,7%	1	47,9%	0	30,0%	0
Macao, China	nd	nd	nd	nd	33,2%	0	98,1%	1	37,6%	0
Macedonia, FYR	nd	nd	nd	nd	nd	nd	60,1%	1	88,6%	0
Madagascar	48,0%	1	40,5%	0	50,1%	0	31,6%	0	36,9%	0
Malawi	15,2%	1	0,4%	0	82,3%	1	69,6%	0	12,4%	1
Malaysia	48,3%	1	53,9%	1	78,2%	1	54,0%	0	95,7%	1
Maldives	nd	nd	nd	nd	nd	nd	nd	nd	41,8%	0
Mali	nd	nd	44,2%	1	7,7%	1	66,8%	0	92,0%	0
Mauritania	95,6%	1	0,0%	0	2,3%	0	11,1%	1	13,2%	0
Mauritius	nd	nd	nd	nd	10,7%	1	4,7%	0	30,7%	0
Mexico	10,8%	1	40,5%	1	61,6%	0	96,6%	1	0,2%	0
Moldova	nd	nd	nd	nd	nd	nd	2,1%	0	90,2%	1
Morocco	37,4%	1	23,2%	0	63,1%	1	34,9%	0	28,3%	0
Mozambique	nd	nd	nd	nd	44,9%	0	27,8%	1	99,9%	0
Namibia	nd	nd	nd	nd	0,4%	0	94,2%	1	72,5%	1
Netherlands	40,3%	1	30,9%	0	49,6%	0	37,7%	1	22,2%	0
New Zealand	73,7%	1	52,2%	1	39,1%	0	35,2%	1	37,2%	0
Nicaragua	43,7%	0	33,2%	0	12,3%	1	0,0%	0	45,5%	0
Norway	26,8%	1	42,7%	0	25,3%	1	45,5%	1	29,5%	0

Country	Subperiod									
	1960-1967		1968-1977		1978-1987		1988-1997		1998-2007	
	Assessed	Observed	Assessed	Observed	Assessed	Observed	Assessed	Observed	Assessed	Observed
Oman	nd	nd	nd	nd	nd	nd	64,4%	0	30,9%	0
Pakistan	73,1%	1	5,3%	0	75,0%	1	26,7%	0	4,1%	0
Panama	nd	nd	nd	nd	38,5%	0	92,9%	1	23,6%	0
Papua New Guinea	29,3%	0	41,5%	0	20,8%	0	94,5%	0	0,0%	0
Paraguay	46,4%	0	23,9%	0	0,1%	0	48,5%	1	16,4%	1
Peru	11,7%	0	7,0%	0	55,0%	0	84,3%	1	50,2%	0
Philippines	38,3%	1	40,0%	1	61,2%	1	40,2%	0	32,0%	1
Poland	nd	nd	nd	nd	nd	nd	32,2%	0	37,9%	1
Portugal	53,9%	1	0,6%	0	32,1%	0	34,8%	1	25,8%	0
Romania	nd	nd	nd	nd	nd	nd	78,1%	1	17,2%	1
Russian Federation	nd	nd	nd	nd	nd	nd	27,9%	1	96,8%	0
Rwanda	92,4%	0	37,5%	0	77,8%	0	90,1%	0	74,4%	0
Saudi Arabia	nd	nd	nd	nd	nd	nd	nd	nd	67,3%	1
Senegal	52,0%	1	66,1%	0	17,9%	0	63,7%	1	25,0%	0
Serbia	nd	nd	nd	nd	nd	nd	nd	nd	64,1%	1
Seychelles	nd	nd	nd	nd	100,0%	0	6,8%	0	8,0%	0
Slovak Republic	nd	nd	nd	nd	nd	nd	30,4%	0	64,5%	0
Slovenia	nd	nd	nd	nd	nd	nd	48,9%	1	30,1%	0
South Africa	32,4%	1	60,7%	1	34,8%	1	52,8%	0	35,6%	1
Spain	27,5%	0	49,2%	1	18,4%	0	44,4%	1	29,9%	0
Sri Lanka	nd	nd	nd	nd	nd	nd	96,1%	1	37,4%	0
St. Kitts and Nevis	nd	nd	nd	nd	42,3%	0	99,9%	1	68,3%	0
St. Vincent and the Grenadines	nd	nd	nd	nd	22,6%	0	99,0%	0	21,8%	1
Sudan	67,5%	1	50,6%	0	23,5%	1	62,4%	0	52,3%	0
Swaziland	nd	nd	nd	nd	53,5%	0	10,9%	0	99,7%	0
Sweden	42,8%	1	67,0%	0	23,9%	0	53,1%	1	27,8%	0
Switzerland	25,0%	0	66,6%	0	32,7%	1	42,1%	1	44,9%	0
Syrian Arab Republic	nd	nd	nd	nd	6,4%	0	56,1%	1	39,5%	0
Tajikistan	nd	nd	nd	nd	nd	nd	0,0%	0	99,5%	1
Tanzania	nd	nd	nd	nd	nd	nd	13,5%	1	41,0%	0
Thailand	31,5%	1	44,6%	1	39,8%	1	72,0%	0	99,1%	1
Togo	52,8%	0	91,1%	0	73,5%	1	84,4%	0	36,8%	1
Trinidad and Tobago	23,0%	0	62,2%	0	82,1%	1	18,5%	1	39,6%	0
Tunisia	16,5%	1	57,5%	0	12,5%	1	28,2%	1	43,4%	0
Turkey	nd	nd	nd	nd	nd	nd	nd	nd	68,8%	1
Uganda	nd	nd	nd	nd	9,6%	1	8,0%	0	36,8%	0
Ukraine	nd	nd	nd	nd	nd	nd	98,3%	0	55,1%	1
United Arab Emirates	nd	nd	nd	nd	nd	nd	44,6%	0	0,0%	1
United Kingdom	27,5%	1	20,0%	1	56,5%	0	29,2%	0	41,3%	1
United States	44,5%	1	54,9%	0	35,2%	1	50,1%	1	35,2%	0
Uruguay	29,4%	0	18,9%	1	82,0%	0	49,0%	1	86,5%	0
Venezuela, RB	nd	nd	0,0%	0	30,5%	1	54,8%	1	53,9%	0
Vietnam	nd	nd	nd	nd	nd	nd	31,6%	0	44,7%	0
West Bank and Gaza	nd	nd	nd	nd	nd	nd	1,4%	1	84,8%	0
Yemen, Rep.	nd	nd	nd	nd	nd	nd	45,5%	0	39,6%	0
Zambia	0,0%	0	0,1%	1	17,0%	0	0,0%	0	42,8%	0
Zimbabwe	nd	nd	20,0%	0	2,6%	1	5,9%	0	7,7%	1

Tab 2A – Out-of-sample fitting test (nr. and % of observations with assessed probabilities greater than the given level)

Probability level	N° of observations with assessed probability greater than given level	% of fitting	Probability level	N° of observations with assessed probability greater than given level	% of fitting	Probability level	N° of observations with assessed probability greater than given level	% of fitting	Probability level	N° of observations with assessed probability greater than given level	% of fitting
0%	71	59,2%	25%	15	73,3%	50%	15	73,3%	75%	14	71,4%
1%	23	82,6%	26%	15	73,3%	51%	15	73,3%	76%	14	71,4%
2%	22	81,8%	27%	15	73,3%	52%	15	73,3%	77%	14	71,4%
3%	21	81,0%	28%	15	73,3%	53%	15	73,3%	78%	14	71,4%
4%	21	81,0%	29%	15	73,3%	54%	15	73,3%	79%	14	71,4%
5%	21	81,0%	30%	15	73,3%	55%	15	73,3%	80%	14	71,4%
6%	21	81,0%	31%	15	73,3%	56%	15	73,3%	81%	14	71,4%
7%	20	80,0%	32%	15	73,3%	57%	15	73,3%	82%	14	71,4%
8%	20	80,0%	33%	15	73,3%	58%	15	73,3%	83%	14	71,4%
9%	20	80,0%	34%	15	73,3%	59%	15	73,3%	84%	14	71,4%
10%	19	78,9%	35%	15	73,3%	60%	15	73,3%	85%	14	71,4%
11%	19	78,9%	36%	15	73,3%	61%	15	73,3%	86%	14	71,4%
12%	19	78,9%	37%	15	73,3%	62%	15	73,3%	87%	14	71,4%
13%	19	78,9%	38%	15	73,3%	63%	15	73,3%	88%	14	71,4%
14%	19	78,9%	39%	15	73,3%	64%	15	73,3%	89%	14	71,4%
15%	19	78,9%	40%	15	73,3%	65%	15	73,3%	90%	14	71,4%
16%	19	78,9%	41%	15	73,3%	66%	15	73,3%	91%	14	71,4%
17%	19	78,9%	42%	15	73,3%	67%	14	71,4%	92%	14	71,4%
18%	19	78,9%	43%	15	73,3%	68%	14	71,4%	93%	14	71,4%
19%	19	78,9%	44%	15	73,3%	69%	14	71,4%	94%	14	71,4%
20%	19	78,9%	45%	15	73,3%	70%	14	71,4%	95%	14	71,4%
21%	19	78,9%	46%	15	73,3%	71%	14	71,4%	96%	14	71,4%
22%	18	77,8%	47%	15	73,3%	72%	14	71,4%	97%	12	75,0%
23%	18	77,8%	48%	15	73,3%	73%	14	71,4%	98%	12	75,0%
24%	17	76,5%	49%	15	73,3%	74%	14	71,4%	99%	11	72,7%

Fig. 1A – Out-of-sample fitting test of the 2SIVProbit