**The link between trade openness, export diversification, institutions and output volatility in transition countries**

# 1. Introduction

While the growth prospects of transition economies have been investigated in the literature, the volatility of output has attracted little attention. This paper analyses a panel of annual data (1996-2010) from 25 transition countries to contribute the first empirical analysis of the trade and institutional determinants of output volatility in the context of transition. Negative effects of output volatility in the forms of decreased economic growth (Martin and Rogers, 2000; Imbs, 2007), lower private investment in human capital (Aizenman and Marion, 1999; Hnatkovska and Loayza, 2005) and increased income inequality (Hausmann and Gavin, 1996) are held to widen differences in economic development between developed and developing countries and to contribute to a persistent development gap. Moreover, output volatility may have particularly adverse effects on the poor. Lower investment in human capital increases income inequality, especially among low-income individuals. Poorer households face larger credit constraints and can rely only on very limited private funds for education purposes (Aizenman and Pinto, 2005). Moreover, volatility increases poverty by leaving individuals without liquid assets for consumption even if it has no effect on growth. However, a different strand in the literature highlights positive effects of volatility. Growth-cycle literature suggests that recession might reduce the opportunity cost of research (Aghion and Saint-Paul, 1991) and drive out inefficient firms from the market (Caballero and Hammour, 1994), which is likely to support technological changes and economic growth. In spite of these different perspectives, the aim of this paper is not to assess the costs and benefits of volatility but, rather, to achieve a better understanding of the determinants of volatility in the context of transition.

Some authors argue that developing countries have substantially larger volatility than do developed ones (Hakura, 2009). In both developing and emerging countries volatility is mainly the consequence of external shocks (Reinhart and Rogoff, 2009; 2014). External shocks take the basic forms of trade shocks and international capital flow shocks. Trade is becoming an important transmission mechanism of external shocks throughout the world economy, especially in developing countries. These countries usually concentrate their exports in a small number of sectors, particularly volatile sectors, which exposes them to greater risk and uncertainties. Such concentration makes them more vulnerable to external shocks and so induces greater volatility. Therefore, export diversification should alleviate the volatility effects of external shocks. Furthermore, developing and transition countries are characterised by poorly developed financial market and weak monetary and fiscal policy, which lower capacity to hedge against volatility compared to developed countries. Hence, they are facing more serious economic consequences from volatility compared to developed ones (Jansen et al., 2009). However, diversification of the sectoral composition of economy may enhance development of financial markets and decrease uncertainty in the economy. Considering all of this, it is important to discover which policy measures should be used to promote diversification and so reduce volatility.

Countries in transition are particularly susceptible to output volatility. At the economic level, transition is a process of radical restructuring. Unless the Schumpeterian output and employment effects of destruction and creation were to be continuously in balance, a corollary of growth-enhancing restructuring is corresponding output volatility, even at the aggregate level. In particular, transition encompasses increasing openness. Yet unless the decline of import-competing industries is exactly offset by the rise of exporting industries, increased openness not only enhances growth but also increases output volatility. In this investigation, we also highlight diversification of production and export lines. The literature suggests that diversification may influence output volatility not only *directly*, in its own right, but also *indirectly*, by moderating the influence of openness.

This paper also contributes to the small literature analyzing output volatility by estimating fixed effects panel models not only by ordinary least squares (OLS) but also by the general method of moments (GMM) system approach. GMM estimation is particularly appropriate for panel models, because this approach enables us to address the possibility that openness is potentially endogenous without recourse to “external” instruments. The potential endogeneity of openness may arise because both openness and output volatility are jointly determined as aspects of a broader restructuring process under transition. However, to the extent that the transition process in each country is conditioned by unobserved factors that are either time invariant (such as the particular initial conditions) or, at least, “slowly moving” (such as the degree of national consensus and the quality of policy making), we address the potential endogeneity of openness by estimating the determinants of output volatility conditional on country fixed effects. The possibility that openness is potentially endogenous to output volatility because of simultaneity is much weaker. Nonetheless, we allow for this possibility by using system GMM estimation to exploit the “internal” instruments made available by the time-series depth of our panel data. The same approach is used to address the potential endogeneity of our measure of institutional quality.

# 2. Literature review

Before the latest financial and economic crisis, only a few studies focused on volatility. The crisis opens up the question as to how to manage volatility (Haddad and Shepherd, 2011). Hence, the sources of volatility need to be understood. Volatility of output is primarily related to shocks that hit the economy. According to Cavallo (2008), the shocks could be domestic or external in origin and, in the case of external shocks, transmitted through trade and/or financial channels. Our investigation focusses on trade shocks, which are the primary external source of shocks to transition economies (see Section 2.1 below). Since trade openness exposes countries to trade shocks, we will explore the effects it has on output volatility together with the strategies for moderating such effects.

While the literature examines the relationship between openness and growth in detail, the openness and growth volatility relation has not been completely clarified (Haddad et al., 2013). Although many studies investigate the trade openness-volatility relationship (Easterly et al., 2001; Calderon et al., 2005; Cavallo, 2008; Jansen et al., 2009; Malik and Temple, 2009; Haddad et al., 2013), openness remains the most controversial of all volatility determinants. It is well-known that trade expose countries to external shocks (Jansen et al., 2009; di Giovanni and Levchenko, 2009) and that external shocks are a source of macroeconomic volatility (Easterly et al., 2001; Kose et al., 2003); yet, greater openness decreases sensitivity to internally induced shocks (such as domestic demand shortage), as more open sectors are less correlated with the rest of the home economy.

Di Giovanni and Levchenko (2009) find two possible effects of openness on volatility: on the one hand, openness is correlated with sector volatility and export specialization (*volatility-enhancing effect*)*;* on the other, trade could have a volatility-reducing effect as it changes co-movement between sectors within an economy and isolates open sectors from domestic fluctuations (*co-movement effect*). Overall in their study, the sign of the coefficient on trade openness reflects which of these two effects prevails. In their empirical analysis on a wide panel of countries at different levels of development, higher specialization and sector-volatility effects have predominance over the co-movement effect, which results in increased aggregate volatility, especially in countries at lower levels of development.

In the light of the global economic crisis from 2008, outward orientation particularly attracted attention in the literature (Haddad and Shepherd, 2011). The policy-propositions for developing economies range from building internal markets and supplying domestic demand to implementation of policies to promote domestic tradable sectors but without currency devaluation (Rodrik, 2008). A rising number of studies acknowledge the risks induced by increased openness, but claim that such risks are manageable. Export diversification is usually proposed as a mechanism that will enable countries to manage risks that arise from trade transmitted volatility and reap the benefits of openness (Eichengreen, 2011; Haddad et al, 2013).

Diversification is generally considered as a strategy for the reduction of volatility. It offers protection against adverse external shocks by providing countries with access to a broader range of global value chains and insurance schemes. A strategy of export diversification is recommended to smooth out a country’s output volatility, by decreasing the country’s vulnerability to demand shocks in the global market. The issue of export diversification is particularly interesting for commodity-rich countries. Diversification of exports may be desirable to smooth the effects of volatility on commodity export earnings, although conversely might have a negative influence on resource rents in the case when resources are transferred from more to less profitable industries (Massol and Banal-Estañol, 2014).

Abundant empirical literature confirms the theoretical predictions regarding the influence of export diversification on output volatility. Malik and Temple (2009) argue that natural barriers to trade such as coastal access or distance from major markets result in a more concentrated structure of exports. Fewer varieties in the export base ultimately increase terms of trade (ToT) volatility and output volatility. The distribution of ToT volatility by groups of countries based on their level of export concentration shows that countries with more diversified export baskets have lower terms of trade volatility. As higher concentration translates into greater price shocks and higher volatility of output, export concentration is a possible channel through which geography affects output volatility.

Empirical studies find a negative but not always significant effect of export diversification on volatility. Cavalcanti et al. (2012) find that export diversification is an important buffer against commodity price volatility in resource abundant countries. Cavallo (2008) did not find that the degree of export diversification significantly determines output volatility. Calderón and Schmidt-Hebbel (2008) discover a negative relationship between openness and volatility only when exports are diversified. Similarly, Haddad et al (2013) find that the effect of openness on volatility changes sign from positive to negative as the level of a country’s export diversification increases. In addition, the authors identify a threshold point in terms of their diversification measure above which this reversal happened. The greater diversification of exports should stabilise output, while more concentrated exports are expected to increase output volatility. Diversification is thus significant for volatility only through its moderating effect on openness, but in isolation has no significant impact. However, their estimation on a sub-sample of high income countries does not establish a stabilising effect of export diversification on output volatility. It implies that those countries have other forms of protection from external shocks, such as developed financial markets. Conversely, Bejan (2006) finds that the interaction term between openness and export product concentration is significant only in advanced economies.

The importance of institutional quality for macroeconomic volatility has been emphasized by prominent scholars (Rodrik, 1998; Acemoglu et al. 2003). The main point of these studies is that mismanagement of macroeconomic policies, which has usually been part of the research focus of volatility studies, may primarily be attributed to the institutional environment. According to Acemoglu et al. (2003), macroeconomic volatility mainly results from institutional quality. The author argues that some forms of institutions, such as corruption and (lack of) property rights, have been recognized as causes of mismanagement and instability. Yet, the literature usually emphasises macroeconomic policies as the source of crisis. Rodrik (1999) postulates that the quality of domestic institutions influences macroeconomic volatility by affecting countries' ability to manage external shocks. In this respect, the author associates volatility reduction with institutions of internal conflict management as proxied by indices of ethnic fractionalization, democratic rights and the quality of government institutions. These variables are characterised as so called "deep" empirical determinants of macroeconomic stability. While the studies establish that more efficient institutional infrastructure is a pillar of macroeconomic stability, the question remains as to which type of institutions are the most influential in explaining volatility. Very wide categorisation could identify two groups of studies: one that investigates the political regimes as proposed in Rodrik (1998); and the other with a focus on economic institutions in the spirit of Acemoglu et al. (2003).

On the one hand, Rodrik (1998) inspired a large number of empirical investigations on the effect of those determinants. Rodrik (1999) explains that in a participatory political structure there is more certainty that the political elite will reach consensus regarding important economic reforms or regarding safeguards in the case of external shocks. Mobarak (2005) finds that democracy supports macroeconomic stability. This result is expected, since a democratic regime is less prone to undertake risky political decisions. Political institutions are the focus of Klomp and de Haan (2009). They identify measures that capture various dimensions of the political regime and group them into three categories: the type of regime; the stability of the regime; and policy uncertainty. According to their results, democracy tends to decrease volatility, while regime and government instability and uncertain fiscal and monetary policy increase output volatility. Similarly, Guillaumont (2009) finds that high quality of governance is a factor of economic stability and among the determinants of a country's ability to absorb shocks. Likewise, Arin et al. (2011) argues that economic crisis should be better handled when a country has efficient institutions. In a sample of OECD countries, they find that a higher level of corruption in a country decreases the probability that a country will successfully consolidate a budget in a period of economic crisis.

On the other hand, researchers focus on the inefficiency of institutions such as inadequate property rights protection or enforcement of contracts. According to Rohn et al. (2009), inadequate property rights protection increases uncertainty and volatility, since such influences on the business climate encourage investors to direct capital into sectors from which it is easy to withdraw investment. They find that only the legal and administrative systems explain output volatility in European transition countries. However, Barseghyan and DiCecio (2010) find that protection of property rights has no influence on output volatility, but that entry barriers do have a significant influence. Findings of a direct relationship between entry barriers and output volatility could be explained in the light of a dynamic industry model à la Hopenhayn (1992) and Melitz (2003). These authors argue that higher entry barriers allow low-productivity firms to survive in the market, resulting in more heterogeneity among the firms in the industry. Greater heterogeneity with respect to business efficiency will increase macroeconomic volatility. Taking a sample of 77 developing countries, Malik and Temple (2009) find institutions (proxied by an aggregated governance index, constraints on the executive, the competitiveness of political participation and the type of government) to be very strong predictors of output volatility.

The theoretical and empirical literature recognize many other important factors such as financial development and capital account openness (Easterly et al. 2001; Cecchetti et al, 2005), mismanagement of macroeconomic policies, such as fiscal, monetary and exchange rate policies (Hasumann and Gavin, 1996; Fatas and Mihov, 2006), and the set of usual controls, namely gravity-like variables such a size of the economy, level of economic development and the level of human capital (Easterly et al., 2001; Bejan, 2006; Caldéron and Schmidt-Hebbel,2008; Malik and Temple, 2009).

Easier access to foreign financial markets and greater openness of the capital account could help a country to smooth the shock adjustment process, but simultaneously induce greater volatility. Increased financial openness creates more opportunities for risk sharing and portfolio diversification that producers and investor can use to reduce risks (Kose et al., 2003; Kim, 2007). Hausmann and Gavin (1996) see developed financial market as shock absorbers that help countries to stabilise output in times of crisis. Better access to credit, which comes with greater integration of a country’s financial market into the global market, sustains demand during a negative output shock (Aizeman and Pinto, 2005). On other hand, greater dependence on credit might make a country more vulnerable (Easterly, 2001). However, investors could more easily withdraw invested money in a period when firms or financial institutions are weakening. In turn, this could further slowdown the performance of firms and institutions and potentially intensify economic downturn. Empirical findings are not always robust. Some studies argue that the sign of trade openness on output volatility varies with the development of financial sectors. Cavallo (2007) argue that more opportunities to credit access in more open economies should help countries to more easily overcome fluctuations in output. The author finds that the volatility increasing effect of openness is more pronounced in countries that are more exposed to capital flows.

In developing economies poor macroeconomic policies have been identified as an important cause of volatility of macroeconomic volatility. For example, Hausmann and Gavin (1995) and Fatas and Mihov (2006) argue that mismanagement of fiscal and monetary policy, including exchange rate policy, lead to output instability. Rohn et al. (2009) find significant and positive effects of inflation and exchange rate variation on output volatility in transition economies. Section 2.1 focusses the literature review more specifically on output volatility in the context of transition.

***2.1. Output volatility in transition economies***

Before the onset of transition, the national outputs of the centrally planned economies were not characterised by high volatility. After the process of transition started, output became increasingly volatile.[[1]](#footnote-1) Some studies find similarities in business cycles in some Central Eastern Europe countries and the euro area, but rather idiosyncratic behavior of business cycles in others (Fidrmuc and Korhonen, 2006; Artis et al., 2008).

Yet, to date the determinants of output volatility have been little studied. Trade openness has been important in transition economies. Studies find that greater openness of transition countries is beneficial for GDP growth (Awokuse, 2007; Nannicini and Billmeier, 2011) and welfare (Jansen, 2004). However, the literature also argues that openness makes economies, especially the small ones, more vulnerable to external shocks, causing increased volatility of GDP. The open economies that were oriented to global integration were among those hardest hit by the global financial crisis (Haddad et al, 2013).

Since transition economies do not have highly developed financial markets, trade was the major transmission mechanism of crisis. However, the macroeconomic effect of the crisis differed among transition countries. The crisis caused a sharp collapse in GDP growth rates across the majority of the Western Balkan economies (WBEs) accompanied by rapid increases in trade deficits (Gligorov 2009).[[2]](#footnote-2) In the WBEs (primarily Albania, Croatia), negative effects are primarily the results of demand shocks in developed economies, since those countries are predominantly oriented toward EU markets. The exports from the Commonwealth of Independent States (CIS), traditional oil and commodity exporters, declined considerably due to decrease of world manufacturing production and, consequently, lower demand for energy and industrial raw materials. Moreover, the decline of oil prices on the world market exposed those countries to large commodity price shocks. Hence, the crisis effects in those countries were of much larger size, since not just the volume of exports decreased, but also the unit value of exported goods. The decrease in world manufacturing production was responsible for the decline of the Central Eastern European Countries’ (CEEC) exports (Czech and Slovak Republics, Poland, Hungary and, to some extent, Romania), since their exports are concentrated on machinery (UNCTAD, 2010; EBRD, 2010). Considering strategies proposed to deal with demand and product specific shocks, geographical diversification should be proposed to the WBEs and production diversification to the CIS and CEEC for crisis recovery and attenuation of volatility (EBRD, 2008).

# 3. Data and methodology

The sample includes 25 transition countries. We use three-year non-overlapping averages of the annual data over the period 1996 to 2010. All volatility measures are calculated for each country using the standard deviation for each successive 3-year period of either annual growth rates (GDP per capita and the price level) or annual levels (average terms of trade, average exchange rate and government expenditure). This is standard procedure in the literature particularly when variables may be subject to business cycle variations, as with per capita growth rates (Haddad et al, 2013).

The dependent variable is GDP volatility. There are several factors why output growth instead of output level volatility is used. Many studies (Easterly and Kraay, 2000; Bejan, 2006; Cavallo, 2007; Malik and Temple, 2009; Jansen et al., 2009; Haddad et al, 2013) argue that the growth rate and not the output level determines the planning horizon and as such it is of greater interest to policy makers to maintain growth stability (Haddad et al, 2013).

The main variables of interest are trade openness, export diversification and institutions. Consistent with most of the literature (Easterly et al., 2001; Haddad et al, 2013), openness is proxied by the ratio of the sum of a country's exports and imports to GDP. Export diversification is proxied in different models by the concentration indicators (the Hirschman-Herfindahl index-HHI and the overall Theil index), and by the “between” and “within” components of the Theil index. The within component of the Theil index measures the degree of equality of the distribution of the export shares of existing export lines, i.e. changes at the intensive margin of export growth. The between component of the Theil index measures changes in the number of new product lines in the export basket, i.e. change along the extensive margin of export growth. The HHI, by construction, predominantly measures changes in the distribution of export shares (i.e. changes at the intensive margin). Accordingly, we expect to get similar results from the HHI and the within Theil component. (This anticipation is reflected in the results reported below.) In our sample, the within component is also the predominant components of the total Theil, with 81% of the total Theil explained by the within component. Hence, we expect results from the total Theil to be similar to those obtained from its within component. Indicators of export diversification are calculated by using the 6-digit level of the Harmonised System (HS) data from COMTRADE, 1996 revision, which recorded data in 5113 export lines. Data recorded at the 6-digit level is the highest level of internationally comparable disaggregated country-level export data.

Although there are many indicators of institutions used in the literature, in our preferred specification we use the index of political rights from Freedom House. The index ranges from 1 to 7, with 1 indicating the most “free” country. We also use as robustness checks alternative institutional indicators such as indices of economic, political and legal quality taken from Kuncic (2012), institutional quality measures from the World Governance Indicators (WGI) database and the Corruption Perception Index (CPI) by Transparency International.

Government expenditure is proxied by the volatility of total government expenditure. Total expenditure is used rather than government consumption, because total expenditure includes transfers and substitutes, which are used by policymakers as an insurance tool. Chinn and Ito’s (2008) indicator of financial openness is used to measure financial openness in transition countries. The level of financial development is proxied by financial depth measured by the private credit to GDP ratio. Appendix A contains more detailed descriptions of the variables considered in this study and their data sources.

# 4. The econometric model and methodology

To investigate how openness influences output volatility at different levels of export diversification, a two-way interaction between openness and export diversification is introduced:

(1)

where the dependent variable, *GDPVOLi,t* is the standard deviation of real GDP per capita for country *i* in period *t*, *OPENi,t* is trade openness (the total trade as a share of GDP), *DIVi,t* is a calculated measure of export diversification, *INST i,t*is a proxy for institutions, and is the multiplicative interaction between trade openness and diversification. Vector *X* includes proxies for the effects of the terms of trade, the exchange rate, fiscal and monetary volatility, as well as proxies for financial openness and financial system development. Note that reflects the effect of openness when exports are fully diversified (*DIVi,t* =0) and the sum reflects the effect of openness at different values of *DIVi,t*.

Potential endogeneity is one of the major methodological challenges. The potential endogeneity of trade openness in output volatility regressions is extensively debated in the literature. It is generally agreed that endogeneity is of greater concern in growth regressions, as growth rates, current and past, potentially influence both components of the denominator in the openness ratio (exports and imports). Yet, the case for the potential endogeneity or exogeneity of openness in volatility models is mixed and correspondingly less compelling. On the one hand, somewhat indirectly, the endogeneity of openness could arise in a volatility regression if the government perceives openness as a shock transmission mechanism that causes volatility and pursues policies that affect the level of trade openness. Similarly, policy makers can pursue policies that simultaneously affect the liberalization of trade and output volatility, such as privatization and financial liberalisation. An example is the Washington Consensus, which has been on the policy agenda in the transition countries in our sample. On the other hand, the counter (political) argument in favour of the exogeneity of the openness variable suggests that trade openness is primarily dependent on foreign demand and supply and trade barriers, which are not under the responsibility of national governments, but dependent on global/regional decision makers. Also, small and distant countries are more susceptible to external shocks, but also more likely to open up their economies than are large countries. However, the size effect in our models is controlled by the inclusion of country fixed effects. Overall, then, the theoretical case for treating openness in a volatility model is not strong. Moreover, this conclusion is confirmed by Haddad et al. (2013, p.776) who obtain ‘qualitatively very similar’ results from estimating a volatility model using panel data in two variants: a random effects model, in which openness is treated as exogenous; and a fixed effects model estimated by GMM, in which the openness and the openness/diversification variables are treated as endogenous (which is the approach to potential endogeneity adopted in the present study).

Institutional variables also entail the problem of potential endogeneity. The relationship between institutions and volatility might be subject to simultaneity bias, as it not straightforward whether better institutions brings stability or stability improves institutional quality. The literature uses a range of instruments for institutional quality such as settler mortality, population density and European languages.

The arguments concerning the exogeneity or potential endogeneity of openness are inconclusive and mainly developed in the context of output levels or output growth rather than output volatility, which is our concern. Moreover, while the case for considering institutions to be potentially endogenous is better established in relation to output levels and growth it is not similarly well established in relation to output volatility. Accordingly, we use two estimation strategies: fixed effects (FE) estimation on the assumption that openness and institutions are exogenous with respect to output volatility; and, GMM estimation to take account of the potential endogeneity of openness and institutional quality.

Although the theoretical case for treating openness as potentially endogenous is not compelling and the empirical comparison provided by Haddad et al. (2013) is not supportive, we address uncertainty on this issue – as noted in the Introduction, above – by estimating fixed effects panel models not only by ordinary least squares (OLS) but also by the general method of moments (GMM) system approach. In so doing, we exploit “internal” instruments made available by the time-series depth of our panel data. Instruments for openness that are “external” to our dataset, such as “natural openness” (Frankel and Romer, 1999) as well as instruments for institutions such as dummies for languages, geographic latitude and the fraction of the population speaking a major European language (Hall and Jones, 1999), legal origin (La Porta et al., 1999), former colonies (Barseghyan and DiCecio, 2010), European settler mortality and indigenous population density (Acemoglu et al., 2003) are all time invariant. This makes them inappropriate for use in panel estimation. Instruments must be highly correlated with the variable to be instrumented. Yet time invariant instruments cannot replicate the within group variability, which is particularly an issue given that openness and institutional quality change throughout the course of transition. Accordingly, these instruments are suitable only for models estimated on cross-section data (Di Giovanni and Levchenko, 2009; Haddad et al., 2013). For example, Di Giovanni and Levchenko (2009, pp.562-563) note, referring to the “natural openness” instrument for openness developed by Frankel and Romer (1999),

… that this instrument is not available in a panel, because the gravity coefficients do not exhibit sufficient time variation. Thus, it can only be used in the cross-sectional specifications.[[3]](#footnote-3)

However, if we analyse cross-section data alone, we will not be able to control for unobservables that may be correlated with other variables in the model. This is particularly important in the transitional context, as elaborated in the Introduction.

The main rational for the choice of the fixed in opposition to the random effect (RE) estimator is the structure of our sample. FE estimation addresses any doubts we may have concerning the correlation of our independent variables with the country-specific effects and, hence, with respect to a potential source of endogeneity (omitted variable) bias. Both time and country specific fixed effects are included. Taking into consideration the heterogeneous structure of our sample in terms of time-invariant country characteristics such as size, climate, geography or communist history, estimation with country-fixed effects reduces concerns regarding potentially omitted variables (Durlauf *et al.,* 2005; Baltagi, 2006).[[4]](#footnote-4) Time dummies control for output fluctuations common to all countries in the sample in a particular year. The latest global economic crisis is a good example, which makes a strong case for inclusion of time dummies in our specification. In panel estimation, the inclusion of time dummies also minimises possibilities for cross-residual correlation by removing time-related shocks from the errors (Roodman, 2009).

A small sample and an unbalanced panel support the use of System GMM rather than the difference GMM estimator for our model. It has been shown that system GMM has better finite sample properties in terms of bias and root mean squared error than difference GMM (Blundell and Bond, 1998). System GMM also seems superior to difference GMM in unbalanced panels, since difference transformation in difference GMM could magnifies gaps (Roodman, 2009b), which is of some importance given our data set. We use the finite sample Windmeijer (2005) correction to the two-step covariance matrix to make estimation efficient and robust to panel-specific autocorrelation and heteroskedasticity.

**5. Main results**

The estimates of model (1) are reported in Table 1. Since the measure of diversification is central to our analysis, we report results for model (1) using a range of alternative diversification measures to represent *DIVi,t*. The results presented in columns 1-4 and 5-8 in Table 1 are obtained when diversification is calculated using the Hirschman-Herfindahl index and the overall Theil together with its between and within components (corresponding to the intensive and extensive margins, respectively).

The results of the FE diagnostic tests raise no doubts about coefficient validity. The Woodbridge test of autocorrelation in panel data indicates that there is no evidence of serial correlation (Table 1). The highly significant result of the test for groupwise heteroscedasticity suggests that the variance of the error terms differs across cross-section units, given the p-value of 0.000 (Table 1). In order to correct standard errors for this heteroscedasticity, we estimated the model with robust standard errors. Likewise, the system GMM diagnostics, including those for instrument validity are all highly satisfactory (Roodman 2009a and 2009b). Judgment on the appropriate number of instruments was based on the results of the standard diagnostics on instrument validity (m1 and m2 statistics and the over-identifying restrictions tests).[[5]](#footnote-5) The preferred results of this procedure limit the lag depth of the instruments on the predetermined and endogenous variables to a minimum, which decreases the number of instruments to just below the number of countries.

**Table 1.** Fixed effect and System GMM estimation of Model (1)

*Dependent variable: Standard deviation of the real GDP per capita growth rates*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ***Fixed effect*** | | | | ***System GMM*** | | | |
| **Export diversification indicator** | **Hirschman-Herfindahl index** | **Theil** | **Intensive** | **Extensive** | **Hirschman-Herfindahl index** | **Theil** | **Intensive** | **Extensive** |
| **VARIABLES** |  |  |  |  |  |  |  |  |
| Export diversification | 16.914\*\* | 0.661 | 1.162 | -6.493\* | 24.74\* | 1.872 | 4.716\*\* | -7.397 |
|  | (6.156) | (1.377) | (1.303) | (3.776) | (13.471) | (2.092) | (2.119) | (5.482) |
| Openness | 0.098\*\* | 0.049 | 0.099\* | -0.02562 | 0.203\*\* | 0.035 | 0.208\* | -0.091 |
|  | (0.047) | (0.042) | (0.051) | (0.029) | (0.089) | (0.143) | (0.118) | (0.094) |
| Diversification#Openness | -0.149\*\* | -0.01 | -0.02\* | 0.03008 | -0.271\*\* | -0.009 | -0.043\*\* | 0.065 |
|  | (0.071) | (0.009) | (0.011) | (0.020) | (0.124) | (0.024) | (0.022) | (0.063) |
| Institutions | 0.51\* | 0.415\* | 0.474\* | 0.499\*\* | 0.407 | 1.189\* | 0.793\*\* | 0.855\*\* |
|  | (0.261) | (0.241) | (0.245) | (0.218) | (0.523) | (0.686) | (0.363) | (0.416) |
| Terms of trade volatility | -4.182 | -8.288\* | -7.864\* | -3.869 | -4.499 | -6.303 | -1.601 | -7.045 |
|  | (6.551) | (4.400) | (4.292) | (3.133) | (7.055) | (7.149) | (5.714) | (5.347) |
| Exchange rate volatility | -0.002\* | -0.001 | -0.0007 | -0.0004 | -0.002 | -0.001 | -0.001 | -0.001 |
|  | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Inflation rate volatility | 0.008\*\*\* | 0.008\*\*\* | 0.008\*\*\* | 0.007\*\*\* | 0.008\*\*\* | 0.006\*\*\* | 0.007\*\*\* | 0.008\*\*\* |
|  | (0.002) | (0.002) | (0.002) | (0.002) | (0.001) | (0.002) | (0.002) | (0.001) |
| Government expenditure volatility | 0.052  (0.044) | 0.033  (0.042) | 0.028  (0.041) | 0.0296  (0.041) | 0.012  (0.040) | 0.031  (0.057) | 0.036  (0.053) | 0.018  (0.032) |
| Cred. to private/GDP | 0.032 | 0.036 | 0.036\* | 0.032\*\* | 0.023 | 0.025 | 0.031 | 0.046\* |
|  | (0.021) | (0.025) | (0.019) | (0.014) | (0.022) | (0.025) | (0.019) | (0.024) |
| Financial openness | 0.29001 | 0.31156 | 0.341 | 0.059 | 0.248 | 0.525\*\* | 0.46304\* | 0.060 |
|  | (0.435) | (0.417) | (0.409) | (0.272) | (0.250) | (0.267) | (0.259) | (0.288) |
| Conflict | 1.242\*\* | 1.111 | 0.946 | 0.596 | 1.393\*\* | 1.031\* | 1.458\*\* | 0.134 |
|  | (0.558) | (0.657) | (0.655) | (0.674) | (0.598) | (0.555) | (0.660) | (0.836) |
| Time dummies | ***Included*** | ***Included*** | ***Included*** | ***Included*** | ***Included*** | ***Included*** | ***Included*** | ***Included*** |
| Constant | 0.032 | 0.036 | 0.036\* | 0.033\*\* | 0.023 | 0.025 | 0.031 | 0.046\* |
|  | (0.021) | (0.025) | (0.019) | (0.014) | (0.022) | (0.025) | (0.019) | (0.024) |
| Observations | 107 | 109 | 109 | 109 | 107 | 109 | 109 | 109 |
| Number of countries | 24 | 25 | 25 | 25 | 24 | 25 | 25 | 25 |
| R-squared | 0.61 | 0.59 | 0.61 | 0.62 |  |  |  |  |
| Wooldridge test for autocorrelation in panel data | 0.111  (0.7419) | 0.252  (0.6202) | 0.109  (0.7443) | 0.032  (0.8600) |  |  |  |  |
| Wald test for groupwise heteroskedasticity in FE | 1202.72 (0.000) | 1440.73 (0.000) | 1845.97 (0.000) | 1083.89 (0.000) |  |  |  |  |
| Number of instruments |  |  |  |  | 23 | 21 | 23 | 23 |
| Arellano-Bond test AR(1) |  |  |  |  | -3.03  (0.002) | 0.94  (0.345) | -2.86 (0.004) | -2.00  (0.046) |
| Arellano-Bond test AR(2) |  |  |  |  | 0.76  (0.448) | 0.02  (0.980) | 0.29  (0.776) | -1.34  (0.181) |
| Sargan test of overidentifying restrictions |  |  |  |  | 1.73  (0.943) | 4.84  (0.848) | 2.59  (0.920) | 1.21  (0.751) |
| Hansen test of overidentifying restrictions |  |  |  |  | 1.76  (0.940) | 9.18  (0.421) | 3.98  (0.782) | 1.49  (0.685) |
| Difference-in-Hansen  GMM instruments for levels |  |  |  |  | 0.26  (0.968) | 0.62  (0.893) | 1.14  (0.768) | 1.49  (0.685) |

*Robust standard errors in parentheses; for diagnostic tests, p-values \*\*\* p<0.01, \*\* p<0.05, \* p<0.10*

The first set of results are obtained by using the HHI, overall Theil and the within component of the Theil index as export diversification proxies (columns 1-3 in Table 1). It has been shown that the within component of the Theil index maps onto diversification at the intensive margin of export growth, i.e. captures changes between the shares of active export products (Cadot et al., 2003). Since the HHI measures changes in the distribution of export shares, it is expected that this concentration indicator mainly reflects diversification at the intensive margin. Note that in our sample changes in the overall Theil are mainly influenced by changes of its within component. Hence, we expect to get similar results from both the overall Theil and its within component. As expected, we find the same qualitative results for openness, diversification and their interaction when these diversification indicators are used. The results in Columns 1-3 in Table 1 show positive coefficients on overall diversification, diversification at the intensive margin and openness together with a negative coefficient on the interaction term, indicating that the effect of openness on output volatility attenuates as overall diversification and diversification at the intensive margin increases.

The interaction coefficient is only significant in the cases of the HHI and the within Theil. The estimated coefficient on openness in Table 1 suggests that openness tends to increase volatility but only when the country is perfectly diversified (DIV=0). However, this is irrelevant in our case, since there are no observations (countries) that are perfectly diversified. Similarly, the standard errors reported in Table 1 are the standard errors only for that particular effect. Hence, we are primarily interested in the marginal effect of openness and the extent it is modified by export diversification. The marginal effects of openness on volatility at different values of export diversification along the intensive margin (Table 1, Column 3) are plotted in Figure 1: the right-hand panel displays marginal effects of openness from FE estimation treating openness and the openness/diversification interaction as exogenous; the left-hand panel displays marginal effects of openness from system GMM estimation treating openness and the openness/diversification interaction as endogenous.[[6]](#footnote-6)

**Figure 1.** Average marginal effects of openness as a function of export diversification (x-axis): from FE estimation (LH panel) and from System GMM estimation (RH panel)



*Source: Author's illustration*

The marginal effects derived from both estimation strategies are similar. First, we find that openness does not have a statistically significant effect on output volatility at higher levels of diversification along the intensive margin, which encompass 90 per cent of our sample observations. Yet, for the 10 per cent of our observations at lower levels of diversification – respectively, lower than 3.72 (FE estimation) and 3.62 (GMM estimation) – the effect of openness is not only positive and significant but is also attenuated by increased diversification along the intensive margin. Within the range of statistically significant results obtained from FE estimation, which are of similar magnitude to those obtained from GMM estimation, a change in within-Theil index from 2.42 to 3.82 (compared to a range 1.72 and 6.76) reduces the marginal effect of openness from 0.50 to 0.21: in round terms, a reduction in output volatility of 0.3 percentage points. This effect is non-negligible, as can be seen by comparing it either to the mean value of our dependent variable, 2.90, or to the mean value of the observations within the range of the significant marginal effects, 3.60. Qualitatively, these findings are consistent with those of Haddad et al. (2013) who also report a positive openness effect on output volatility that attenuates with diversification. Quantitatively, however, the findings differ: Haddad et al. (2013) report this effect over a much wider range of their sample (in the range of 56 per cent to 80 per cent of their observations on 77 developed and developing countries, depending on the indicator used).

We find that the effect of openness on volatility attenuates as the overall diversification and diversification at the intensive margin of export growth increase. Yet our findings suggest that this relationship is not universally applicable but is highly conditional; indeed, the marginal analysis shows that the effect is statistically significant only for the small portion of the sample at the lower levels of diversification. Accordingly, our results suggest that diversification may not attenuate the volatility effects of openness for transition countries already at medium or higher levels of diversification, but nonetheless may have this effect for countries at lower levels of diversification. In our sample, such countries are Azerbaijan, Kyrgyzstan and Russia, which together account for all nine of the observations from FE estimation, and eight of the nine from system GMM estimation, subject to statistically significant moderating effects of diversification on the volatility effects of openness (Figure 1).[[7]](#footnote-7)

Next, we consider the estimated results involving diversification at the extensive margin (the between component of the Theil index). Both openness and diversification have a negative coefficient and their interaction has positive coefficient; however, these coefficients are mainly not statistically significant (columns 4 and 8 in Table 2) and their corresponding marginal effects are uniformly insignificant.

The related literature (Rodrik, 1998; Haddad et al., 2013) uses only the HHI and the total Theil as diversification indicators and does not distinguish between diversification at the intensive and extensive margins of export growth, often using the terms interchangeably. Our results show that it is important to distinguish which export margin is measured by the indicator used in the analysis, as openness may influence volatility differently when diversification is the result of a changing distribution across existing products (i.e. at the intensive margin) or when diversification arises from broadening the country’s export portfolio to new products (i.e. at the extensive margin). Our findings that trade openness has different effects on volatility when the country diversifies exports along the extensive margin than when exports are diversified along the intensive margin show that differences between diversification at the export margins are not just conceptual, but also substantive.

## Further, institutional quality, represented by the political rights, has a statistically significant effect on output volatility; in round terms, an improvement of institutional quality by one point (on an inverted seven point scale) is associated with a reduction of output volatility of somewhere between half (FE estimates) and one (GMM estimates) percentage point. The difference in size of the estimated effects does not resolve the issue as to whether in principle institutional quality is potentially endogenous to output volatility. However, in our sample, whichever assumption we make, the corresponding estimation strategies yield estimates that are consistent with respect to sign, statistical significance and order of magnitude. Whichever assumption we make, therefore, our estimates suggest that transition countries with higher levels of political rights and democracy experience lower levels of output volatility. In the next Section, robustness checks show the consistency of these estimates with those obtained from other measures of institutional quality as well as from other measures of output volatility in transition countries.

Among the control variables, the only variable identified as exerting a systematic effect on output volatility is inflation volatility: the estimated effect is uniformly positive, statistically significant and of about the same size. In round terms, an increase of 10 percentage points standard deviation of the inflation rate causes an increase in the standard deviation of output in the volatility of 0.10 percentage points). Other studies also find that inflation instability increase volatility in transition countries (Rhon et al., 2009). Otherwise, on the criterion of the estimates being of the same sign and half or more statistically significant, only the conflict dummy is informative: as expected, conflict is associated with a substantial increase in output volatility.

# 6. Robustness checks

In order to investigate the stability of our findings several robustness checks are undertaken. We report estimates using: different dependent variable proxies; different institutional proxies; and controls for dependence on natural resources to investigate the possibility that our results reflect a potential "resource curse". Given that our FE and system GMM estimates are similar, for reasons of space we report only FE estimates of these additional models in Table 2.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 2.** Fixed effect robust estimation of model (1) for different institutional proxies, different dependent variables and additional control | | | | | | | | | | | | | | |
|  | **Different institutional proxy** | | | | | | | | | **Diff. dependent (standard deviation)** | | | | **Control for natural resource** |
| **Dependent variable** | **Standard deviation of the real GDP per capita growth rates** | | | | | | | | | **Real GDP growth rate** | | **HP gdp growth** | | **Standard deviation of the real GDP per capita** |
| **Institutional proxies** | **Kuncic** | | | **World Government Indicators (WGI)** | | | | | **Transp. Inter.** |  | | | | |
| **Economic** | **Political** | **Legal** | **Govern.**  **efficiency** | **Regulat. quality** | **Rule of law** | **Political stability** | **Corruption** | **Corruption** | **Political rights** | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  | |  | |
| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | | (12) | |
|  |  |  |  |  |  |  |  |  |  |  |  | |  | |
| Export diversification | 1.224  (1.358) | 1.981  (1.392) | 1.296  (1.345) | 1.290  (1.337) | 1.806  (1.384) | 1.317  (1.427) | 1.246  (1.189) | 1.852  (1.425) | 0.882  (1.244) | 1.114  (1.351) | 3.954\*\*  (1.722) | | 1.2001  (1.333) | |
|  |  |  |  |  |  |  |  |  |  |  |  | |  | |
| Openness | 0.099\* | 0.129\*\* | 0.101\* | 0.101\* | 0.128\*\* | 0.103\* | 0.091\* | 0.130\*\* | 0.109\*\* | 0.0955\* | 0.133\*\* | | 0.10001\* | |
|  | (0.051) | (0.056) | (0.051) | (0.051) | (0.058) | (0.057) | (0.045) | (0.057) | (0.051) | (0.050) | (0.053) | | (0.051) | |
|  |  |  |  |  |  |  |  |  |  |  |  | |  | |
| Diversification# | -0.021\* | -0.027\*\* | -0.021\* | -0.021\* | -0.0265\* | -0.021 | -0.020\* | -0.027\*\* | -0.021\* | 0.4326\* | -0.136 | | 0.474\* | |
| Openness | (0.012) | (0.013) | (0.012) | (0.012) | (0.013) | (0.013) | (0.010) | (0.013) | (0.010) | (0.234) | (0.285) | | (0.247) | |
|  |  |  |  |  |  |  |  |  |  |  |  | |  | |
| Institutions | -1.344 | -8.002\*\* | -0.599 | 0.107 | -3.069\*\* | -1.64 | -2.17\*\*\* | -3.037\*\*\* | -0.114 | -0.019\* | -0.03\*\* | | -0.021\* | |
|  | (3.465) | (3.026) | (5.575) | (1.064) | (1.352) | (1.069) | (0.717) | (1.004) | (0.283) | (0.011) | (0.011) | | (0.012) | |
| Terms of trade volatility | -6.56688  (4.519) | -5.80962  (3.945) | -6.603  (4.437) | -6.64  (4.598) | -3.703  (3.882) | -5.846  (4.312) | -3.732  (4.410) | -5.154  (4.186) | -8.98645\*  (5.200) | -6.252  (4.797) | 20.018  (12.97) | | -7.879\*  (4.294) | |
|  |  |  |  |  |  |  |  |  |  |  |  | |  | |
| Exchange rate volatility | -0.0008  (0.001) | -0.00080  (0.001) | -0.001  (0.001) | -0.001  (0.001) | -0.0006  (0.001) | -0.001  (0.001) | -0.001  (0.001) | -0.0003  (0.001) | 0.0007  (0.001) | -0.0008  (0.001) | -0.005  (0.003) | | -0.0007  (0.001) | |
|  |  |  |  |  |  |  |  |  |  |  |  | |  | |
| Inflation rate volatility | 0.001\*\*\*  (0.001) | 0.011\*\*\*  (0.001) | 0.009\*\*\*  (0.002) | 0.009\*\*\*  (0.001) | 0.007\*\*\*  (0.001) | 0.009\*\*\*  (0.001) | 0.009\*\*\*  (0.001) | 0.008\*\*\*  (0.001) | 0.009\*\*\*  (0.001) | 0.007\*\*\*  (0.002) | -0.002  (0.002) | | 0.008\*\*\*  (0.002) | |
|  |  |  |  |  |  |  |  |  |  |  |  | |  | |
| Government expenditure | 0.008  (0.040) | -0.023  (0.052) | 0.005  (0.041) | 0.007  (0.041) | -0.0084  (0.042) | -0.009  (0.042) | -0.002  (0.043) | -0.033  (0.045) | 0.025  (0.042) | 0.01492  (0.043) | 0.007  (0.058) | | 0.026  (0.043) | |
| volatility |  |  |  |  |  |  |  |  |  |  |  | |  | |
| Credit to private/GDP | 0.027  (0.017) | 0.031\*  (0.016) | 0.029\*  (0.017) | 0.028  (0.018) | 0.015  (0.018) | 0.033\*  (0.017) | 0.027  (0.018) | 0.037\*  (0.019) | 0.025  (0.019) | 0.036\*  (0.018) | 0.014  (0.034) | | 0.036\*  (0.019) | |
| Financial openness | 0.327 | 0.332 | 0.306 | 0.307 | 0.515 | 0.235 | 0.335 | 0.287 | 0.265 | 0.4219 | 0.165 | | 0.335 | |
|  | (0.441) | (0.405) | (0.443) | (0.433) | (0.444) | (0.397) | (0.410) | (0.379) | (0.385) | (0.426) | (0.590) | | (0.417) | |
| Conflict | 0.874 | 0.911 | 0.894 | 0.886 | 0.771 | 0.998\* | 0.726 | 1.054\* | 0.627 | 0.946 | 0.684 | | 0.944 | |
|  | (0.669) | (0.623) | (0.688) | (0.645) | (0.641) | (0.573) | (0.664) | (0.521) | (0.727) | (0.659) | (1.422) | | (0.656) | |
| Natural resource rent |  |  |  |  |  |  |  |  |  |  |  | | -0.01873  (0.055) | |
| Time dummies | Included | Included | Included | Included | Included | Include | Included | Included | Included | Include. | Include. | | Included | |
| Constant | -1.405 | -2.058 | -2.026 | -2.244 | -4.618 | -2.979 | -1.983 | -6.454 | -0.029 | -2.835 | -15.843 | | -3.327 | |
|  | (6.934) | (5.763) | (6.215) | (6.409) | (6.403) | (6.907) | (5.744) | (6.676) | (7.091) | (6.732) | (9.359) | | (6.615) | |
| Observations | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | 109 | | 109 | |
| No. of countries | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | | 25 | |
| R-squared | 0.59 | 0.60 | 0.59 | 0.59 | 0.61 | 0.59 | 0.61 | 0.62 | 0.61 | 0.60 | 0.39 | | 0.61 | |
| Wooldridge test for autocorrelation | 0.134  ( 0.717) | 0.184  ( 0.6723) | 0.272  (0.6072) | 0.225  ( 0.639) | 0.028  (0.868) | 0.184  ( 0.668) | 0.11  (0.7426) | 0.037  (0.8498) | 0.045  ( 0.8350) | 0.159  (0.694) | 0.216  (0.6462) | | 0.109  (0.7445) | |
| Wald test for groupwise hetero. | 777.79  (0.000) | 2100.16  (0.000) | 706.87  (0.000) | 730.32  (0.000) | 1801.09  (0.000) | 4233.6  (0.000) | 610.52  (0.000) | 522.17  (0.000) | 941.71  (0.000) | 1800.59  (0.000) | 1800.6  (0.000) | | 2221.15  (0.000) | |

*Robust standard errors in parentheses; for diagnostic tests, p-values \*\*\* p<0.01, \*\* p<0.05, \* p<0.10*

The first set of checks is obtained by using the whole range of different proxies for institutions: indices of economic, political and legal quality taken from Kuncic (2012) (Table 2 below, columns 1-3); institutional quality measures taken from the World Governance Indicators (WGI) database (columns 4-8); and the Corruption Perception Index (CPI) from Transparency International (column 9).[[8]](#footnote-8),[[9]](#footnote-9)

The evidence emerging from all these alternative indexes covering several institutional dimensions is very similar to that resulting from the indicator used in our preferred specification. The most striking finding is that political institutions are the most important institutional aspects that influence output volatility in transition countries, rather than the economic and legal institutions. The results for different proxies of political institutions, ranging from the main measures of political rights, the political component in Kuncic (2012) and corruption from WGI, all show that better political freedom, lower corruption and polity in broader terms support the stability of output in transition countries. In the case of economic institutions, regulatory quality from WGI is the only significant component, while the legal environment is not an important determinant of volatility in transition countries. So, our results suggest that political institutions in the spirit of Rodrik (1999) better explains volatility in transition countries that do economic institutions in the spirit of Acemoglu et al. (2003).

Next, in columns 10 and 11 in Table 2, we report regression results for different proxies of the dependent variable: namely, the 3-year non-overlapping standard deviation of gdp growth; and the 3-year non-overlapping standard deviation of the Hodrick–Prescott (HP) filtered gdp growth. The same qualitative and very similar quantitative findings are obtained in comparison to the results reported in Table 1.

The regression in column 12 in Table 2 adds a measure of natural resource abundance, proxied by natural resource wealth. Van der Ploeg and Poelhekke (2009) suggest that resource dependence may amplify the effect of weak institutional quality on output volatility, leading us to control for resource abundance. Controlling for this variable did not change the main effects identified in Table 1.

# 7. Conclusion

We investigate the determinants of output volatility in the context of transition using a sample of 25 transition countries in the period 1996-2010. Our main focus is on the effects of openness on output volatility. Our review of the small cognate literature suggests that the arguments concerning the exogeneity or potential endogeneity of openness are inconclusive, while the case for considering institutions to be potentially endogenous is better established in relation to output levels and growth than it is in relation to output volatility. Accordingly, we use two estimation strategies: fixed effects (FE) estimation on the assumption that openness and institutions are exogenous with respect to output volatility; and, GMM estimation with “internal” instruments to take account of the potential endogeneity of openness and institutional quality. All of the main findings are similar with respect to sign, significance and size (or, at least, order of magnitude). In addition, to investigate the robustness of our findings, we report estimates using: different dependent variable proxies; different institutional proxies; and controls for dependence on natural resources to investigate the possibility that our results reflect a potential "resource curse". Both FE and system GMM (not reported) estimates yield results similar to those obtained from our preferred specification.

Our results suggest that diversification may not attenuate the output volatility effects of openness for transition countries already at medium or higher levels of diversification, but nonetheless may have this effect for countries at lower levels of diversification. By allowing the effects of openness to be moderated by diversification, we find that at higher levels of diversification along the intensive margin encompassing 90 per cent of our sample observations openness does not have a statistically significant effect on output volatility. Yet for observations of countries in periods with relatively low levels of diversification, our findings accord with previous findings that openness does have an adverse effect. Haddad et al. (2013) find that the positive effect of openness on volatility attenuates as diversification increases. However, our findings qualify this result in two respects. First, we establish that the type of diversification matters: this attenuation effect holds for diversification at the intensive margin (i.e. the volatility effect of openness attenuates as the country moves towards a more equal distribution of export shares across *existing* export products); but it does not hold for diversification at the extensive margin (i.e. as a country develops *new* exports and so increases its range of exports). Secondly, this attenuation effect at the intensive margin is identified only at lower levels of diversification applying to fewer than 10 per cent of observations in the sample, all of which arise from Azerbaijan, Kyrgyzstan, Russia and Tajikistan. This finding is consistent with Di Giovanni and Levchenko (2009) who find that openness tends to increase output volatility in countries at lower levels of development.

We also find that improvements in institutional quality – especially political institutions – attenuate output volatility in transition countries. Lack of political rights and problems with polity in the broader sense are the most important institutional characteristics affecting output volatility in transition countries.

From the policy perspective, these findings are non-negligible compared to the mean value of our dependent variable (2.90). For the low-diversification CIS countries, an increase in diversification at the intensive margin to the level of even the next most diversified country could – ceteris paribus – reduce output volatility by half a percentage point or more. Similarly, a modest increase in institutional quality can reduce output volatility by somewhere between half and one percentage point. In addition, two control variables yield robust and quantitatively non-negligible estimates: macroeconomic instability – proxied by inflation volatility – increases output volatility; while, as anticipated, conflict greatly increases output volatility.

Finally, we recommend that future studies should distinguish between diversification at the two margins, since the overall indicators used in most of the current literature may hide structural differences between the volatility effects of diversification at the different margins.

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**Appendix A**

**Table 1.** Description of data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Definition** | **Source** | **Mean (standard deviation)** | | **Min**  **(Max)** |
| **Dependent variable** | | | | | |
| Output volatility | Standard deviation of the real GDP per capita growth rates | World Bank, World Development Indicators | 2.935  (2.546) | | 0.112  (12.335) |
| **Independent variables** | | | | | |
| ***Sources of shocks*** | | | | | |
| Terms of trade volatility | Standard deviation of terms of trade. Terms of trade are constructed by dividing each year's export deflator by the import deflator. Deflators are measured as the ratio of current to constant local currency exports/imports. | World Bank, World Development Indicators | 0.046  (0.059) | 0.0002  (0.416) | |
| Inflation rate volatility | Standard deviation of the annual percentage changes of average consumer prices. | World Economic Outlook (WEO) | 11.546  (56.134) | 0.145  (574.165) | |
| Exchange rate volatility | Standard deviation of exchange rate, annual average. | European Bank for Reconstruction and Development (EBRD), macroeconomic indicators | 58.033  (191.77) | 0.002  (1379.783) | |
| Government expenditure volatility | Standard deviation of the ratio of general government total expenditure (total expense and the net acquisition of nonfinancial assets) to GDP. | World Economic Outlook (WEO) | 3.229  (3.339) | 0  (23.24) | |
| ***Variables influencing the transmission of shocks*** | | | | | |
| Export diversification | Herfindahl index, Gini coefficient, total Theil and components of the Theil index: the between (extensive) and the within (intensive)  The main results explained with the within component. | Author's own calculation using export data at the HS6-digit level from UNCTAD | 5.306  (0.981) | 1.722  (6.759) | |
| Trade openness | The trade dependency ratio is the sum of exports and imports of goods and services measured as a share of gross domestic product. | World Bank, World Development Indicators | 100.963  (31.01) | 47.211  (199.675) | |
| Financial openness | An index of restrictions on cross-border transactions.  The index includes capital flows and capital restrictions | Chin and Ito (2008) | 0.414  (3.339) | 0  (23.242) | |
| Credit to private sector | Financial resources provided to the private sector, such as loans, purchases of non-equity securities, and trade credits and other accounts receivable that establish a claim for repayment. | WB, World Development Indicators | 31.012  (23.876) | 2.449  (109.082) | |
| Institutional quality | Index of political rights, ranging from 1 to 7—for political rights and civil liberties, with 1 representing the most free and 7 the least free. | Freedom House | 3.035  (0.529) | 1.592  (3.965) | |
| Conflict | Dummy variable, taking the value of 1 in a year of conflict | [Central Intelligence Agency](https://www.cia.gov/) | 0.0826  (0.276) | 0  (1) | |
| Sample of countries  Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, Tajikistan, Ukraine, Uzbekistan. | | | | | |

**Appendix B**

**Diversification at the extensive and intensive margin**

Unlike most studies, which only quantify overall diversification (usually measured by one or other of the standard concentration indices, such as the Theil index), we argue that it is important to investigate diversification in a more differentiated manner, focusing also on diversification at the different margins of export growth. Our approach is based on Cadot et al. (2011) – namely, we rely on the decomposition property of the Theil index into the within and between components to capture changes along the intensive and extensive margins of export growth. It is important to make this distinction as the literature often falls into one or both of the following confusions:

1. identifying export growth at the extensive margin with export diversification as such; and/or,
2. at either margin, conflating export growth and diversification.

Exports grow at the extensive margin when the number of export varieties in the export basket increases, while exports grow at the intensive margin when the value of the existing exports increases. While at the extensive margin exports are more diversified the greater the number of export varieties, exports at the intensive margin are more diversified the more equal is the distribution of existing product values. Hence, export growth and export diversification at the extensive margin are essentially synonymous, since exports become more diversified as they grow at the extensive margin. In contrast, at the intensive margin growth in the value of the existing export products does not necessarily indicate changes in their distribution. Increase in value can arise due to increase in the value of the largest export categories (which will give rise to more unequal distribution); value can increase due to increase in the value of the smaller export categories (which tend to equalise the distribution) and increase can be linear in all categories (which does not alter diversification). We conclude that in studies that analyse export diversification by way of concentration indices, either one or both of the confusions indicated above are the corollary of failing to account separately for changes at the intensive and extensive margins.

1. Stylized facts about the persistence of output falls and subsequent poor economic performance are outlined in Campos and Coricelli (2002). [↑](#footnote-ref-1)
2. However, in some economies, such as Bosnia and Herzegovina, the trade deficit decreased in the crisis, as the drop in imports outpaced the drop in exports. [↑](#footnote-ref-2)
3. Accordingly, neither Di Giovanni and Levchenko (2009) nor Haddad et al. (2013) use such time-invariant instruments in their panel estimation. [↑](#footnote-ref-3)
4. In addition, because the properties of the RE estimator are asymptotic, FE estimation is preferred for small and moderate-size samples, which applies in our case. [↑](#footnote-ref-4)
5. Whether the additional subset of instruments in system GMM is valid depends on the “steady state” assumption, which requires that there is no correlation between changes in the instrumenting variables and the fixed effects. The results of the difference-in-Hansen diagnostic in Table 1 indicate that the “GMM instruments for levels”, the additional set of instruments for system GMM, are valid and, in addition, that there is no undue problem with cross-section dependence in our data. Hence, these diagnostics tests support the theoretical argument for system GMM. It is valid to employ a system estimator in our model and accept the “steady-state” assumption required for system estimation. [↑](#footnote-ref-5)
6. For presentational simplicity, we present only results for the within component of the Theil index. The results from the other indicators are available on request. [↑](#footnote-ref-6)
7. The ninth observation in the GMM estimates is from Tajikistan. [↑](#footnote-ref-7)
8. Kuncic (2012) computes the latent quality of legal, political and economic institutions with factor analysis for every country in the world and for every year, relative to the values of others. Legal institutions are formal institutions such as property rights, the origins of legal systems and their effects, and the rule of law. Political institutions capture polity in a broad meaning, the voters, electoral rules, political parties and rules of and limits of a government or state. Economic institutions measure regulatory quality. [↑](#footnote-ref-8)
9. Indices from WGI are compiled by Kaufmann et al. (2010) and represent an aggregation of 37 different data sources constructed by 31 different organizations. Governance indicators include: i) Voice and Accountability; ii) Political Instability and Violence; iii) Government Effectiveness; iv) Regulatory Quality; v) Rule of Law; and vi) Control of Corruption. Potential problems with these indicators arise in the interpretation of the subjective data used in WGI potentially causing imprecision and systematic biases. Kaufman et al. (2010, 2007, 2004) investigate this possibility but find little evidence of such biases. [↑](#footnote-ref-9)