Output volatility and trade openness revisited: the role of export diversification and institutions in transition countries

Merima Balavac[1] Pugh Geoff[2]

1. Introduction

Overview of the literature identifies the following group of determinants of output volatility: openness; terms of trade volatility; exchange rate volatility; fiscal and monetary policy indicators; financial development; institutions and country's characteristics such as geography or country size. The most debated among them is the influence of trade openness. Theory and empirical studies find an ambiguous effect of openness on output volatility. However, very recent discussion in the literature posits that the effect of openness could be moderated through other variables such as export diversification (Haddad et al., 2013). Moreover, the possibility that trade openness may exert an important indirect effect on the effects of other economic variables is developed in other strands of the literature. Probably the most prominent is the work of Epifani and Gancia (2009), who investigated the Rodrik (1998) hypothesis on the positive effect of trade openness on government size. They confirm the positive effect only when a country exports differentiated goods.

Besides the potential role of the openness predictor, we are interested to investigate whether export diversification has an independent effect of the level of output volatility. The theoretical framework provides an argument that the desirability of outward orientation from the perspective of output stability depends on structural determinants, i.e. institutions and the degree of export diversification.

Do export diversification and institutions in transition economies moderate the role of trade openness with respect to output volatility? And, in particular, do export diversification and institutions absorb part of the shocks potentially arising from trade openness? These are the main research questions we empirically test in this paper.

2. Determinants of output volatility

The literature identifies a large numbers of factors that potentially influence output volatility. However, the theories of volatility are not mutually exclusive, which impose uncertainty regarding the theoretical model informing empirical investigation of volatility determinants. Before the latest 2008.-2010 financial and economic crisis, only a few studies had the issue of volatility as their main focus. The crisis opens up the

[1] Lecturer at Bournemouth University; email:mbalavac@bournemouth.ac.uk
[2] Professor at Staffordshire University; email:G.T.Pugh@staffs.ac.uk

question of how to manage volatility (Haddad and Shepherd, 2011) and, in order to provide the answer, the sources of volatility need to be understood. Volatility of output is primarily related to shocks that hit the economy. And, in second place, to the structural characteristics of the economy, the institutional characteristics and policy responses that can either absorb or amplify the effects of shocks.

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, 2009). A rising number of studies acknowledge the risks induced by openness, but acknowledge 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 of the benefits of openness (Eichengreen, 2011; Haddad et al, 2013). Another important factor affecting volatility is the domestic institutional environment (Rodrik, 1998; Acemoglu et al, 2003). A weak institutional environment is expected to create volatility by amplifying economic displacement caused by shocks.

The role of trade openness, export diversification and institutions as potential predictors of output volatility are the main focus of our analysis. Conjoint effects of standard economic variables (i.e., openness and diversification) and institutional variables may inform richer understanding of their effects on the level of output volatility. To develop an argument, we rely on two groups of studies that relate to our proposition in many different respects. The first group of studies investigate trade, geography and institutions as the "deep determinants" of national output (Rodrik et al., 2004) and the volatility of national output (Malik and Temple, 2009). However, the second group such as studies by Rodrik (1998) and his successors Epifani and Gancia (2009) and Bejan (2006), that investigate the effect of openness on the size of government, stimulate us to consider potentially moderated effects of variables of interest.

The studies of Rodrik et al. (2004) and Malik and Temple (2009) focus on the main effects that our variable of interest could have on the level and volatility of national output. Although those studies investigate geography and not export diversification, Malik and Temple (2009) explain that remoteness is connected to lack of export diversification. So volatility induced by remoteness may arise from higher terms of trade volatility due to more concentrated export. Accepting that export diversification may reflect the geographic characteristics of a country, we are interested in the effect of the so-called "deep" determinants; however, our focus is their impact on income volatility. Moreover, while the main concern of those studies is whether effects from one of the variables dominate the effect from the others, we investigate the possibility that the effect of any individual variable is different at different levels of the other two. The second group of studies (Rodrik, 1998; Bejan, 2006 and Epifani and Gancia, 2009) motivate us to investigate the possibility that such moderator effects exist.

The second group of studies develop at least two important concepts relevant for our analysis. Although these studies primarily focus on government size rather than on output volatility, in this framework government size offsets exposure to risks. Accordingly, government spending is expected to influence output volatility. Rodrik (1998) associates volatility coming from trade openness with a greater share of government

consumption as a percentage of GDP. Starting from the prevailing premises that greater openness is linked to greater exposure to risk, Rodrik (1998) develops a "compensation theory", according to which more open economies are associated with higher government shares in national income, which is expected to mitigate the risks arising from openness. The argument is that in countries more exposed to risks, government has a mitigating role, offsetting such external risks, as the government sector is more secure due to higher employment security and relatively stable government purchases. Rodrik (1998) proxies the external shocks by terms-of-trade volatility and product concentration of exports. His results suggest that when such shocks are controlled for, openness does not seem to have an independent effect on government consumption. The openness has a stronger effect on government consumption in the countries that have more concentrated export and highly volatile terms of trade (ToT). As expected, the effect of openness is realized through the influence it has on external shocks. Yet, although Rodrik (1998) argues that openness increases the size of government, the author does not directly relate government consumption and openness to output volatility. This was subsequently done by Bejan (2006), who finds that higher government spending smoothes output volatility in developed countries only, while for developing countries no significant effect is identified. Bejan (2006) finds that only developed countries simultaneously benefit from higher government spending and better trade integration into world markets. On the other hand, in developing countries more openness brings greater output volatility, while government will have no impact on output volatility. In addition, some of the successor studies argue that the effect of trade openness is conditioned by other factors. Epifani and Gancia (2009) find that openness is positively associated with the size of a government, but only when a country exports differentiated goods (which proxy goods with low-elasticity of substitution). These studies are important as they allow that direct effect of openness on volatility could be moderated by the other variables. Epifani and Gancia (2009) condition the effect of openness on spending share volatility by the level of the elasticity of substitution of exports, while Bejan (2006) moderates the relationship between openness and volatility by the level of export diversification. Bejan also (2006) find that the effect of openness disappears once the level of development is controlled for. Such findings may be a reflection of different institutional quality (richer countries usually have better institutions) indicating that institutional quality and effectiveness could moderate effect on openness on volatility.

Since trade openness exposes a country to trade shocks, we will explore the effects of trade openness on output volatility and the strategy that could be used to moderate such effects. We propose that trade openness shapes output volatility conditional on both the institutional quality and the level of export diversification. Yet, institutions and export diversification are candidates to be moderator variables, they are focal independent variables at the same time. The literature leads us to the conclusion that in a system of trade, with trade openness, export diversification and institutional quality on the right-hand side and output volatility on the left-hand side, the effect of any of the three focal or independent variables on output volatility is potentially moderated by one or both of the other two.

2.1. Trade openness and volatility: outward orientation re-considered?

Expectation that trade openness increases average GDP growth rates is the traditional argument in favour of outward trade strategies. Still, the growth effect of trade openness is not a clear-cut issue, as openness may

increase the volatility of a country's output, by exposing the country to adverse trade shocks. 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, 2010) and that external shocks are a source of macroeconomic volatility (Easterly et al., 2001; Kose et al., 2003; Raddatz, 2009); yet, greater openness decreases the 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: while, on the one hand, openness is correlated with sector volatility and export specialization (*volatility-enhancing effect*)*;* on the other hand, trade could have a volatility-reducing effect as it changes co-movement between sectors within the economy and isolates open sectors from domestic fluctuations (*co-movement effect*). Overall, the sign of the coefficient on trade openness reflects which of the two trade openness effects is prevalent. In their empirical analysis on a wide panel of countries at different levels of development, higher specialization and sector-volatility effects dominate the co-movement effect, which results in increased aggregate volatility, especially in countries at lower levels of development.

Ambiguity of the theoretical preposition and empirical findings regarding the influence of openness on output volatility motivates the question as to whether the effect may depend on some other, moderating, variables. Export diversification has attracted the most research attention (Haddad et al, 2013; Epifani and Gancia, 2009; Calderón and Schmidt-Hebbel, 2008), but the potentially moderating role of institutions has also been discussed.

Export diversification is proposed in the literature as a strategy to manage external shocks. In line with an argument that openness is a transmitter of external shocks, the degree of a country's vulnerability to external shocks (including shocks induced by trade) may depend on the level of export diversification. As more concentrated exports makes a country more vulnerable, it is expected that greater openness together with more concentrated export result in a higher level of output volatility. Conversely, more diversified exports tend to amortize shocks, offsetting the negative effect of openness on output volatility. According to Haddad et al. (2013), openness reduces output volatility in diversified economy due to following reasons: first, idiosyncratic shocks to specific product markets are more prone to cause large swings in country's export volume and TOT when export is concentrated on a few sectors; and, second, there is higher probability that a more diversified country is involved in implicit and explicit insurance schemes, which may serve to attenuate the impact of external, but also domestic shocks.

The empirical literature confirms theoretical predictions. Calderón and Schmidt-Hebbel (2008) discover a negative relationship between openness and volatility only when export is 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. The greater diversification of export should stabilise output, while

more concentrated export is expected to increase output volatility. Their findings confirm that a country's openness to trade is desirable from the perspective of output volatility only if diversification of export is also a policy objective in the lower and middle income countries. Their results show that diversification is significant for volatility only through its moderating effect on openness, while individually it has no significant impact. However, the effects are not significant for the high income countries. 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.

Scholars discussed the quality of institutions as another factor that might shape the openness-volatility relationship. The literature explicitly recognises the possibility that the relationship between trade and output volatility is moderated by governance quality (Bonaglia et al, 2001; Gatti, 2004; Neeman et al., 2008). Certain types of trade policies may be damaging when the quality of institutions are poor. For example, when quantitative restrictions are imposed, as opposed to tariffs, firms that are connected to corrupt custom officials could extract significant economic rents (Bonaglia, 2001). In the case of inward-oriented policies with high trade barriers, firms are prone to collude with public officials to get better treatment in exchange for bribes. In other words, if a country has a restrictive trade policy, but a poor institutional environment, it is likely that economic agents will engage in all sorts of rent-seeking activities and so distort incentives and reduce economic growth. Accordingly, appropriate institutional quality is a pre-condition for output stability in open countries. Wei (2000) concludes that naturally more open countries (as determined by the geography) have more incentives to establish more efficient institutions in order to attract and retain investment, because more open economies face greater risk that foreign investors may withdraw export capacity and other investments. Montalbano et al. (2005) argue that negative macroeconomic consequences of trade in Eastern Europe are related to the weak institutional capacity to limit the effects of trade shocks on macroeconomic volatility. However, in contrast to export diversification, the institutional moderating role for such relationship remains in the sphere of theoretical discussion, having yet to be investigated empirically. Due to our interest in the effects of export diversification, we proceed with more detailed discussion of the relationship between export diversification and the volatility of output.

2.2. Export diversification as a strategy to manage volatility

Diversification is generally considered as a strategy for the reduction of uncertainty and volatility. This is primarily recognised in the context of financial markets, but the same analogy is applicable to other aspects of the economy. 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 a recommended policy to smooth out a country's output volatility, by decreasing the country's vulnerability to demand shocks and price swings in the global market. The issue of export diversification is particularly interesting for commodity-rich countries. Yet, diversification of exports may be desirable to smooth the

effects of volatility of 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, 2012).

Abundant empirical literature confirms the theoretical prediction regarding the influence of export diversification on output volatility. Malik and Temple (2009) explain that diversification and ToT volatility are intermediate outcomes determined endogenously, while the majority of previous studies consider them to be exogenously determined. They 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 ToT volatility and output volatility. Distribution of ToT volatility by group 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.

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. Yet, as we previously elaborated, the trade literature has often perceived export diversification to be a moderator variable for the volatility-induced risks associated with openness to trade. Accordingly, interaction between openness and export diversification could be considered from the conceptual perspective of openness as the moderator.

The institutional environment may have implications for the effect of export diversification on output volatility, although interaction of institutional influences and export diversification has not yet attracted attention in the trade literature. However, an interesting discussion is to be found in the management literature. Hitt et al (2006) discuss the moderating the relationship between international diversification and firms' performance (accounting, markets, growth). Among other moderating variables, the authors emphasize that diversification-performance relationships depend on institutional environments. Similarly, the effect of export diversification on output volatility may differ in different institutional environments. For example, if a country has low institutional quality, it might not benefit from access to a broader range of insurance schemes provided by diversified exports, which is a channel throughout which diversification is expected to smooth output volatility. Another example is the society with inefficient institutions (such as corrupted society) and the access to global value chains provided by diversified export: a country with a high level of corruption might not benefit from the possibility to utilise of global value chains if ruling elites and corrupted bureaucracy gain no personal benefits. According to Acemoglu and Robinson (2008), the risk of political replacement motivates elites to oppose technological improvement as they fear the changes wrought by technical progress. What is more, an incumbent elite may pursue a strategy of concentration in primary resources to preserve its position by limiting the scope for political opponents to challenge them (Dunning, 2005). It is particularly important in the context of our study as primary resource prices are traditionally highly volatile and reliance on primary exports for foreign currency to pay for imports may be correspondingly risky. Similar arguments may be used not just for primary resource exports, but may apply to any sector that is determined primarily by government rather than by market forces (Hare, 2008). It is

more likely that government lacks the information and knowledge on the international competitiveness of products and sectors that arises from open markets. This again points to the salience of adequate institutions as a precondition for market efficiency. Conversely, inefficiency of certain types of institutions, such as rule of law, property rights, and contract enforcement among others, precludes market efficiency (North, 1990). However, in a good institutional environment, the structure of exports is probably a reflection of comparative advantage and efficiency of production sectors rather than of the interests of the ruling elite. Thus, when production and exports are strategic decisions taken by ruling elites rather than determined by market forces, it is likely that this will induce a higher level of volatility.

All things considered, we expect that the (dis)advantage from the level of export diversification is a function of institutional quality. We expected to reap more benefits from diversification when a country has better institutional environment.

2.3. The institutional environment

The importance of institutional quality for macroeconomic volatility has been emphasized by prominent scholars (Rodrik, 1998; Acemoglu et al. 2003; 2006). 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), bad macroeconomic policies are a reflection of poor institutions. The author argues that some forms of institutions, such as corruption and property rights, have been recognized as causes of mismanagement and instability. Yet, the literature usually emphasises the macroeconomic policies as the source of crisis. Rodrik (1998) postulates that the quality of domestic institutions influences macroeconomic volatility by affecting countries' ability to manage external shocks. In this respect, the author find important institutions of internal conflict management as proxied by indices of ethnic fractionalization, democratic rights and the quality of government institutions. Those variables are considered as so called "deep" empirical determinants of macroeconomic stability. While the studies establish that better institutional infrastructure is a pillar of macroeconomic stability, the question remains as to which type of institutions are the most influential in explaining volatility. Wide categorisation could identify two group of studies; one that investigate the political regimes as proposed in Rodrik (1998); and the other with a focus on economic institutions in the spirit of Acemoglu (2003; 2006).

On 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. Mobarek (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 by applying dynamic factor analysis. The identified factors are grouped 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 (factors of the regime stability) and uncertainty of fiscal and monetary policy (factors of policy uncertainty) increase output volatility. Similarly,

Guillaumont and Guillaumont (2009) find 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 the economic crisis should be better handled when country has efficient institutions. On a sample of OECD countries, they find that higher level of corruption in a country decreases probability that country will successfully consolidate budget in a period of economic crisis.

On the other hand, researchers focus on the 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 a business climate encourages investors to direct capital into sectors from which it is easy to withdraw investment. They have conducted analysis on a sample of European transition economies and examine the effect of institutional dimensions (political/constitutional system, market regulations, legal and administrative system, corruption, and infrastructural reform), but find that only legal and administrative systems explain output volatility (better systems reduce volatility). 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-productive firms to survive in the market, resulting in more heterogeneity among 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 a very strong predictors of output volatility. Leaderman and Xu (2009) develop a mismanagement hypothesis, according to which ToT volatility is a product of low institutional quality.

We find in the literature that the impact of institutions on volatility may be moderated by the other variables. Acemoglu et al. (2008) suggests that future research should investigate the possibility that the causal effect between income and democracy is conditional on some other characteristics. Isham et al (2005) propose that export concentration is conducive to certain type of institutions that reduce countries' ability to absorb shocks. Similarly Van der Ploeg et al. (2007) indicate that resource dependence may amplify the effect of weak institutional quality on output volatility.

We have shown so far that the level of trade openness, degree of export diversification and quality of domestic institutions are directly related to the level of output volatility. Interactions between the variables (i.e. trade openness, export diversification and institutions) allow for multiple moderation effects. The controversy around volatility induced by openness might be better understood if the other structural determinants of volatility considered above, institutions and diversification, are considered jointly with openness. Thus, our main argument is that trade shapes output volatility conditional on the quality of institutions and the level of export diversification. Overall, in addition to direct links from openness, diversification and institutions to output volatility, our theoretical discussion allows for possibilities of moderation that include all three variables.

2.4. Control variables

The output volatility differs between countries of the similar level of countries openness, which is assigned to a whole set of country's characteristics. Consulting the theoretical and empirical literature, following controls are recognised:

- financial development and capital account openness (Gavin et al., 1995; Easterly et al. 2000; Easterly et al., 2001; Cecchetti et al, 2005);
- mismanagement of macroeconomic policies, such as fiscal, monetary, and exchange rate policies (Gavin et al., 1995; Fatas and Mihov, 2006; Hakura, 2009)

A developed financial market might reduce output volatility acting as a buffer against uncertainty, but could also make country more vulnerable. Developed financial markets and stabilization policies could enter as shock absorbing mechanisms that helps countries' to stabilise output in time of crisis (Gavin et al.; 1995), but greater dependence on credit could also increase a country's vulnerability (Easterly et al.; 2000).

Likewise, easier access to global financial market and greater openness of capital account could help country to smooth the shocks adjustment, 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). Better access to credit, that comes with greater integration of country's financial market into global market, preserve demand during a negative output shock (Aizeman and Pinto, 2005). However, the investor could easier pull out invested money in a period when firm or financial institution is weakening. In turn, this could further slowdown the performance of firms and institutions and potentially intensify economic downturn (Eastery et al., 2000).

Empirical findings are not always robust. Significant negative effect is found in Calderon et al. (2005) and Jansen et al. (2009), while Easterly et al. (2000) and Kose et al. (2003) did not find significant effect of financial openness on volatility. Some studies argue that direction of the effect of trade openness on output volatility vary with a level of financial sector development. Cavallo (2008) relies on Bulow and Rogoff's (1989) idea that trade openness could have positive effect on creditworthiness of a country which should consequently reduce volatility of country's output. More opportunities to credit access in more open economies should help countries to more easily overcome fluctuations in output. The author finds that positive 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 macroeconomic volatility. For example, Gavin et al. (1995) and Fatas and Mihov (2006) argue that mismanagement of fiscal and monetary policy, including exchange rate policy, leads to output instability. Rohn et al. (2009) find significant and positive effect of inflation and exchange rate variation on output volatility in transition economies. Empirical evidence indicates that domestic financial development is associated with lower volatility (Easterly et al., 2001).

3. The econometric model, methodology and data

3.1. The model

According to theoretical priors discussed in the previous section, volatility is determined by both the degree and intensity of the domestic or external shocks that strike a country and the country's ability to cope with such shocks. Therefore, we account for various variables representing both sources of shocks (volatilities) and mediators of such shocks. In our framework, mediators are mechanisms that affect the country's ability to cope with shocks and could either smooth shocks or expose a country to more shocks.

In our model, sources of shock are proxied by policy mismanagement (such as monetary, fiscal and exchange rate policy) and supply-side shocks, which are identified in the literature as the most usual triggers of output volatility. Monetary shocks are captured by inflation volatility; fiscal shocks are represented by the volatility of government expenditures and shocks arising from the volatility of the real exchange rate. Finally, supply-side shocks are proxied by the terms of trade volatility, probably the most widely used measure of shocks in the literature (Jansen et al., 2009).

The extent to which a country is adversely affected by shocks depends on its ability to buffer such costs. A number of factors that mediate the impact of shocks are identified in the literature. Following prominent literature (Easterly et al., 2000; Jansen, 2004; Bejan, 2006; Kloomp and de Haan, 2011), we include proxies for trade and financial openness, export diversification, institutions and financial market development in our model. Trade openness is our variable of interest. Theoretical priors presented in the previous section suggest that effect the effects of trade openness is ambiguous: a high level of integration into global trade markets, proxied by trade openness, might make a country more vulnerable to external shocks, but less vulnerable to internal shocks. Concerning ambiguity regarding the direction of the effects, the sign on estimated coefficients will reveal which of the effects is predominant. Depending on the estimated effects, openness variables could be either amplifiers or absorbers of shocks that hit the economy. Theory reviewed in the previous section also hypotheses that a country's ability to manage shocks may depend on the degree of a country's export diversification and its institutional quality. Here, export diversification is understood in terms of product diversification. As discussed in the section we have reasons to believe that the direct effect of openness may be moderated by diversification and institutions. We are particularly interested to investigate whether the effect of openness on output volatility differs in different institutional environments and under different levels of export diversification. To investigate whether the effect of openness depends on the level of export diversification for the group of countries included in our sample, the three-way interaction between trade openness, diversification and institutions is included in our model. In such a specification, the marginal effect of openness at different levels of both diversification and institutional quality will indicate how the effect of openness changes as the level of export diversification and/or institutional quality change. Similarly to trade openness, financial openness and development could enter as shock absorbing mechanisms, but could also increase a country's vulnerability. Hence, we hold constant financial openness and financial development, the variables that might have a similar effect on volatility as our variable of interest, in order to avoid that their effect is confounded with either openness or export diversification.

To test for conjoint effect of trade openness, export diversification and output volatility, the following model is estimated:

$$GDPvol_{i,t} = \alpha_i + \beta_1(OPEN)_{i,t} + \beta_2(DIV)_{i,t} + \beta_3(INST)_{i,t} + \beta_4(OPEN)_{i,t} * (DIV)_{i,t} + \beta_5(OPEN)_{i,t} * (INST)_{i,t} + \beta_6(INST)_{i,t} * (DIV)_{i,t} + \beta_7\left[(OPEN)_{i,t} * (DIV)_{i,t} * (INST)_{i,t}\right] + \beta_8(X)_{i,t}\varepsilon_{i,t} \quad (1)$$

where the dependent variable, $GDPVOL_{i,t}$ is the standard deviation of real GDP per capita for country *i* in period *t*, $OPEN_{i,t}$ is trade openness (the total trade as share of GDP), $DIV_{i,t}$ is a calculated measure of export diversification, $INST_{i,t}$ is proxy for institutions and $OPEN_{i,t}*DIV_{i,t}$ is the multiplicative interaction between the trade openness, $(OPEN_{i,t}*INST_{i,t})$ is the multiplicative interaction between the trade openness and institutional indicators, $(DIV * INST)_{i,t}$ is the multiplicative interaction between the diversification and institutional indicators and $(OPEN_{i,t}*INST_{i,t}*DIV_{i,t})$ is the three-way interaction between trade openness, the institutional indicator and the diversification indicator and the diversification indicator and $\beta_1, \beta_2, \beta_3 \beta_4, \beta_5, \beta_6$ and β_7 are the corresponding parameters to be estimated. $X_{i,t}$ is a k×1 vector of control variables and β_8 is the corresponding k×1 vector of parameters to be estimated and α_i and $\varepsilon_{i,t}$ are the individual-specific effects and independent and identically distributed random distributed terms, respectively. Vector *X* includes proxies for the effect of terms of trade, exchange rate, fiscal and monetary volatility, as well as proxies for financial openness and financial system development. Note that β_4 reflects the effect of openness when export is fully diversified ($DIV_{i,t}$ =0) and the sum $\beta_1 + \beta_4 * (DIV)_{i,t}$ reflects the effect of openness for different values of $DIV_{i,t}$. Correct specification of the model requires inclusion of all terms that constitute an interaction term of the highest order (Jaccard and Turrisi, 2003). In the case of inclusion of a three-way interaction, all possible two-way interactions have to be included as well.

3.2. Estimation methodology

The first part of this section briefly reviews methods used in previous studies and identifies potential shortcomings and, most importantly, account for shortcomings in the empirical analysis that follows. Broadly, we could classify issues of concern as measurement issues, multicollinearity and endogeneity.

Firstly, we are concerned with the measures of the dependent variable (output volatility) as there is no consensus in the literature regarding their measurement. Traditionally, statistical measure applied to capture this departure is the standard deviation of output, that is measured either by the growth rate of GDP per capita (Ramey and Ramey, 1995; Bejan, 2006; Cavallo, 2008; Malik and Temple, 2009; Jansen et al., 2009; Haddad et al, 2012), the real GDP per capita (purchasing-power parity of GDP per worker or Hodrick–Prescott (HP) filtered annual real GDP series (Hou, 2010). Hnatkovska and Loayza (2003) and Denbrun et al. (2008) use standard deviation of output gap. Standard deviation is either calculated using all data in observed period, standard deviation over non-overlapping sub-periods or as rolling standard deviation over sub - periods. Usually, variables are averaged over five year period to remove noise and smooth out business cycle variation. Rolling standard deviation over annual data has drawbacks, in form of added persistence to series (Maddala, 2005) or cyclical pattern even when there are no cycle elements in observations (known as Yule-Slutsky effect). Klomp and de Haan (2009) argue that use of standard deviation does not take into account

growth differences, which seems to be problematic as welfare effects of volatility are more pronounced when the growth is low. In addition, as growth and volatility is deducted from income, suggestion is that volatility should be related to income level. To account for the former, they propose to divide standard deviation by the mean growth, i.e. relative standard deviation. Pritchett (2000) warns that cross-sectional analysis of changes over time could not differentiate year-to-year volatility from the breaks in growth trend and propose to use the standard deviation of the first difference in annual GDP growth rate.

Potential endogeneity is the second methodological challenge. 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 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 propose the liberalization of trade and policies that affect output volatility, such as privatization and financial liberalisation. An example is the Washington Consensus, which has been on the policy agenda in the transition process that countries in our sample experience. 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 local governments, but dependant on global/regional decision makers. A further potential source of endogeneity could be found in the geographic characteristics of countries. This goes back to the argument that 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 estimation is controlled by the inclusion of the country fixed effect.

Institutional variables may aggravate the problem of potential endogeneity. The relationship between institutions and volatility might be subject to simultaneity bias, as it not straightforward whether better institutions bring stability or stability improves institutional quality. Studies usually take into account the potential endogeneity of institutions using the following instruments: geographic latitude and the fraction of the population speaking major European language (Hall and Jones, 1999), legal origin (La Porta et al., 1999), former colonies (Barseghyan and DiCecio, 2010) and European languages (Barseghyan and DiCecio; 2010). Unfortunately, there are no such instruments available for transition countries. Hence, there is a preference for GMM estimation using internal instruments.

Overall, there is no strong concern regarding the endogeneity of variables in output volatility regressions. Considering this, we utilise different estimation strategies depending on the assumption regarding endogeneity. When treating all variables as exogeneous, our choice is fixed effects estimation (FE). The main rational for the choice of the fixed in opposition to the random effect (RE) estimator is the structure of our sample. Countries in our sample are not chosen randomly, but by the strictly defined criteria that they should be transition countries in Europe and Central Asia. According to Judson and Owen (1997), non-random selection is often characteristic of macro panel that usually include the majority or all countries of interest rather than randomly select a sample. Moreover, 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, the inclusion of country-fixed effects should reduce concerns regarding potentially omitted variables. In the FE approach, country dummies capture cross-sectional heterogeneity through different intercepts (Durlauf *et al.,* 2005; Baltagi, 2006). Time dummies serve to control for a fluctuation of output common to all countries in a sample in an observed sub-period. The latest global economic crisis is a good example, which makes a strong case for inclusion of time dummies into our estimation. In panel estimation, the inclusion of time dummies also minimises possibilities for cross-residual correlation (Roodman, 2009).

Econometric requirements also suggest that the fixed effect estimator better fits our model. While RE properties are asymptotic, FE is preferred for small and moderate sized samples, which applies in our case. An emphasized disadvantage of the FE estimates, that inference is restricted to the set of cross-section units included in the estimation (Maddala, 2001), is not of concern as we are not interested in making inference for the countries outside our sample. Yet, the Hausman test makes a borderline case in favour of FE estimation. The main consideration, however, is that the previously presented arguments favours FE estimation.

There is an argument that inclusion of all constitutive terms increases mulicollinearity, which could inflate standard errors and consequently decrease the probability that the interaction effect will turn out to be significant. Practitioners suggest that this is not a credible justification for omission of the interaction term (Jaccard and Turrisi, 2003; Brambour et al., 2006) and that the costs of constitutive term omission prevail over any potential benefits. Jaccard and Turrisi (2003) showed that, although transformation of interaction components could affect the correlation between the interaction term and its individual components, such transformations will leave unchanged the significance of the coefficient on the interaction term, i.e. significance tests and confidence intervals for interaction term coefficients are the same as where transformations are not made. This arises from the fact that in multiplicative interaction models we are not directly interested in the significance of model parameters. Yet the coefficients will almost certainly change when the interaction term is included; however this should not be taken as an indication of multicollinearity. Econometricians argue that the problem of multicollinearity in general (Madalla, 2001) and multicollinearity in multiplicative interaction models (Friedrich, 1982) has been exaggerated. Further, some authors propose centring of variables that constitute interaction terms as a remedy for multicollinearity. Kam and Franzese (2003) argue that centring does not offer any substantial or statistical improvements. Since potential problems with multicollinearity arise when there is lack of information in the data, centring cannot alleviate problems of multicollinearity as it does not offer any new or improved data. Brambour and et all. (2006) show that centred and uncentered models are algebraically the same, from which they conclude that centring cannot change the statistical properties of estimated coefficients and accordingly do nothing about multicollinearity.

To allow for the possibility that openness and institutions are endogenous in our regression, we also use the GMM estimator to address potential endogeneity. 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; Blundell et al., 2010). System GMM also seems superior to difference GMM in unbalanced panels, since difference transformation in difference GMM could magnifies gaps (Roodman, 2006), which is of some importance given our data set. The other consideration regarding our dataset is the small number of observations. We are particularly concerned with the number of instruments given the small data set and, for that reason, we use the xtabond2 STATA written program "principal component" command to additionally decrease the number of instruments (Roodman, 2009). The principal component analysis is used to minimise arbitrariness and reduce the instrument count. A finite sample Windmeijer (2005) correction to the two-step covariance matrix is applied, which makes estimation efficient and robust to heteroskedasticity and autocorrelation within individuals.

3.1. Data

We use annual data over the period 1996 to 2010. The sample includes 25 transition countries (the list of countries is in Table 1 in the Appendix 2). Description of the data used together with their description and sources are presented in Table 1 in the Appendix 2). Our empirical analysis is based on a panel of non-overlapping averages of the data. This is standard procedure in the literature when variables may be subject to business cycle variations, which may be the case with per capita growth rates (Haddad et al, 2012). The previous studies use different time spans for averaging, but usually it is done over five or ten years-periods (Haddad et al, 2012; Calvancanti et al., 2011), but we also find examples of three-years averaging (Mendicino, 2007; Agnello and Sousa, 2009; Huang, 2012). However, all time spans used by these studies are, as acknowledged by Buch et al. (2005), clearly arbitrary.

Due to data constraints, we use 3-year non-overlapping averaging, which leaves us with a maximum of five observations per country. All volatility measures are calculated using standard deviation for successive 3-year periods. Remaining variables in the model are calculated as 3-year averages.

The dependent variable is output volatility, measured as the standard deviation of the annual growth rate of GDP per capita over non-overlapping 3-year periods. There are several factors why output growth instead of output level volatility is used. Many studies (Ramey and Ramey, 1995; Easterly and Kraay, 2000; Bejan, 2006; Cavallo, 2008; Malik and Temple, 2009; Jansen et al., 2009; Haddad et al, 2012) use growth rather than output levels. Arguments are that the growth rate and not the output level determine the planning horizon and as such it is to greater interest of policy makers to maintain growth stability (Haddad et al, 2012).

The main variables of interest are trade openness (henceforth, openness), export diversification and institutions. Consistent with most of the literature (Easterly, 2000; Jansen, 2004; Haddad et al, 2012), trade openness is proxied by the ratio of the sum of a country's exports and imports to GDP. Export diversification is proxied by the between and within components of the Theil index and for robustness purposes, the concentration indicators (Hirschman-Herfindahl index (HHI), Gini and overall Theil index). The within component of the Theil index measures equality of distribution of export shares, i.e. changes at the intensive margin of export growth. The between component of the Theil index measures changes in the number of

products in the export baskets, i.e. change along the extensive margin of export growth. The Appendix 1 elaborated this property of the Theil index in the more details. HHI and Gini by construction measure changes in the distribution of export shares (i.e. changes at the intensive margin) and we expect to get similar results as the one when the within Theil component is used. The within component is also predominant components of the total Theil (with 81% of the total Theil explained by the within component) and we expect that results with total Theil is similar to the one obtained with 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 6-digit level is the highest level of internationally comparable disaggregated country-level export data

Yet there are many indicators of institutions used in literature, in our preferred specification we will be using EBRD indicator of reform progress in transition countries. Since transition country undergo an overwhelming change of the entire socioeconomic system and building of institutions, this favours use of the broadest possible concept of institutional quality, which is complied in EBRD transition index. This indicator is used extensively in empirical literature (Kaminski *et al*. 1996; Havrylyshyn and Al-Atrash ,1998; Javorcik, 2004).

Government expenditure is proxied by the volatility of total government expenditure. Andres et al. (2008) show that different components of government spending reduce output volatility. Total expenditure is used rather than government consumption because total expenditure includes transfers and substitutes, which are used as 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 advantage of the Chinn and Ito (2008) measure is that, in addition to capital inflows and outflows, it takes into account the extent of capital controls imposed. In our model, the level of financial development is measured by the financial depth and financial effectiveness. Two dimensions of financial development are observed: financial depth; and the efficiency of the financial sector. Although, financial depth is popular proxy for the level of financial development (Easterly et al, 2000; Kloomp and de Haan, 2011), financial institutions' development gains increasing attention in the literature (Roland, 2004; Beck et al., 2006). Following Easterly et al. (2000) and others in the literature, financial depth is measured by the private credit to GDP ratio.

4. Main results

In this section model (1) and (2) is estimated using fixed effect and system GMM. Although FE is our preferred estimations, we complement these results by GMM estimation to account for the potential endogeneity of openness and institutions.

Since previous studies assume that the effect of trade openness on output volatility is conditional on the level of export diversification only, we start the analysis by testing such preposition on our data and estimate model where openness is moderated only by the level of export diversification. Hence, this leaves us with the following model:

$$GDPvol_{i,t} = \alpha_i + \beta_1(OPEN)_{i,t} + \beta_2(DIV)_{i,t} + \beta_3(INST)_{i,t} + \beta_4(OPEN)_{i,t} * (DIV)_{i,t} + \beta_5(X)_{i,t} + \varepsilon_{i,t} \quad (2)$$

Here, β_2 reflects the effect of openness when export is fully concentrated ($DIV_{i,t}$ =0) and the sum $\beta_1 + \beta_4 * (DIV)_{i,t}$ reflects the effect of openness for different values of $DIV_{i,t}$.

The estimates of model (2) are reported in Table 1 (fixed effect) and in Table 1 in the Appendix 3 (system GMM). Since the measure of diversification is central to our analysis, we report results for the model (2) using a range of alternative diversification measure to represent DIVi;t. The results presented in columns 1-5 in Table 1 are obtained when diversification is calculated using Hirschman-Herfindahl index, Gini, overall Theil and its between and within components (corresponding to intensive and extensive margins, respectively).

Table 1. Fixed effect estimation of the model (2)

Dependent variable: Standard deviation of the real GDP per capita growth rates					
	(1)	(2)	(3)	(4)	(5)
VARIABLES	hhi	gini	theil	intensive	extensive
Export diversification	16.39482**	15.26429	0.54604	1.35083	-6.42003*
	(7.234)	(37.967)	(1.501)	(1.266)	(3.622)
Openness	0.09964*	0.10471	0.04976	0.10186*	-0.02395
	(0.052)	(0.276)	(0.044)	(0.052)	(0.030)
Diversification#Openness	-0.15407*	-0.12408	-0.01085	-0.02186*	0.02635
	(0.077)	(0.301)	(0.009)	(0.012)	(0.020)
Institutions	-1.23803	-0.47169	-0.60604	-1.36149	1.03488
	(2.419)	(2.434)	(2.563)	(3.114)	(1.989)
Terms of trade volatility	-3.07478	-7.75403	-7.42076	-6.85918	-5.48673
	(7.783)	(5.298)	(6.068)	(5.162)	(3.989)
Exchange rate volatility	-0.00145	-0.00119	-0.00106	-0.00053	-0.00071
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Inflation rate volatility	0.00801***	0.00822***	0.00797***	0.00729***	0.00861***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Government expenditure volatility	0.03773	0.03889	0.03086	0.02713	0.01615
	(0.052)	(0.048)	(0.046)	(0.044)	(0.040)
Cred. to private/GDP	0.02103	0.02299	0.02535	0.02243	0.01929
	(0.017)	(0.017)	(0.022)	(0.017)	(0.014)
Financial openness	0.27308	0.21048	0.25392	0.29424	-0.05881
	(0.461)	(0.436)	(0.448)	(0.470)	(0.291)
Conflict	1.11133*	0.86218	1.05583	0.80745	0.52422
	(0.633)	(0.679)	(0.680)	(0.721)	(0.711)
2.year	-0.72134	-0.86232	-1.05066	-1.08568	-0.75584
	(0.566)	(0.653)	(0.857)	(0.655)	(0.544)
3.year	-1.72862**	-2.04786**	-2.19296*	-2.13575**	-1.91406**
	(0.717)	(0.839)	(1.170)	(0.882)	(0.772)
4.year	-1.69663	-2.13465*	-2.32745	-2.24888	-2.03979*
	(1.143)	(1.205)	(1.768)	(1.450)	(0.993)
5.year	2.68746*	2.27959	2.05572	2.35026	2.69332*
	(1.434)	(1.547)	(1.964)	(1.698)	(1.449)
Constant	-4.25400	-8.55411	3.26821	1.58763	7.64249
	(10.249)	(37.603)	(12.963)	(10.773)	(8.618)
Observations	107	107	109	109	109
Number of country	24	24	25	25	25

R-squared	0.58	0.55	0.57	0.58	0.60
Wooldridge test for autocorrelation in panel data	0.191	1.861	0.266	0.175	0.109
	(0.666)	(0.1877)	(0.6108)	(0.6792)	(0.7445)
Wald test for groupwise heteroskedasticity in FE	786.06	766.59	758.9	755.4	762.9
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

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

The result of the FE diagnostic tests raises no doubts about coefficient validity. The Woodbridge test of autocorrelation in panel data (Table 2) indicates that there is no evidence of serial correlation. The highly significant result of 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). Heteroscedasticity in panel data may arise from unequal variance of the error term across cross-sectional units (Baum, 2001), which we expected considering the heterogeneity of our sample. In order to correct the standard errors for this heteroscedasticity, the model with robust standard errors is estimated in our system GMM estimates (Table 2 in the Appendix 3). Considering that trade openness and institutions are potentially endogenous in volatility regressions, we instrument trade openness and institutions, as well as all interaction term. System GMM utilises internal instruments (Table 2 in the Appendix 3). Referring to Mehrhoff (2009), Roodman (2012) suggests application of principal component analysis (PCA) to optimise the instrument set. Judgment on the appropriate number of instruments was based on the results of the standard diagnostic on instrument validity.[3] The preferred results of this procedure combine to 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. We follow the proposition of Bontempi and Mammi (2012), who suggest retaining only the components that explain 90% of the original variance. Moreover, the Kaiser-Meyer-Olkin test statistics is close to or above 0.6, suggesting that sample is adequate for principle component analysis. This leaves us with 11 retained components. The results of the Sargan and of the Hansen-J test on overidentifying restrictions indicate instrument validity (Table 2 in the Appendix 3).

The first set of results are obtained by using by the Herfindahl, Gini, overall Theil and within component of Theil index as export diversification proxies (columns 1-4 in Table 1). It is shown that the within component of the Theil index map into diversification at the intensive margin of exports growth, i.e. captures changes in the equality between the shares of active export products. Since the HHI and Gini measure changes in the distribution of export shares, it is expected that those concentration indicators also capture diversification at the intensive margins[4]. As expected, we find the same qualitative results for openness, diversification and their interaction when these diversification indicators are used. The results in Table 1 show positive coefficient on diversification and openness and negative coefficient on interaction term, indicating that the effect of openness on output volatility attenuates as the level of the diversification at the intensive margin increases. However, the effect is only significant in case of Herfindahl and the within Theil.

Further, we consider the estimated results involving diversification at the extensive margin (the between component of Theil index). Now, openness and diversification have negative coefficient and their interaction

[3]Testing for residual autocorrelation (m_1 and m_2 statistics); and testing over-identifying restrictions. Measure of sample adequacy of the selected principal components together with test of how well the retained components represent the original data is generated by xtabond2 when interpreting the principal components approach to reduce the instrument set.

[4] Note that in our sample changes in the overall Theil are mainly influenced by the changes at the within component (see Section 3.1). Hence, we expect to get similar results with overall Theil and its within components.

has positive coefficient, but these coefficients are not statistically significant (column 4 in Table 1). Thus, we find that the effect of openness is conditional on the level of diversification, but only when diversification is measured as a change in the distribution of the existing export shares (i.e. diversification at the intensive margin of export growth). However, we do not find statistically significance evidence that the effect of openness on volatility is conditional on the increase in the number of export products (i.e. diversification at the extensive margin of export growth).

The previous related literature (Rodrik, 1998; Haddad et al., 2013) uses only HHI as the diversification indicator and do not distinguish between diversification at the intensive and extensive margins of export growth, often using the terms interchangeably. For example, it is usually the case that export diversification is interpreted as the increasing numbers of export products, even when diversification is captured by the indicators which measures the changes in export shares, not in the number of products. Our results indicate that it is important to distinguish which export margin is measured by the indicator used in the analysis, as the openness will affect volatility differently when diversification is result of equality in distribution across existing products or; when diversification arise from broadening the country's export portfolio to new products.

The fixed effect estimates of the model (1) in Table 2 predict the joint effect of openness, diversification and institutional quality, which is the primer interest of our analysis. The estimation is complemented with system GMM in Table 3 in the Appendix 3. Again, the results presented in columns 1-5 are obtained when diversification is calculated using Hirschman-Herfindahl index, Gini, overall Theil and its between and within components (corresponding to intensive and extensive margins, respectively). Export diversification and interaction term in the FE maintain strikingly similar magnitudes and levels of statistical significance in comparison with the estimates reported in the SGMM and since FE is our preferred method, estimated coefficient from FE model will be interpreted.

We center variables in interaction around their mean to facilitate the interpretation of main effects in model (Aiken and West, 1991). With mean centring, the coefficient on the independent variable represents the simple slope of interest when other moderators are at their mean. Centering does not affect simple slopes or regions of significance in any way and the interaction plot will be exactly the same when using uncentered and centered scores with the only difference that it will include different values on the X-axis.

Table 2. Fixed effect estimation of the model (1)

Dependent variable: Standard deviation of the real GDP per capita growth rates					
	(1)	(2)	(3)	(4)	(5)
VARIABLES	hhi	Gini	theil	intensive	extensive
Export diversification	-6.78505	-3.98402	-0.52709	-0.80939	-4.70371**
	(6.066)	(13.490)	(0.831)	(0.603)	(2.024)
Openness	-0.02499	-0.01485	-0.02415	-0.02308	-0.00098
	(0.026)	(0.020)	(0.022)	(0.021)	(0.020)
Diversification#Openness	-0.13063	-0.14756	-0.01666	-0.01791*	0.11101***
	(0.183)	(0.422)	(0.012)	(0.010)	(0.037)
Institutions	-0.89919	-0.68568	-0.71973	-0.43250	1.91573
	(1.884)	(2.380)	(2.577)	(2.809)	(1.730)
Institutions#Openness	0.04391**	0.01644	0.03559*	0.02474	-0.07678**
	(0.019)	(0.016)	(0.018)	(0.019)	(0.031)
Institutions#Diversification	-21.39739**	-6.35491	-1.50376	-1.54301	-1.35724
	(10.265)	(46.488)	(1.242)	(0.972)	(2.012)
Openness#Diversification#Institutions	0.30070	0.59904	0.01315	0.04270**	0.06619*

	(0.329)	(0.841)	(0.016)	(0.021)	(0.033)
Terms of trade volatility	-0.66598	-7.48300	-5.19199	-3.40237	-7.24886
	(6.004)	(5.121)	(5.642)	(3.780)	(4.666)
Exchange rate volatility	-0.00112	-0.00124	-0.00076	-0.00059	-0.00145
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Inflation rate volatility	0.00796***	0.00829***	0.00763***	0.00788***	0.00755***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Government expenditure volatility	-0.01207	0.02357	0.00100	-0.00046	0.03059
	(0.044)	(0.052)	(0.049)	(0.044)	(0.045)
Cred. to private/GDP	0.02267	0.02894*	0.03359*	0.01881	0.02457*
	(0.015)	(0.016)	(0.018)	(0.020)	(0.012)
Financial openness	0.36281	0.24185	0.40251	0.23724	-0.17167
	(0.413)	(0.453)	(0.434)	(0.439)	(0.293)
Conflict	1.16194*	0.83418	1.17731*	0.94678	0.38928
	(0.676)	(0.680)	(0.621)	(0.730)	(0.641)
2.year	-0.43408	-0.73904	-0.74113	-0.68640	-1.28874*
	(0.489)	(0.660)	(0.780)	(0.530)	(0.748)
3.year	-1.48938**	-1.92266**	-1.79724	-1.78517*	-2.25931**
	(0.677)	(0.869)	(1.153)	(0.872)	(0.889)
4.year	-1.84062*	-2.20750	-2.21509	-2.11435	-2.18357**
	(1.058)	(1.341)	(1.693)	(1.435)	(1.023)
5.year	2.75435*	2.19899	2.20404	2.54234	2.04194
	(1.417)	(1.567)	(1.810)	(1.687)	(1.429)
Constant	2.83854***	2.82645***	3.10570***	3.12569***	3.48382***
	(0.567)	(0.772)	(0.780)	(0.722)	(0.821)
Observations	107	107	109	109	109
Number of country	24	24	25	25	25
R-squared	0.61	0.56	0.59	0.62	0.64
Wooldridge test for autocorrelation in panel data	0.801	0.253	0.175	0.115	0.23
	(0.3801)	(0.6123)	(0.6792)	(0.7245)	(0.6001)
Wald test for groupwise heteroskedasticity in FE	1574.71	1570.16	1424.20	1710.35	1554.21
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

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

The result of the FE diagnostic tests (The Woodbridge test of autocorrelation in panel and test for groupwise heteroscedasticity in Table 2) and system GMM (Hansen, Sargan and tests of adequacy of principal components in Table 3 in the Appendix 3) raises no doubts about coefficient validity. Considering that trade openness and institutions are potentially endogenous in volatility regressions, we instrument trade openness and institutions, as well as all interactions in which these variables appear. Since openness and institutions are constituents of each interaction terms included in model (1), all interactions are treated as potentially endogenous and instrumented together with the focal variables. Simple slope evidence from FE and GMM estimation are very similar for the observed level of moderators and for sake of presentational simplicity only FE estimates will be presented here.

The three-way interaction of trade openness, diversification and institutions is not significant in case of diversification at the intensive export margin (columns 1-4 in Table 3), while it is significant when

diversification at the extensive margin is included (column 5 in Table 3). This means that openness, diversification and institutions jointly determine output volatility, when country diversifies export by increasing the number of export products. However, when diversification is observed in terms of changes in export shares, than openness and diversification has joint effect on volatility, independently of the institutional quality.

The estimated coefficient on the three-way interaction (Openness#Extensive#Institutions in Table 5) measures the impact of a joint increase of *OPENNESS*, *DIV* and *CORRUPT* on *GDPvol*. The coefficient on the interaction term itself reveals only the magnitude of the particular effect of some variable of interest when the other constitutive variables are equal zero. Next, we interpret the openness slope, which reflects the effect of openness moderated by the export diversification and institutions.

The marginal effect of openness in model (1) is calculated as:

$$\frac{\partial volatiltiy}{\partial openness} = \beta_2 + \beta_4(DIV)_{i,t} + \beta_5(INST)_{i,t} + \beta_7(INST)_{i,t} * (DIV)_{i,t} \qquad (3)$$

with variance

$$\hat{\sigma}_{\frac{\partial volatiltiy}{\partial openness}} = var(\hat{\beta}_1) + (DIV)^2_{i,t}\, var(\hat{\beta}_4) + (INST)^2_{i,t}\, var(\hat{\beta}_5) + (DIV)^2_{i,t}(INST)^2_{i,t}\, var(\hat{\beta}_7) +$$
$$2(DIV)_{i,t}cov(\beta_1\beta_4) + 2(INST)_{i,t}cov(\beta_1\beta_5) + 2(DIV)_{i,t}(INST)_{i,t}cov(\beta_1\beta_7) +$$
$$2(DIV)_{i,t}\,(INST)_{i,t}cov(\beta_4\beta_5) + 2(DIV)_{i,t}(INST)^2_{i,t}cov(\beta_4\beta_7) + 2(DIV)_{i,t}(INST)^2_{i,t}cov(\beta_5\beta_7) \qquad (4)$$

This implies that the effect of a change in openness on volatility depends on the values of the conditioning variables *DIV* and *INST*, as well as on the estimated coefficient of openness (β_2). It is easily to deduce from expression (3) that the estimated coefficient on openness (*openness* in Table 2 and β_2 in model (1)) in the uncentred model would illustrate effect of openness on volatility but only when *DIV*=*INST*=0. However, this is irrelevant in our case, because there are no observations (countries) that are perfectly diversified or with an institutional indicator of zero. Note that this is often the case, not just in our particular sample, as they are not variable of direct interest. This helps us to understand why model specification with a three-way interaction term must include also each two-way interactions as well as each primary focal variable. Otherwise, the estimated slope applies only to highly restricted circumstances, which might not be represented in the sample (Brambourg et al., 2006). Similarly, the standard errors related to the coefficient would be standard errors only for that particular effect. It is evident from expression (4) that the standard errors on the individual coefficient should differ at different levels of diversification and institutions. Moreover, with mean centring, the openness coefficient reported in table 2 indicates that openness has no statistically significant effect on volatility when diversification and institutions are at their mean values. However, the marginal effects could reveal effects different from the regression coefficients. This implies that the effect of a change in openness on volatility depends on the values of the conditioning variables *diversification* and *institutions*. So, when a three-way interaction is part of the model, the conclusion we draw only from the coefficients on individual variables and on two-way interaction could be misleading. It is suggested that only the three-way interaction should be interpreted in that case.

In the same vein, the coefficient on export diversification has a significant negative effect on output volatility when a country has the mean level of openness and institutional quality, but this may or may not be the case for other values of openness and institutions. The coefficient on institutions has a non-significant effect on output volatility when diversification and openness take their mean values in the sample, but this may or may not be the case for other values of openness and diversification. Hence, it would be misleading to comment only the individual coefficients on openness, diversification and institutions.

We cannot infer whether openness, diversification and institutions have any relevant and significant conditional effect on volatility from the magnitude and significance on the interaction terms alone. Only the sign of the interaction term is informative. However, the sign should indicate only the average direction of the effect of the focal independent variables on volatility as the conditional variables increase, but not whether this effect is uniformly positive or negative. Yet, the interaction coefficient from the regression output provides us with limited understanding of our research questions. To obtain more informative interpretation, the marginal effect of diversification/openness across the values of diversification other than zero will be presented.

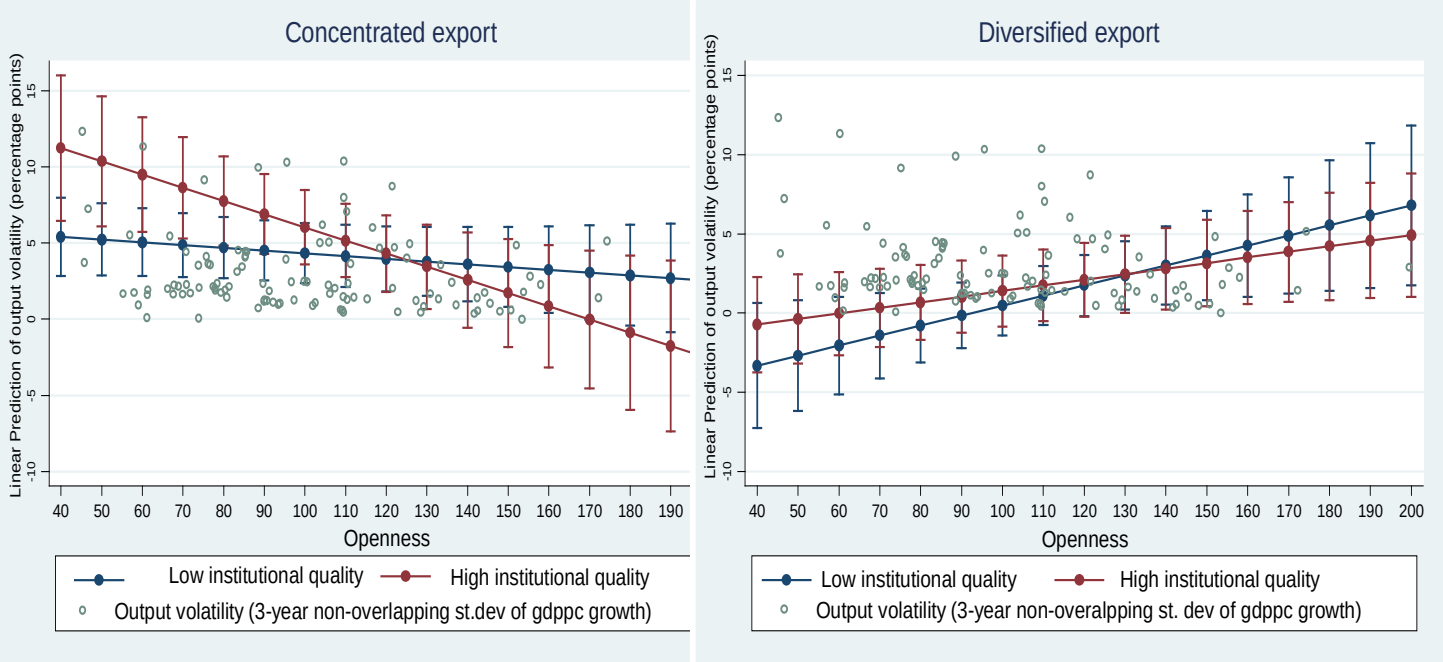
In sum, the interaction coefficient from the regression output provides us with limited understanding of our research questions as it reveals only the magnitude of the particular effect of some variable of interest when the other constitutive variables are at their mean levels. To obtain a more informative interpretation, the marginal effect of one variable in interaction will be interpreted across the values of the moderators other than the mean. The most informative approach to investigate the three-way interaction is graphical presentation of the linear predictions (adjusted margin plot) and simple slope of the variable of interest when the moderator variables are held constant at different levels of interest. Adjusted margin plots along with a scatterplot of the observations help to more easily understand the nature of the interaction effect, while calculation and plotting of simple slopes reveal the size and significance of the interaction effect. Since there is no theoretically suggested level of diversification and institutions of particular interest, for the sake of presentational convenience we follow the Aiken and West (1991) proposition to present the marginal effect at low and high levels of the moderator variables. In our case, the 1st quartile represents a low level and the 3rd quartile represents a high level of each moderator and simple slopes will be the slopes of the dependent variable on the independent variable when the moderator variables are held constant at different combinations of high and low values. Further, we conducted tests to determine whether the simple slopes are statistically different from each other (Dawson and Richter, 2006). However, these results have to be interpreted with caution, because slope difference tests have very low power unless the sample size is quite large (Dawson and Richter, 2006). In order to correct for multiple comparisons, the Bonferroni method is applied to adjust the p-values to take into account that these are post-hoc tests.

First, adjusted margins plots are used to identify simple effects for each variable of interest and all potential interactions. When we inspect the three-way interaction, the main effect of the variable of interest exists if the average value of the dependent variable is different at different levels of the independent variables. The two-way interactions (for example openness-diversification) exist if the simple effect of one variable on the dependent variable in interaction is different at different levels of the other variable, or vice versa. A plot of the data will show non-parallel lines. Finally, the three-way interaction exists if the two-way interaction changes as we change the level of some third variable. The possibilities are two different two-way interactions; or one two-way interaction in one case and no two-way interaction in the other case.

First, we plot the slope of observations across the full range of trade openness. Figure 1 shows interactions between openness and institutions predicting output volatility for countries with concentrated and

diversified export at the extensive margin. Note here that fitted negative values of dependent variable do not reflect data in the sample (figure 1), but are the results of linear fitting of a simple slope (in both panels in figure 1 there are no negative observations).

Figure 1. *Adjusted margin of openness as a function of diversification (separate panels) and institutional quality (separate lines) , predictive margins with 90% CIs*



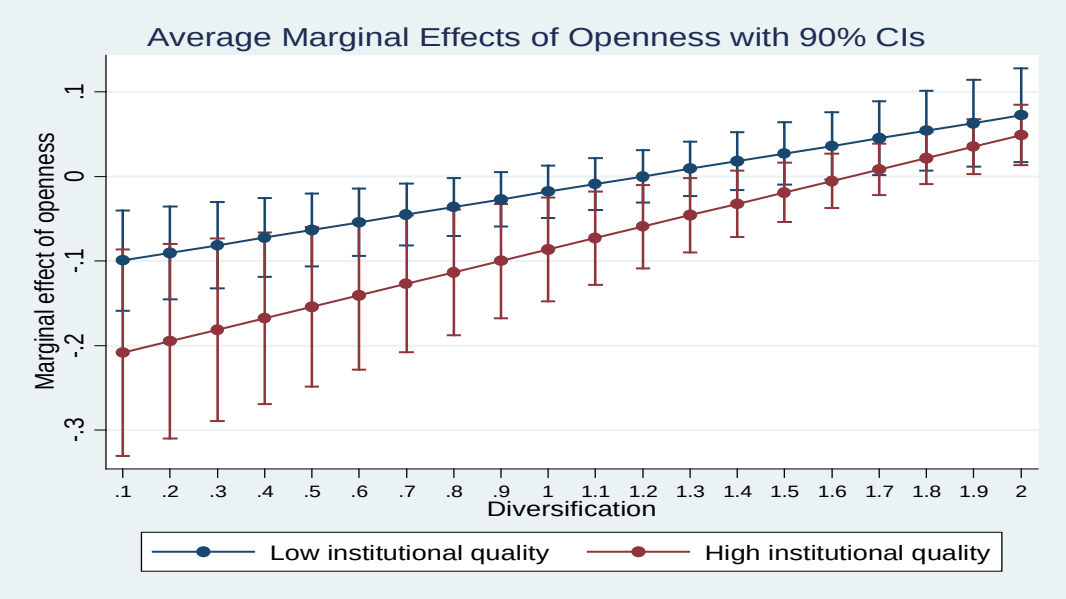
Source: Author's illustration

Figure 1 shows that the openness-institution interaction differs for different levels of diversification. Although in both graphs the lines crossover, the direction of the lines differs. More openness results in greater volatility when export is diversified and in lower volatility when export is concentrated. That is, the two-way institutions-openness interaction for countries with diversified export is different from the two-way institutions-openness interaction for countries with concentrated export. Since a three-way interaction is a change in the two way interaction as the level of the third variable changes, Figure 1 shows that there might be a three-way interaction of trade openness, export diversification and volatility.

For concentrated export and lower openness, countries with better institutions has higher volatility than those with lower level of institutional quality, whereas for those with concentrated export and high openness, countries with low institutional quality have higher volatility scores than those with better institutions. While this doesn't seem to make much sense, from the scatterplot we see that only a few observation combine low openness and good institutions, which does not make convincing evidence that better institutions are associated with volatility when openness is low. In countries with diversified exports, the effect of openness is statistically significant when openness is above about 110% of GDP (which accounts for 47% observations with high diversification) and countries always have lower volatility when institutions are better. For countries with concentrated export, adjusted margins show that openness has a statistically significant effect when the country is in the lower tail of openness distribution (up to about 120% of GDP). Thus, once openness is sufficiently high, more trade openness does not affect volatility when export is concentrated.

Next, trade openness simple slopes across a substantively meaningful range of the modifying variables are presented in Figure 3.

Figure 3. *Average marginal effects of openness as a function of diversification(x-axis) and institutional quality (separate lines)*



Source: Author's illustration

Figure 3 indicates that openness reduces the volatility when export is highly concentrated (divers<0.9 or 24 % of observations) and increases volatility when export is highly diversified (divers<1.8 or 40% of observations). The openness slope is steeper when institutional quality is high, indicating that openness reduces volatility more rapidly when institutions are better.

To quantify evidence in Figures 2 and 3, the value of simple openness slopes are estimated at the low/high levels of the moderator variables. Table 3 presents estimates of marginal effects, which are the slopes of the linear effects displayed in Figure 2 and average marginal effect in Figure 3, together with pairwise comparisons (in each case, the null is no significant differences).

Table 3. Average marginal effects of openness at different levels of diversification and institutions after FE estimation

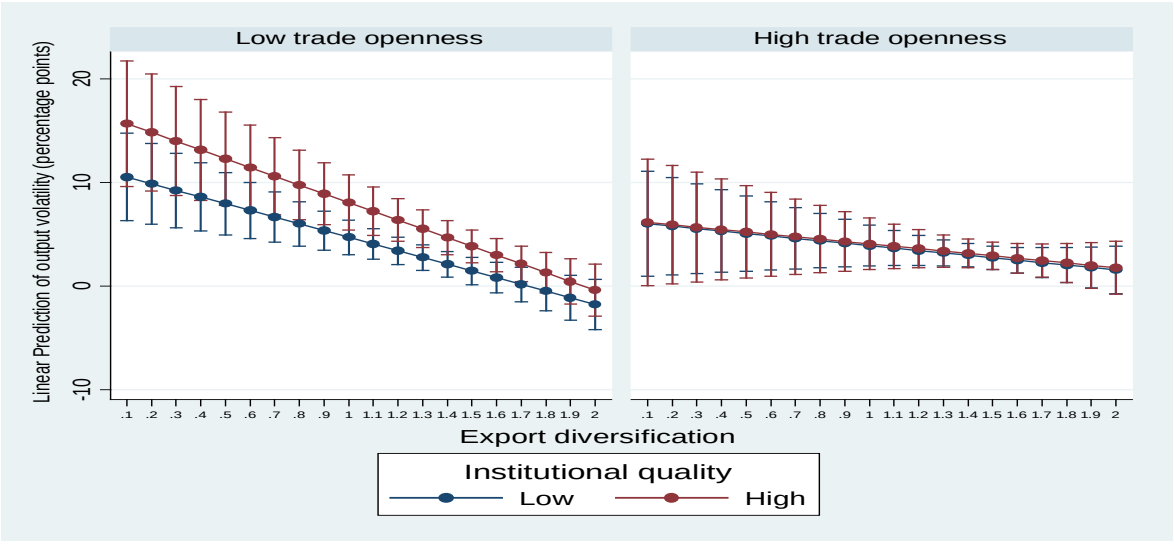
	FE robust						
	Marginal effect			**Pairwise comparison**			
Diversification/ Institutional quality*	Openness slope	St.dev	p-value	at	Contrast	St.dev	p-value
1. Concentration/ Weak institutions	-0.0165	0.019	0. 384	2 vs. 1	-0.067	0.024	0.034
2.Concentration / Strong institutions	-0.0833	0.024	0.022	3 vs. 1	0.078	0.027	0.022
3. Diversification/ Weak institutions	0.0617	0.031	0.044	4 vs. 2	0.116	0.021	0.01
4. Diversification/ Strong institutions	0.0333	0.02	0.087	4 vs. 3	-0.0284	0.019	0.83

The pairwise comparisons reported above reveal that institutional quality only exerts a significant moderating effect on the openness among countries with concentrated export, while effect of openness is not conditional on institutions in countries with diversified export. For countries with concentrated exports (rows 1 and 2 in Table 3), openness is negatively related to volatility when institutions are good (β=-0.083, *p* =0.022 in the row 2) and is not significantly related to volatility in weak institutional regimes (β=-0.016, *p* =0.384 in the row 1). Pairwise comparison of those openness slopes shows that the effect of openness differs in different institutional environment when exports are concentrated (t=-0.067; p=0.034; 2 vs 1. in pairwise comparisons in table). For countries with diversified exports (rows 3 and 4 in Table 3) openness is positively related to volatility when export is diversified, with slopes being economically and statistically more significant in weaker institutional environment (β=0.062, *p* =.0044 in the row 3) than in a better one (β=0.034, *p* =0.082 in the row 4). However, pairwise comparison show no statistically significant difference between slopes (t= -0.0284; p=0.83; 4 vs 3 in Table 3), indicating that institutions do not moderate the effect of openness when countries are diversified

The effect of openness is moderated by the level of export concentration regardless of the quality of institutional environment. Pairwise comparison (3 vs.1) in Table 3 show the openness slope when export is diversified and institutions are strong differs significantly from the openness slope when export is diversified and institutions are weak (t=0.078; p=0.022 in Table 3). Similarly, pairwise comparisons of the slopes (4 vs. 2) in Table 3 indicate that the openness slopes in countries with concentrated export, but different institutional environment, significantly differs from each other (t=0.116; p=0.01 in Table 3). Overall, the results show that the effect of openness is moderated by the level of export diversification and institutional quality. Greater trade openness tends to increase volatility as the number of exported products increase, with effect being similar in countries with different institutional quality. If a country's export at the extensive margin is concentrated (i.e. small entrepreneurship), country will benefit from trade, especially if institutions are good.

Next, figure 4 shows interactions between openness and diversification predicting output volatility for countries with weak and strong institutional quality across the full range of export diversification.

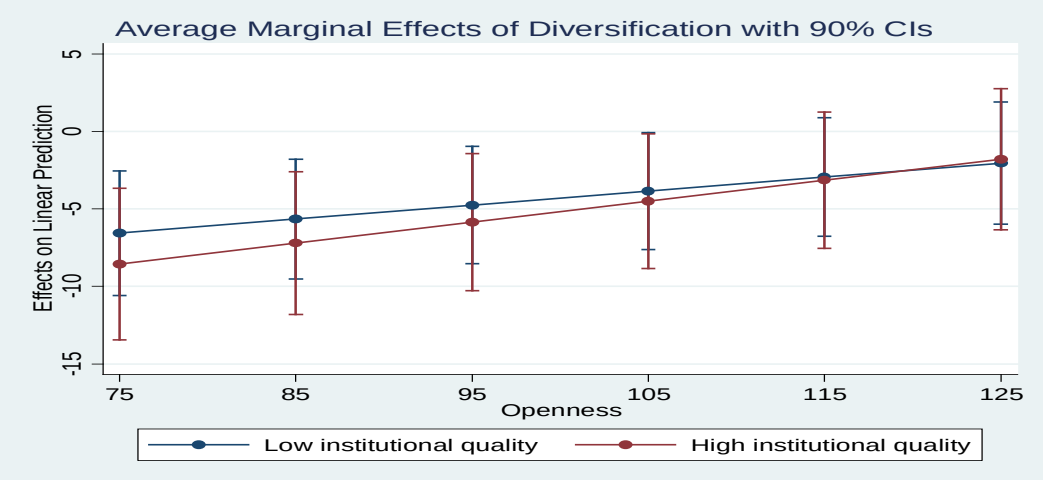
Figure 4. *Adjusted margin of openness as a function of diversification (separate panels) and institutional quality (separate lines), predictive margins with 90% CIs*



Source: Author's illustration

The adjusted margins in Figure 4 show that increasing diversification cause stronger reaction of output volatility in less open than in more open countries. Institutions does not seems to moderate the diversification effect on volatility in neither closed nor open countries. Average changes in the diversification slopes are depicted by the average marginal effect of export diversification across a substantively meaningful range of openness in Figure 5.

Figure 5. *Average marginal effects of diversification as a function of openness (x-axis) and institutional quality (separate lines)*



Source: Author's illustration

The Figure 5 suggests that an increase in diversification has a negative effect on the volatility, but significant only when openness is lower than 105% of gdp (right-hand side panel in figure 5). It turn out that less than 70% of the sample fall into required level of significance, which is compelling evidence for claim that magnitude of the diversification effect decrease with the level of openness, up to sufficiently enough level of openness (around 105% of gdp) above which diversification has no statistically significant effect. Average marginal effect of diversification at low/high level of openness and institutions calculated in Table 4 quantify what we see in Figure 5. The results in Table 4 show that diversification reduces volatility when country has low openness (rows 1 and 2) and no significant when openness is high (rows 3 and 4). Pairwise comparisons in Table 4 show that diversification slopes for low/high openness significantly differs from each other in weak (3 vs. 1) and strong institutional regimes (4 vs. 2) .

Figure 3 shows almost overlapping average marginal effect of diversification for low and high institutional quality, indicating that institutions do not make significant differences for the effect of diversification conditional on openness is expected. The pairwaise comparisons in Table 4 confirm that diversification effect on volatility does not significantly differ at low/high institutional quality. In Table 4, the pairwise comparisons of diversification slopes at low/high institutions do not find significant difference between when the openness is low (2 vs. 1); nor when the openness is high (4 vs. 3).

Table 4. Average marginal effects of diversification at different levels of openness and institutions

after FE estimation

	FE robust						
	Marginal effect			Pairwise comparison			
Openness/ institutional quality*	Diversification slope	St.dev	p-value	at	Contrast	St.dev	p-value
1. Low openness/ Weak institutions	-6.343	2.42	0.009	2 vs. 1	-1.88	1.728	1.00
2. Low openness/ Strong institutions	-8.223	2.92	0.005	3 vs. 1	4.316	1.425	0.002
3. High openness / Weak institutions	-2.201	2.385	0. 356	4 vs. 2	6.195	2.005	0.012
4. High openness / Strong institutions	-2.026	2.74	0.46	4 vs. 3	0.174	1.24	1.00

Diversification is beneficial when country is less open and is not associated with volatility when openness is high. The institutional quality does not make any significant differences in both cases. In other words, diversification-openness interaction is not conditional on institutional quality. However, diversification-institutions interaction is significantly conditional on the level of country's openness.

We find that when export diversification at the intensive margin (i.e. changes in distribution of export shares) is observed, than the effect of openness is conditional on the export diversification only. The results show that the effect of openness on volatility reduces as country has more equal distribution of export shares across product exported. Such finding corresponds to the evidence found in the previous literature (Rodrik, 1998; Epifani and Gancia, 2009 and Haddad et al, 2013).

However when diversification is measured at the extensive margin (i.e, when change in the number of export products), we find that trade openness, export diversification at the extensive margin and institutional quality jointly affect output volatility in transition countries. Analysis of marginal effect reveals that both, export structure and institutions, moderate the effect that exposure to trade has on output volatility. Openness has a pervasive effect for different levels of diversification, resulting in a greater stability of output if exports are concentrated on a few products and greater instability if country's export basket is fairly diversified. When country has export basket concentrated on a few products, trade openness is significantly more beneficial when institutions are better. However, when export basket is diversified, the effect of openness is similar in different institutional environment. Greater number of product in export basket appears to reduce output volatility, but having significantly more success in less open than in more open countries. Institutions do not play any significant role for the effect of diversification. The results of our analysis provide the evidence that increasing number of export products is an effective strategy for output volatility reduction, especially in less open economies. Flipping the story from the angle of trade openness, we found that in transition countries more openness is beneficial only if country export a few products and have good institutions. Otherwise, when number of products increases, more openness may result in more volatility, especially when institutions are poor. Institutions do not appear as a prime mover of volatility, but it influences how the reaction of output to increasing trade.

Empirical literature did not investigate the effect of openness conditional on the diversification at different margins of export growth. In the previous similar studies, export diversification is measured by the concentration indices (usually by the Herfindahl index only), which measures changes at the export shares (i.e. intensive margin). However, diversification calculated by the concentration indices is often interpreted as a change in number of export products, which is not conceptually correct. Our findings that the trade

openness has different effect on volatility when country diversifies exports along the extensive that when export is diversified along the intensive margin show that differences between diversification at the export margins are not just conceptual, but also substantive.

Evidence on the volatility-enhancing effect of openness when country increase the number of export products in transition economies should be interpreted taking into consideration specificity of the economics in transition, which experience remarkable external and internal shocks in the beginning of the 90s. External shock results in major fundamental changes of their external trade, while internal shocks cause changes in the resource allocation and institutions. Considering very short period of time from beginning of transition, we could expect that exporters are still finding right mode of their presence at the external markets. This is along the line with Besedes's (2011) findings on increased hazard of transition country's export that is a consequence of their increased participation in international trade. Moreover, Besedes (2011) find that hazard of exporting over time increased the most for differentiated goods and that mostly richer transition economies (such as Czech Republic or Slovenia) reoriented trade towards differentiated goods at expense of the other type of goods. The richer economies in Besedes(2011) sample are the most diversified in our sample, which implies that churning could explain volatility-enhancing effect of openness in diversified countries. In addition, such evidence may indicate that too many different products may not form large, internationally competitive industries, which may reduce probability for domestic producer to successfully participate on the global market. These new exporters are usually not the most efficient once, since in transition context, given limited opportunities at the home market, firms are pushed into export market. Also, these are small economies with limited potential to exploit economies of scale which may result in a high cost of moving into many new products (Papageorgiou and Spatafora, 2012). On the other hand, volatility-reducing effect of openness when country is concentrated could be reflection of exporters with monopolistic competition and market power (Buch 2002).

Variables that proxy for shocks that hit the economy such as volatility of terms of trade, inflation, exchange rate and government expenditure do not exhibit significant effects. Similar to Acemoglu et al. (2003), we find that institutions are significant but also shocks that arise from mismanagement of macroeconomic policies (such as inflation or exchange rate) are not. In Acemoglu et al. (2003), this most likely indicates that the effect of institutions is not mediated by macroeconomic policies, but by other, possibly microeconomic policies. Acemoglu et al. (2003) hypothesis that the effect of macroeconomic mismanagement is probably a reflection of a weak institutional environment, i.e. weak institutions may create macroeconomic problems and exert negative effects on volatility through a range of macroeconomic and microeconomic channels.

Financial development appears to be a very important element in the explanation of output volatility in the transition economies of Europe and Central Asia. Progress in the institutional development of the financial sector tends to reduce the volatility of output in transition economies, while the effect of the level of credit/GDP is ambiguous and, in the case of high dependency on credit, it could make a country more vulnerable. Turning to the regression results in our analysis (table 2), a very similar proposition is suggested. The index of progress in the reform of the financial sector, which proxies for the efficiency of financial development, is statistically significant across all specifications (Table 2). As expected, progress in

institutional environment of the financial market tends to reduce output and is highly statically significant across all specifications. On the other hand, credit to the private sector is statistically significant only in FE estimation (Table 2). However, the sign on the financial depth proxy is positive, suggesting that the greater the level of credit/GDP the greater the output volatility. It is likely that a high credit ratio makes a country dependent and exposes it to greater risks. To conclude, the estimated results suggest that in transition countries volatility increases with financial depth, but reduce as the efficiency of the financial market increases.

Government actions do not seems to perform a "buffer" role, as fiscal shocks do not prove to be statistically significant. The greater volatility of government expenditure results in greater output volatility, but the effect is not significant. A potentially destabilizing effect of government expenditure volatility could indicate that greater deviation in government spending either reflects macroeconomic imbalances or that spending supports extravagant government behaviour rather than capital investment.

We contribute to the literature on output volatility by reporting a finding that seems to be neglected in the previous discussion on a subject. Our finding indicates that the relationship between openness and export diversification on output volatility is related to the quality of institutions. When export is diversified, trade openness tends to increase output volatility. If the export is concentrated, trade reduces volatility. In both cases, weak institutions are more costly. Yet diversification has pervasive influence on the effect of openness on volatility, diversification on its own is beneficial for output stability.

5. Robustness checks

In order to investigate stability of our findings several robustness checks are obtained (Table 4 in the Appendix 4). The effect is estimated using different proxy for dependent variables such as 3 -year non-overlapping standard deviation of gdp growth and 3 -year non-overlapping standard deviation of Hodrick–Prescott (HP) filtered gdp growth, but the same qualitative and very similar quantitative findings are obtained in comparison to the preferred result (Column 1 in table 4 in Appendix 4). Another check is obtained by using the whole range of different proxies for institutions. In addition to corruption, other WGI indices are used such rule of law, government effectiveness and political instability.

We also estimate the model with institutional quality measure taken from Kaufmann et al. (2010), Corruption Perception Index (CPI) by Transparency International and European Bank for Reconstruction and Development (EBRD) market and trade institutional efficiency a part of a robustness check. From the later group, overall institutional index and indices that asses market and trade (index of price, forex and trade liberalisation and competition index). However, measures used for a robustness has high degree of simple correlation with Kaufman indicators (0.8 and 0.7, respectively). Columns (2) to (7) in Table 5 presents the results with those institutional proxies along with other WGI indicators such as rule of law, government effectiveness and political instability.

Evidence emerging from all these alternative indexes covering several institutional dimensions is very similar to those resulting from the indicator used in proffered specification. The simple slope of openness at high/low combinations of moderator variables has the same intuition behind the results: effect of openness on output volatility is smaller when institutional environment is better, regardless of the level of export diversification.

According to regional principle, we estimate model using data from Central and South Eastern Europe countries only. The evidence from CEB+ CIS sample aligns to evidence from transition sample. Yet we undertake investigation on sample of Commonwealth Independent States we do not consider those findings reliable due to small number of observation retained in a sample.

6. Conclusion

We contribute to the literature on output volatility by reporting a finding that seems to be neglected in the previous discussion on a subject. Our analysis raises the questions of the importance of distinction between diversification at different export margins when investigate the effect of openness on volatility conditional on a level of diversification and re-examine the role of institutional quality for the effect of trade openness on output volatility.

We find than the effect of openness is conditional on the export diversification only when export diversifies at the intensive margin (i.e. changes in distribution of export shares) is observed. The results show that the effect of openness on volatility reduces as country has more equal distribution of export shares across product exported. Such finding corresponds to the evidence found in the previous literature (Rodrik, 1998; Epifani and Gancia, 2009 and Haddad et al, 2013).

However when diversification is measured at the extensive margin (i.e, when change in the number of export products), we find that trade openness, export diversification at the extensive margin and institutional quality jointly affect output volatility in transition countries. Analysis of marginal effect reveals that both, export structure and institutions, moderate the effect that exposure to trade has on output volatility. Openness has a pervasive effect for different levels of diversification, resulting in a greater stability of output if exports are concentrated on a few products and greater instability if country's export basket is fairly diversified. When country has export basket concentrated on a few products, trade openness is significantly more beneficial when institutions are better. However, when export basket is diversified, the effect of openness is similar in different institutional environment. Greater number of product in export basket appears to reduce output volatility, but having significantly more success in less open than in more open countries. Institutions do not play any significant role for the effect of diversification. The results of our analysis provide the evidence that increasing number of export products is an effective strategy for output volatility reduction, especially in less open economies. Flipping the story from the angle of trade openness, we found that in transition countries more openness is beneficial only if country export a few products and have good institutions. Otherwise, when number of products increases, more openness may result in more volatility, especially when institutions are poor. Institutions do not appear as a prime mover of volatility, but it influences how the reaction of output to increasing trade.

Our results indicate that it is important to distinguish which export margin is measured by the indicator used in the analysis, as the openness will affect volatility differently when diversification is result of equality in distribution across existing products or; when diversification arise from broadening the country's export portfolio to new products. In the similar studies export diversification is measured by the concentration indices only. However, although diversification indices measures changes at the export shares (i.e. intensive margin), diversification calculated by the concentration indices is often interpreted as a change in number of export products, which is not conceptually correct. Our findings that the trade openness has different effect on volatility when country diversifies exports along the extensive that when export is diversified along the intensive margin show that differences between diversification at the export margins are not just conceptual, but also substantive.

Evidence on the volatility-enhancing effect of openness when country increase the number of export products in transition economies should be interpreted taking into consideration specificity of the economics in transition, which experience remarkable external and internal shocks in the beginning of the 90s. External shock results in major fundamental changes of their external trade, while internal shocks cause changes in the resource allocation and institutions. Considering very short period of time from beginning of transition, we could expect that exporters are still finding right mode of their presence at the external markets. This is along the line with Besedes's (2011) findings on increased hazard of transition country's export that is a consequence of their increased participation in international trade. Moreover, Besedes (2011) find that hazard of exporting over time increased the most for differentiated goods and that mostly richer transition economies (such as Czech Republic or Slovenia) reoriented trade towards differentiated goods at expense of the other type of goods. The richer economies in Besedes (2011) sample are the most diversified in our sample, which implies that churning could explain volatility-enhancing effect of openness in diversified countries. In addition, such evidence may indicate that too many different products may not form large, internationally competitive industries, which may reduce probability for domestic producer to successfully participate on the global market. These new exporters are usually not the most efficient once, since in transition context, given limited opportunities at the home market, firms are pushed into export market. Also, these are small economies with limited potential to exploit economies of scale which may result in a high cost of moving into many new products (Papageorgiou and Spatafora, 2012). On the other hand, volatility-reducing effect of openness when country is concentrated could be reflection of exporters with monopolistic competition and market power (Buch 2002).

In order to investigate stability of our findings several robustness checks are obtained. We use different proxies for dependent variables, the whole range of different proxies for institutions and divide sample according to similar country groups. However, the evidence emerging from all these alternative strategies is very similar to those resulting from the preferred specification.

References

1. Agnello, L. and Sousa, R.M. 2009.The determinants of public deficit volatility. ECB Working Paper Series No. 1042.
2. Acemoglu, D. et al. (2003). Macroeconomic Symptoms: Volatility, Crises and Growth. Institutional Causes. *Journal of Monetary Economics*. 50(1) p.49-123.
3. Acemoglu, D. and Robinson, J.A. 2008. Persistence of Power, Elites, and Institutions. *American Economic Review*. 98(1) p. 267-93.
4. Aizenman J. and B. Pinto (eds.) Managing Economic Volatility and Crises: A Practitioner's Guide. Cambridge: Cambridge University Press, 2005.
5. Andres et al. 2008. The Stabilizing Role of Government Size," *Journal of Economic Dynamics and Control 32* (2) p.571-593.
6. Arin et al. 2011. Why are corrupt countries less successful in consolidating their budgets?. *Journal of Public Economics.* 95 (7-8) p. 521-530.
7. Barseghyan, L., & DiCecio, R. 2010. Institutional causes of output volatility. *Federal Reserve Bank of St. Louis Review*. *92*(3) p.205-23.
8. Beck, T. et al. 2006. Financial intermediary development and growth volatility: Do intermediaries dampen or magnify shocks?. *Journal of International Money and Finance*. 25(7) p. 1146-1167
9. Bejan, M. 2006. "Trade Openness and Output Volatility," MPRA Paper 2759, University Library of Munich, Germany.
10. Bontempi, M.E. and Mammi, I. 2012. A strategy to reduce the count of moment conditions in panel data GMM. MPRA Paper No. 40720.
11. Bonaglia, F. et al. 2001. "How Globalisation Improves Governance," OECD Development Centre Working Papers 181, OECD Publishing.
12. Brambour, T et al. 2006. Understanding Interaction Models: Improving Empirical Analyses. *Political Analysis.* 14: 63-82.
13. Buch, C. M. et al. 2005. "Financial openness and business cycle volatility," Journal of *International Money and Finance*, Elsevier, 24(5), p. 744-765.
14. Cavalcanti, T.V.de V et al. (2012). "Commodity Price Volatility and the Sources of Growth," IMF Working Papers 12/12, International Monetary Fund.
15. Cavallo, E.A. 2008. Output Volatility and Openess to Trade: a Reassessment. *Economía* 9 (1) p. 105-152
16. Calderón, C. and Schmidt-Hebbel, K. 2008. Openness and Growth Volatility, Working Papers Central Bank of Chile 483, Central Bank of Chile.
17. Chin and Ito. 2008. A New Measure of Financial Openness. *Journal of Comparative Policy Analysis*. 10 (3), p. 309 - 322

18. di Giovanni, J. and. Levchenko, A.A. 2009. Trade Openness and Volatility. *The Review of Economics and Statistics*. 91(3) p. 558-585.
19. Dollar, D. and Kraay, A.2003. Institutions, trade, and growth. *Journal of monetary economics* 50.1 p.133-162.
20. Easterly, W.R. et al. 2001. Explaining growth volatility. Annual World Bank Conference on Development Economics, p.191-211.
21. Easterly, W. R. and Kraay, A. C. 2000. Small States, Small Problems? Income, Growth, and Volatility in Small States. *World Development*. 28 (11) p. 2013-27.
22. Eichengreen, B. Managing Openness: Lessons from the Crisis for Emerging Markets. Prepared in *Managing Openness: Trade and Outward-Oriented Growth After the Crisis*, Mona Haddad and Ben Shepherd, eds., World Bank Publications, 2011.
23. Epifani, P. and Gancia, G. 2009. "Openness, Government Size and the Terms of Trade,"*Review of Economic Studies*, 76(2) p. 629-668, 03.
24. Fatas, A. and Mihov, I, 2006. The macroeconomic effects of fiscal rules in the US states. *Journal of Public Economics*. 90(1-2) p. 101-117.
25. Gavin et al. 1995. Macroeconomics of Capital Flows to Latin America: Experience and Policy Issues,Research Department Publications 4012, Inter-American Development Bank, Research Department.
26. Guillaumont, S. J. and Guillaumont, P. 2009. State fragility and economic vulnerability: what is measured and why?. Working Papers 200918, CERDI.
27. Hall, R. E. and Charles I. J. 1999. Why Do Some Countries Produce so Much More Output per Worker than Others? *Quarterly Journal of Economics* 14.p.83-116
28. Haddad et al. 2013. Trade openness reduces growth volatility when countries are well diversified. *Canadian Journal of Economics*, 46(2) p.765-790.
29. Haddad, M. and Shepherd, B. 2011. Managing Openness: Trade and Outward-oriented Growth After the Crisis, World Bank Publications, The World Bank, No. 2283.
30. Hitt et al. 2006. International Diversification: Antecedents, Outcomes, and Moderators. *Journal of Management.* 32 (6) p. 831-867.
31. Huang,Y. 2012. Is Economic Volatility Detrimental to Global Sustainability?. *World Bank Economic Review*. 26(1) p.128-146.
32. Gatti, R. 2004. Explaining Corruption: Are Open Countries Less Corrupt?. *Journal of International Development*. 16(6) p.851-861.
33. Cindy, K. and Franzese, F. 2003. “Modeling and Interpreting Interactive Hypotheses in Regression Analysis: A Brief Refresher and Some Practical Advice.” Unpublished Manuscript, University of Michigan.
34. Jaccard, J., and Turrisi, R. (2003) Interaction effects in multiple regression. Newbury Park: Sage.
35. Jansen, M. et al. 2009. "Exposure to External Country Specific Shocks and Income Volatility. CEPR Discussion Papers 7123, C.E.P.R. Discussion Papers.
36. Jansen, M. 2004. Income Volatility in Small and Developing Economies: Export Concentration Matters. WTO Discussion Paper 3, World Trade Organization.

37. Judson. R. and Owen, A. 1997. Estimating Dynamic Panel Data Models: A Practical Guide for Macroeconomists", *Finance and Economics Discussion* papers 1997-3, Federal Reserve, Washington, D.C.
38. Kaufmann, Daniel et al. 2010. The Worldwide Governance Indicators: Methodology and Analytical Issues. World Bank Policy Research Working Paper No. 5430.
39. Kaufmann, D and Kraay,A. 2008. "Governance Indicators: Where Are We, Where Should We Be Going?," *World Bank Research Observer*. 23(1) p.1-30
40. Kaufmann, D. et al. 2007. "The worldwide governance indicators project : answering the critics," Policy Research Working Paper Series 4149, The World Bank
41. Klomp, J. and de Haan, J. 2009. Political institutions and economic volatility. *European Journal of Political Economy*. 25(3) p.311-326.
42. La Porta et al.1998. Law and Finance. *Journal of Political Economy* 106 p.1113-55.
43. Maddala,G.S.(2001), Introduction to Econometrics, Third Edt., John Wiley&Sons, Ltd.
44. Malik, A. and Temple, J.R.W. 2009. The geography of output volatility. *Journal of Development Economics.* 90(2) p.163-178.
45. Massol, O. and Banal-Estanol, A. 2012. Export diversification and resource-based industrialization: the case of natural gas. Working Papers 12/01, Department of Economics, City University London.
46. Mehrhoff, J. 2009. A solution to the problem of too many instruments in dynamic panel data GMM. Discussion paper no.1/2009, Deutsche Bundesbank.
47. Mendicino, C. 2007. Credit market and macroeconomic volatility. ECB Working Paper Series No. 743.
48. Neeman, Z.et al.2008. Corruption and Openness, *The B.E. Journal of Economic Analysis & Policy,* 8(1).
49. Papageorgiou, C. and Spatafora,N. 2012. Economic Diversification in LICs: Stylized Facts and Macroeconomic Implications. IMF Staff Discussion Notes 12/13, International Monetary Fund.
50. Ramey, G. and Ramey, V. 1995. Cross-country evidence on the link between the volatility and growth. American economic review. 85 (5), p. 1138-1151.
51. Rodrik, D. 2009. Growth After the Crisis, CEPR Discussion Papers 7480, C.E.P.R. Discussion Papers.
52. Rodrik, D. et al. 2004. Institutions Rule: The Primacy of Institutions Over Geography and Integration in Economic Development. *Journal of Economic Growth* . 9(2) p.131-165.
53. Rodrik, D. 1999. Where Did All the Growth Go? External Shocks, Social Conflict, and Growth Collapses. *Journal of Economic Growth*. 4(4), p. 385-412.
54. Rodrik, D. 1998. "Why Do More Open Economies Have Bigger Governments?," *Journal of Political Economy*, 06(5), p.997-1032.
55. Roland, G. 2004. "Understanding Institutional change: Fast-moving and Slow-Moving Institutions" *Studies in Comparative International Development* 38(4) 109-131.
56. Roodman, D. 2009. How to do xtabond2: An introduction to difference and system GMM in Stata. *Stata Journal*. 9(1) p.86-136.

APPENDIX 1

Decomposition of Theil index to map into diversification at the export margins

Empirical researches usually calculate product export diversification using the Theil index:

$$T = \frac{1}{n}\sum_{i=1}^{n}\frac{x_i}{\bar{x}} ln\left(\frac{x_i}{\bar{x}}\right) \qquad (1.1.)$$

where $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$ is the average value of total exports.

The index is inversely related to the degree of diversification: it is zero if exports are equally distributed among n export lines (i.e. perfect diversification) and it achieves its maximum value, ln(n), and if all exports is concentrated in one export line, while the export in other lines is equal to 0 (i.e. perfect concentration). It is straightforward from 1.1. that higher *n* (the introduction of new export categories in a country's export mix) lowers index and accordingly increase diversification, keeping all else constant. However, if new product is large enough, it can even increase concentration. Hence, in addition to number of export lines, diversification is determined by the equality of export values across export lines. Since this is not straightforward from 1.1., we make derivative of the Theil to show in which way distribution of export values affects value of index:

$$\frac{\partial F}{\partial x_1} \approx \frac{1}{n\bar{x}} \ln\left(\frac{x_1}{\bar{x}}\right) \qquad (1.2)$$

Since $\bar{x}$ and n are always positive, sign of derivative (i.e. whether index will decrease or increase when x_1 increase for 1) depend on $\ln\left(\frac{x_1}{\bar{x}}\right)$: for $x_1 < \bar{x}$, increase in x_1 toward $\bar{x}$ will decrease value of index (i.e. decrease concentration) and for $x_1 > \bar{x}$, increase in x_1 will incearase value of index (increase concentration). The export is more concentrate the more further is x_i from $\bar{x}$, and is more diversified the closer is x_i to $\bar{x}$. In other words, the more evenly spread across a set of exported goods will increase diversification, indicated by decrease in the Theil index.

The Theil index can be calculated for groups of individuals and decomposed additively into within-groups (T_w) and between-groups (T_b) components:

$$T_w = \sum_{j=1}^{J}\frac{n_j}{n}\frac{\bar{x}_j}{\bar{x}}\left[\frac{1}{n_j}\sum_{i\epsilon j}\frac{x_i}{\bar{x}_j} ln\left(\frac{x_i}{\bar{x}_j}\right)\right] \qquad (1.3.)$$

$$T_b = \sum_{j=1}^{J}\frac{n_j}{n}\frac{\bar{x}_j}{\bar{x}} ln\left(\frac{\bar{x}_j}{\bar{x}}\right) \qquad (1.4.)$$

where T_w + T_b = T; $G_j(j = 0, \dots J)$ is group of individuals $(i = 1 \dots n)$, n_j is the number of individuals in group j and $\bar{x}j$ is the group's average value.

The decomposability property is considered to be the main advantage of Theil index over alternative measures of diversification. We follow Cadot et al. (2011) and use this property to measure diversification along the intensive and extensive margins of export growth.

In order to construct these sub-indices, Cadot et al. (2011) differentiate the total number of potential export lines (n) (products classified according to the Harmonized System at the 6-digit level -HS6) into the group of lines for which positive export is recorded for that country and year (group of traded export lines denoted by G_1) and the groups of lines with no amount exported (group of non-traded lines denoted by G_o). Considering this partition, the between-group index is:

$$T_b = \underbrace{\frac{n_0}{n}\frac{\bar{x}_0}{\bar{x}} ln\left(\frac{\bar{x}_0}{\bar{x}}\right)}_{\text{Non-traded}} + \underbrace{\frac{n_1}{n}\frac{\bar{x}_1}{\bar{x}} ln\left(\frac{\bar{x}_1}{\bar{x}}\right)}_{\text{Traded}} \qquad (1.5.)$$

In this case, the between component is not defined for non-traded categories as non-traded lines have no value ($x_i = 0$ for all i, then $\bar{x}_0 = 0$ and accordingly logarithm in (1.8.) is not defined). However, when H'Lopital's rule is applied, the first addend in (1.8.) is equal to zero (1.9.).

$$\lim_{x_0 \to 0} \left(\sum_{j=1}^{J} \frac{\bar{x}_j}{\bar{x}} ln\left(\frac{\bar{x}_j}{\bar{x}}\right)\right)=0 \qquad (1.6.)$$

Accordingly, the between component is reduced to:

$$\lim_{x_0 \to 0} T_b = \frac{n_1}{n}\frac{\bar{x}_1}{\bar{x}} ln\left(\frac{\bar{x}_1}{\bar{x}}\right) \qquad (1.7.)$$

Considering the already established fact that the value of non-traded lines tends to zero and their means also tend to zero, it follows that $\sum_{i \epsilon G_1} x_i = \sum_{i=1}^{n} x_i$. Since $\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$ and $\bar{x}_1 = \frac{\sum_{k \epsilon G_1} X_i}{n_1}$, it further follows that $n_1 \bar{x}_1 \to n\bar{x}$ and (1.10.) takes the form of:

$$\lim_{x_0 \to 0} T_b = ln\left(\frac{\bar{x}_1}{\bar{x}}\right) = ln\left(\frac{\frac{\sum_{i \epsilon G_1} X_i}{n_1}}{\frac{\sum_{i=1}^{n} x_i}{n}}\right) = ln\left(\frac{n}{n_1}\right) \qquad (1.8.)$$

Total number of potential export lines within the current harmonized (SITC) system is time invariant. Then, if period-to-period change (Δ) in the index is observed, and the property of the log of a quotient is applied, the between components will reduce to

$$\lim_{x_0 \to 0} \Delta T_b = - \Delta ln\,(n_1) \qquad (1.9.)$$

It means that change in the between component of the index measures changes in the number of traded export lines (n_1), i.e. it reflects changes at the extensive margin of export growth. Since the natural logarithm is an increasing function, and diversification is related to the value of the Theil index (being greater at lower values), the introduction of new export categories is an indication of increased diversification at the extensive margin.

The within-group component will take a form of:

$$T_w = \underbrace{\frac{n_0}{n}\frac{\bar{x}_0}{\bar{x}}\left[\frac{1}{n_0}\sum_{k\epsilon G_0}\frac{x_i}{\bar{x}_0} ln\left(\frac{x_i}{\bar{x}_0}\right)\right]}_{\text{Non-traded}} + \underbrace{\frac{n_1}{n}\frac{\bar{x}_1}{\bar{x}}\left[\frac{1}{n_1}\sum_{k\epsilon G_1}\frac{x_i}{\bar{x}_1} ln\left(\frac{x_i}{\bar{x}_1}\right)\right]}_{\text{Traded}} \qquad (1.10.)$$

The group-specific Theil index is in square brackets. If it is assumed that all export lines have the same arbitrary positive value x_o, so that $x_0 = \bar{x}_0$, then $\sum_{i\epsilon G_0}\frac{x_i}{\bar{x}} ln\left(\frac{x_i}{\bar{x}}\right) = n_o \ln(1)$ which reduces the first addend in (1.9) to $\frac{n_0}{n}\frac{\bar{x}_0}{\bar{x}} ln(1) = 0$. Consequently, the within component reduces to

$$\lim_{x_0\to 0} T_w = \frac{n_1}{n}\frac{\bar{x}_1}{\bar{x}}\left[\frac{1}{n_1}\sum_{k\epsilon G_1}\frac{x_i}{\bar{x}_1} ln\left(\frac{x_i}{\bar{x}_1}\right)\right] \qquad (1.11.)$$

Equation 1.14 is the Within-Group Theil Index for Group 1. Considering the already proven identity that $n_1\bar{x}_1 \to n\bar{x}$ when $x_0 \to 0$, it follows that the within component is equal to the Theil index for the Group 1 traded export lines:

$$\lim_{x_0\to 0} T_w = \frac{1}{n_1}\sum_{i\epsilon G_1}\frac{x_i}{\bar{x}_1} ln\left(\frac{x_i}{\bar{x}_1}\right) = T_1 \qquad (1.12.)$$

And changes in the within-group components are a measurement of the changes of concentration among traded lines only ($\Delta T_w = \Delta T_1$), by definition capturing changes at the intensive margin of export growth. Here, more even spread among the value of existing export lines is an indication of increased diversification.

Change in the between component of the index reflects diversification at the extensive margin of export growth by measuring changes in the number of traded export lines, while changes in the within-group components reflects diversification at the intensive margin of export growth by measurement of the changes of concentration among traded lines only.

APPENDIX 2

Description of data

Table 1. Description of data

Variable	Definition	Source
Dependent variable		
Output volatility	Standard deviation of the real GDP per capita growth rates	World Bank, World Development Indicators
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 export/import.	World Bank, World Development Indicators
Inflation rate volatility	Standard deviation of the annual percentage changes of average consumer prices.	World Economic Outlook (WEO)
Exchange rate volatility	Standard deviation of exchange rate, annual average.	European Bank for Reconstruction and Development (EBRD), macroeconomic indicators
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)
Mediators of shocks		
Export diversification	Change in the between component of the Theil index, capturing changes in the number of export products.	Author's own calculation using export data at the HS6-digit level from UNCTAD
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
Financial openness	An index of restrictions on cross-border transactions. The index includes capital flows and capital restrictions	Chin and Ito (2008)
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
Institutional quality	EBRD Institutional index	European Bank for Reconstruction and Development (EBRD), transition indicators
Conflict	Dummy variable, taking value of 1 in year of conflict	Central Intelligence Agency
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 3

System GMM estimation results

Table 2. System GMM estimation of the model (2)

Dependent variable: Standard deviation of the real GDP per capita growth rates					
	(1)	(2)	(3)	(4)	(5)
VARIABLES	hhi	gini	theil	intensive	extensive
Export diversification	28.63289**	-76.19098	1.82284	3.14262	-5.74648
	(11.431)	(55.027)	(5.462)	(3.943)	(3.869)
Openness	0.15474*	-0.84130	-0.05178	0.11737	-0.04285
	(0.092)	(0.547)	(0.211)	(0.168)	(0.066)
Institutions	-1.64234	-4.79128*	-7.37464	-1.27449	1.56176
	(2.780)	(2.635)	(7.674)	(3.868)	(4.007)
Export diversification#Openness	-0.29929***	0.88082	-0.00797	-0.03221	0.04384
	(0.114)	(0.613)	(0.049)	(0.038)	(0.029)
Terms of trade volatility	-5.95654	-9.23460**	-6.51961	-2.65100	-0.36528
	(6.485)	(4.420)	(7.867)	(5.066)	(6.303)
Exchange rate volatility	0.02505	0.01303	0.07587	0.01229	-0.00313
	(0.090)	(0.067)	(0.094)	(0.059)	(0.088)
Inflation rate volatility	-0.00121	-0.00090	-0.00228	-0.00108	-0.00050
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Government expenditure volatility	0.00872***	0.00697***	0.00712	0.00802***	0.00616***
	(0.002)	(0.002)	(0.005)	(0.003)	(0.002)
Cred. to private/GDP	0.04839	0.05394**	0.09739	0.04119	-0.01874
	(0.043)	(0.027)	(0.097)	(0.056)	(0.060)
Financial openness	0.10186	0.48661	1.05052	0.23495	-0.28459
	(0.486)	(0.304)	(1.219)	(0.695)	(0.586)
Conflict	1.24511*	0.43787	0.77759	1.19052**	0.39068
	(0.699)	(0.630)	(1.385)	(0.543)	(0.493)
2bn.year	-0.01842	-0.05610	1.34719	-0.29796	-1.25729
	(1.210)	(0.994)	(2.815)	(1.369)	(1.264)
3.year	-0.97390	-1.05121	0.33982	-1.35758	-2.23464*
	(1.071)	(1.100)	(2.897)	(1.360)	(1.176)
4.year	-1.01081	-1.11630	0.40860	-1.59764	-2.13082*
	(1.019)	(1.087)	(3.142)	(1.277)	(1.111)
5.year	2.59104**	2.93091***	2.58051	2.28245	3.09820***
	(1.040)	(1.076)	(2.765)	(1.433)	(1.167)
Constant	-7.70952	89.32153*	20.26636	-5.31182	5.59276
	(13.162)	(51.966)	(22.964)	(18.304)	(12.473)
Observations	107	107	109	109	109
Number of country	24	24	25	25	25
Number of instruments	22	22	23	23	23
Arellano-Bond test AR(1)	-3.10	-2.8	-2.98	-3.32	-2.12
	(0.002)	(0.005)	(0.003)	(0.001)	(0.034)

Arellano-Bond test AR(2)	1.11	0.04	0.58	0.91	0.24
	(0.266)	(0.970)	(0.564)	(0.364)	(0.812)
Sargan test of overidentifying restrictions	2.47	5.1	0.05	0.53	6.92
	(0.872)	(0.747)	(0.977)	(0.970)	(0.227)
Hansen test of overidentifying restrictions	1.63	3.08	0.04	0.75	2.77
	(0.950)	(0.929)	(0.979)	(0.945)	(0.735)
Portion of variance explained by the components	0.950	0.920	0.927	0.87	0.92
Kaiser-Meyer-Olkin measure of sampling adequacy	0.634	0.700	0.701	0.695	0.643

Table 3. System GMM estimation of the model (1)

Dependent variable: Standard deviation of the real GDP per capita growth rates					
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Model	Model	Model	Model	Model
Export diversification	-5.51667	-25.75361	0.10855	-0.81854	-1.45991
	(12.084)	(25.363)	(0.437)	(0.526)	(1.553)
Openness	-0.00480	-0.06718*	-0.03244	-0.06356***	-0.08585**
	(0.035)	(0.038)	(0.032)	(0.024)	(0.040)
c.Export diversification#c.Openness	-0.40505	-0.54236	-0.06638**	-0.05320	0.05771
	(0.255)	(0.738)	(0.026)	(0.035)	(0.068)
Institutions	0.38264	1.72512	-1.77381	2.10669	1.86560
	(0.414)	(2.122)	(0.023)	(0.037)	(0.091)
Institutions#Openness	0.01782	-0.00386	0.08214	-0.00008	-0.05068
	(0.034)	(0.038)	(0.059)	(0.032)	(0.072)
Institutions#Diversification	-11.23774	-2.03234	-1.27099	-0.57313	-1.54752
	(1.785)	(3.532)	(2.980)	(2.273)	(3.940)
Openness#Diversification#Institutions	-0.15506	2.00769	0.02535	0.08060**	0.16511*
	(27.629)	(121.915)	(1.555)	(2.158)	(4.036)
Terms of trade volatility	4.98750	-3.68114	9.11467	3.91295	-4.10699
	(7.646)	(6.886)	(8.887)	(7.893)	(7.154)
Exchange rate volatility	-0.01008	-0.01584	-0.06113	-0.01833	-0.01503
	(0.057)	(0.075)	(0.050)	(0.053)	(0.098)
Inflation rate volatility	-0.00061	-0.00057	-0.00064	-0.00021	-0.00093
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
Government expenditure volatility	0.00698***	0.00796***	0.00841***	0.01167***	0.00869**
	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)
Cred. to private/GDP	0.00135	0.02507	0.02265	0.01766	0.03069
	(0.022)	(0.037)	(0.034)	(0.034)	(0.033)
Financial openness	0.16774	0.01648	0.23467	-0.20615	-0.54745
	(0.432)	(0.460)	(0.310)	(0.498)	(0.649)
Conflict	1.04109**	0.91996	2.03174***	1.66721**	1.13714
	(0.487)	(0.662)	(0.725)	(0.830)	(0.859)
2bn.year	-0.67438	-0.55631	-0.13508	-0.30425	-0.90717

	(0.651)	(1.509)	(0.871)	(0.876)	(0.954)
3.year	-2.06372***	-1.95165	-0.61560	-1.38411	-1.44134
	(0.708)	(2.224)	(1.252)	(1.250)	(1.261)
4.year	-1.88613***	-2.27545	-0.77606	-1.50157	-1.34217
	(0.687)	(2.040)	(1.026)	(1.211)	(1.206)
5.year	2.88274**	1.22361	3.82038**	2.11398	2.16675
	(1.269)	(2.246)	(1.858)	(1.794)	(1.514)
Constant	3.55863***	2.98046*	2.06427	2.72099*	2.53889
	(1.027)	(1.537)	(1.499)	(1.567)	(1.567)
Observations	107	107	109	109	109
Number of country	24	24	25	25	25
Number of instruments	23	23	24	24	24.
Arellano-Bond test AR(1)	-3.07	-2.99	-2.07	-2.76	-2.46
	(0.002	(0.003)	(0.039)	(0.006)	(0.014)
Arellano-Bond test AR(2)	1.68	0.16	0.51	0.53	0.09
	(0.092)	(0.875)	(0.608)	(0.595)	(0.932)
Sargan test of overidentifying restrictions	3.29	4.39	2.78	2.89	6.14
	(0.656)	(0.496)	(0.734)	(0.716)	(0.293)
Hansen test of overidentifying restrictions	3.98	4.29	2.74	2.72	6.30
	(0.552)	(0.508)	(0.740)	(0.744)	(0.287)
Portion of variance explained by the components	0.986	0.992	0.982	0.983	0.975
Kaiser-Meyer-Olkin measure of sampling adequacy	0.696	0.721	0.724	0.721	0.717

APPENDIX 4

Diff. dependent	Different institutional proxy	CEB and SEE

Robustness checks

Table 4. Fixed effect robust estimation of model (1) for different institutional proxies

Institutional proxy	Control of corruption - World Bank	Corruption Perception Index- Transparency international	Control of corruption - World Bank	EBRD market and trade institutional efficiency	Rule of law- World Bank	Government efficiency- World Bank	Political instability- World Bank	Control of corruption - World Bank
VARIABLES	Col (1)	Col (2)	Col (3)	Col (4)	Col (5)	Col (6)	Col (7)	Col (8)
Export diversification	0.03673*	18.90780**	-18.66102*	-4.92105	9.97755**	9.82069**	10.34815**	19.42838***
	(0.019)	(7.761)	(10.164)	(4.036)	(4.121)	(4.144)	(4.191)	(5.941)
Openness	9.87808***	0.20019***	0.17012	0.18822**	0.03580*	0.04533**	0.04826**	0.08585**
	(3.498)	(0.057)	(0.103)	(0.075)	(0.020)	(0.022)	(0.020)	(0.034)
Institutions	7.16038**	3.45746***	3.66601	3.23965	5.89106**	3.54759	2.58158	11.52791**
	(3.106)	(1.170)	(3.874)	(2.671)	(2.568)	(2.863)	(1.577)	(4.212)
Extensive# Openness	-0.08868***	-0.19173**	0.13154*	0.02501	-0.08425**	-0.07934**	-0.08760***	-0.15309***
	(0.025)	(0.075)	(0.075)	(0.043)	(0.031)	(0.030)	(0.031)	(0.037)
Institutions# Openness	-0.06286**	-0.03670***	-0.02892	-0.03662*	-0.04544**	-0.03834	-0.03213**	-0.12016**
	(0.028)	(0.011)	(0.028)	(0.021)	(0.020)	(0.023)	(0.015)	(0.041)
Institutions# Extensive	-1.32833	-2.29471*	11.97201***	10.00284***	-0.59087	1.05264	2.32324	-6.93308
	(1.867)	(1.131)	(3.875)	(2.478)	(1.275)	(2.087)	(1.774)	(5.151)
Openness#Extensive#Institutions	-0.01303	0.02590*	-0.08575***	-0.06712***	-0.01315	-0.01540	-0.01768	0.05920
	(0.021)	(0.013)	(0.029)	(0.022)	(0.017)	(0.020)	(0.016)	(0.062)
Terms of trade volatility	0.55476	-3.50180	-6.74715	-2.58770	-1.78744	-3.57356	-3.65094	19.49897***
	(4.347)	(6.204)	(5.001)	(4.013)	(6.049)	(4.925)	(5.657)	(5.281)
Exchange rate volatility	-0.00168**	-0.00131*	-0.00198*	-0.00087	-0.00266**	-0.00154	-0.00201**	-0.00036
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Inflation rate volatility	0.00931***	0.00915***	0.00740***	0.00502**	0.00956***	0.00792***	0.00785***	0.00650***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Government expenditure volatility	0.04007	0.04619	0.02430	0.02313	0.04411	0.03285	0.02697	0.02933
	(0.043)	(0.045)	(0.049)	(0.047)	(0.041)	(0.045)	(0.048)	(0.042)
Cred. to private/GDP	0.05096***	0.04476***	0.04412***	0.03727***	0.04958***	0.04604***	0.05198***	0.06649***
	(0.013)	(0.011)	(0.013)	(0.013)	(0.013)	(0.013)	(0.012)	(0.012)
Financial openness	-0.00020	-0.00053	0.00017	0.00161	-0.00034	0.00059	0.00086	0.00019
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Banking reform index	-1.39469*	-1.56198**	-1.73356**	-1.44306**	-2.12274*	-1.65524	-1.98684*	-1.49728
	(0.815)	(0.685)	(0.653)	(0.679)	(1.049)	(1.085)	(1.064)	(1.195)
2.year	-1.19117	-1.57363**	-3.00850**	-2.51605**	-1.49016*	-1.53633*	-1.39485*	-0.73600
	(0.850)	(0.691)	(1.156)	(0.998)	(0.850)	(0.865)	(0.792)	(1.218)
3.year	-1.90473***	-2.42247***	-3.92146***	-3.36979***	-2.14508***	-2.32318***	-2.26116***	-1.66413*
	(0.658)	(0.585)	(1.346)	(1.115)	(0.652)	(0.664)	(0.635)	(0.869)
4.year	-1.94144***	-2.25656***	-3.84787**	-3.29518**	-1.73582***	-2.10049***	-2.18539***	-1.80826
	(0.514)	(0.498)	(1.427)	(1.304)	(0.564)	(0.592)	(0.568)	(1.455)
5.year	2.12806**	2.09512**	0.02713	0.46695	2.40521**	2.05003**	1.76765*	1.68501
	(0.867)	(0.927)	(1.694)	(1.546)	(0.914)	(0.917)	(0.971)	(1.057)
Constant	0.95574	-12.81296**	-13.38853	-13.48530*	3.26488	1.17119	2.16000	-6.39713
	(4.052)	(5.749)	(11.571)	(7.421)	(4.293)	(4.595)	(4.222)	(6.379)

Observations	107	102	106	106	107	107	107	61
R-squared	0.66	0.68	0.68	0.70	0.65	0.65	0.67	0.85
Number of country	25	25	25	25	25	25	25	14
Adj. R-squared	0.59	0.61	0.61	0.64	0.58	0.58	0.60	0.79
Wooldridge test for autocorrelation in panel data	0.965	0.749	0.103	0.033	0.769	1.581	0.560	1.149
	(0.3361)	(0.3976)	(0.7512)	(0.8565)	(0.3895)	(0.2213)	(0.4620)	(0.3032)
Wald test for groupwisehetero skedasticity	1.3e+31	14621.48	214.98	517.32	548.73	1150.19	517.32	14621.48
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

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