DOES EXPORT DIVERSIFICATION LOWER GROWTH VOLATILITY? AN EMPIRICAL ANALYSIS

Barbaros GÜNERİ[1]

Abstract

This paper, following the recent literature, discussing about the theoretical connections, and applying an empirical analysis, studies the relationship between export diversification and growth volatility. Using several export diversification indices, a large number of countries, various control variables and dynamic panel data methodology, the empirical model present strong evidence on the effects of diversification on volatility. The results show that countries with a diversified export basket experience lower growth volatility. Among diversification indices, intensive margin (more balanced basket of exports) is found to have a stronger negative impact on volatility, rather than extensive margin (number of firms exporting).

Keywords: Growth Volatility, Export Diversification, Dynamic Panel Data.

[1] Çankırı Karatekin Üniversitesi, İİBF, İktisat Bölümü, barbarosguneri@karatekin.edu.tr, ORCID No: 0000-0003-1341-9380.
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İHRACAT ÇEŞİTLENDİRMESİ BÜYÜME OYNAKLIĞINI ETKİLER Mİ? AMPİRİK BİR ANALİZ

Barbaros GÜNERİ

Öz

Bu çalışma, güncel literatürü izleyerek, teorik bağlantıları tartışarak ve ampirik bir analiz uygulayarak, ihracat çeşitlendirmesi ve büyüme oynaklığı arasındaki ilişkiyi analiz etmektedir. Farklı ihracat çeşitliliği endeksleri, çok sayıda ülke, çeşitli kontrol değişkenleri ve dinamik panel veri metodolojisinin kullanıldığı ampirik model, çeşitlendirmenin oynaklık üzerindeki etkileri konusunda güçlü kanıtlar sunmaktadır. Sonuçlar, çeşitlendirilmiş ihracat sepetine sahip ülkelerin daha düşük büyüme oynaklığı yaşadıklarını göstermektedir Çeşitlilik endeksleri acısından, yoğun ticaret (daha dengeli ihracat sepeti) oynaklık üzerinde yaygın ticarete (ihraç yapan firma sayısı) göre daha etkilidir.

***Anahtar Kelimeler*:** Büyüme Oynaklığı, İhracat Çeşitlendirmesi, Dinamik Panel Data.

Introduction

Sustainability and stability in economic growth has always been one of the most important policy targets, since the way to economic development involves stable growth rates as well as economic growth. Macroeconomic fluctuations and instability in growth rates cause various problems to an economy. For example, in a seminal paper, Ramey and Ramey (1994) examined the link between output volatility and growth and stated that countries with a higher volatility experience lower growth. Fogli and Perri (2015) found out that in volatile economies, individuals prefer to hold more foreign assets, which decreases the available funds in domestic market and harms growth. They also argued that there is a strong connection between volatility and uncertainty, and a higher uncertainty lower investment, in addition to shifting resources to foreign markets. These unfavorable implications indicate that growth volatility should be considered as an important obstacle on economic development, thus it is crucial to discuss about the sources of volatility.

Acemoglu and Zilibotti (1997) argued that diversification opportunities are restricted in initial stages of development due to the insufficient physical and human capital. Thus, as countries climb the ladder of development, it is observed that they have more opportunities for diversification and the structure of production shifts from risky sectors to safer ones, which decreases volatility. In this context, Rodrik (2014) and Yildirim (2014) argued that economic development is a process of accumulating capital and capabilities of a country among more complex sectors. Therefore, countries should start by diversifying their export structure to reach the target of producing sophisticated goods. This process can be defined as the structural transformation (Felipe, Kumar, and Abdon, 2010). Koren and Tenreyno (2007) analyzed the sources of macroeconomic volatility and argued that sectoral composition of production among countries significantly contributes to volatility. That is, countries that produce and export simple goods in general, such as agriculture and mining, are expected to experience higher growth volatility. On the other hand, countries that produce and export sophisticated/complex goods, such as electronics and chemicals, are inclined to experience less growth volatility. Therefore, the transformation of production and thus exports is also expected to help countries in decreasing macroeconomic volatility.

The channels between diversification and volatility can be discussed through two channels: Firm/Micro level and Country/Macro level. At the micro level, firms/regions that specialize on one or few industries might suffer if a

shock hits those specific industries, which in turn leads to high instability in wages, employment, growth and exports. However, if firms/regions are well diversified, the negative effects of risks would be less severe, since when one industry collapses due to a negative shock, others might absorb the collapse of this industry by creating other employment opportunities and protects the performance on exports (Felix, 2012). Similarly, Juvenal and Santos Monteiro (2013) argued that diversification in export markets decreases the uncertainty in demand for products of an exporter, and in turn, firms invest more in innovations and technology. Empirically, many papers such as Felix (2012), Juvenal and Santos Monteiro (2013) and Hirsch and Lev (1971) found out that firm/regional diversification leads to more stable growth rates in wages, employment and sales; and thus, reduce the uncertainty and volatility.

At the macro level, export diversification has also many benefits. The pioneers in benefits of export diversification are probably Prebish (1950) and Singer (1950). They argued that specializing in primary products would harm countries by deteriorating their terms of trade, thus countries need to diversify. Furthermore, as Hesse (2008) states the prices of commodity products are usually sensitive, thus countries that depend on these products are more likely to suffer from uncertainty in export earnings. This uncertainty might prevent firms to invest in new capital and create macroeconomic volatility. Moreover, as Haddad et al. (2013) states, more diversified countries in terms of exports are more likely to involve in international insurance schemes, which would decrease the effects of not only external, but also internal shocks.

Several papers have analyzed the relationship between macroeconomic volatility and export diversification. Jansen (2004) argued that countries with high export concentration have experience higher growth volatility. Bacchetta et al. (2007) argued that export diversification negatively affects output volatility in developing countries. Kartalciklar (2016) also argued that diversification leads to lower volatility, for both aggregate and sectoral level. McIntrye et al. (2018) analyzed this relationship for small states only, since small states have fewer opportunities for diversification, and found out that more diversified states have lower growth volatility.

These findings suggest that diversification is an important tool in decreasing the growth volatility. In this context, the purpose of this paper is to examine the relationship between export diversification and growth volatility for a large set of countries. Although there are several papers analyzing this link, only very few of them consider the effects of intensive and extensive margin

of exports in terms of export diversification. Intensive margin refers to the idea of a more balanced basket of exports, and extensive margin suggests introducing new basket of goods to current exports (IMF, 2014). Detailed information about these indices can be found in the appendix four. There are very few papers that consider the effects of these margins on macroeconomic volatility. Kartalciklar (2016) found that extensive margin has a negative impact on volatility, and IMF (2014) found that although both intensive and extensive margin has significant effects, the relationship actually depends on the selection of country groups and other control variables. Therefore, in addition to the effect of export diversification index on growth volatility, this paper also contributes to the relevant literature by considering the effects of intensive and extensive margins of trade. The rest of the paper is organized as follows. Second chapter covers the data and examines the empirical methodology. Third chapter presents the empirical results, and last but not least, chapter four concludes.

Data and Methodology

Data

The data set consist of 94 countries[2] for the period 1980 and 2014. The dependent variable is the volatility of growth of gross domestic product (GDP) per capita. In the literature, volatility has been measured in different ways, such as standard deviation of an economic variable, standard deviation of a residual, and standard deviation of a cycle with isolation. The most common technique to measure volatility among these is the first one, standard deviation of an economic variable. Several studies such as Ramey and Ramey (1994), and Yang (2008) used the standard deviation of growth, thus following these papers; standard deviation of GDP per capita growth is used as the measurement of volatility.

In terms of data, it has been chosen to use 5-year averages for both growth volatility and other control variables due to several reasons. First of all, the control variables, including diversification indices, might suffer from short timed business cycle fluctuations such as economic or financial crisis. Thus, taking averages helps filtering possible noises in the data. Second of all, the preferred econometric model to estimate the empirical relationship (system GMM) works best with short time periods and large observations. Taking 5-year averages allow us to deal with 7 periods, which is totally suitable for the purpose of this paper. Last but not least, many papers in volatility literature

[2] The list of the countries is presented in Appendix.

also choose to use pooled data (aggregate over periods) such as Haddad et al. (2013), Easterly, Islam and Stiglitz (2000) and Koskela and Viren (2003).

The main variables of interest are the export diversification, extensive margin and intensive margin. The data for these variables comes from the IMF (2014). To calculate the export diversification, IMF (2014) classifies products into three types, which are Traditional, New or Non-traded. Traditional products are in the sample if they were exported from the beginning, new goods participate into the sample when a country export these goods in at least two consecutive years and non-traded goods are the goods that a country does not engage in trade. Based on these explanations and Theil's entropy index[3] used in Cadot, Carrere and Strauss-Kahn (2011), IMF (2014) creates three components to measure diversification. Among these, extensive margin considers only the type of goods among an export basket, and intensive margin takes into account both the type of goods and their market value. Thus, as Cadot et al. (2011:4) states

> *"The intensive margin reflects variation in export values among existing exports whereas the extensive margin reflects variation in the number of new products exported or in the number of new markets for existing exports."*

Finally, export diversification is calculated as the sum of these two measures. By their construction, a higher value for all three indexes indicates lower diversification.

There are also other control variables expected to have an impact on growth volatility. Among these, trade openness and foreign direct investment (FDI) points the relationship of a country with international markets. There is a vast literature on the relationship between trade openness and growth volatility. In a theoretical setting, this link looks ambiguous. On one side, as integration with international markets increases, countries are more likely to get affected from external shocks (Haddad et al, 2013). On the other side, as Krebs, Krishna and Maloney (2005) states, trade openness may act as an insurance against country specific shocks, since the world economy as a whole, is less prone to economic distortions than individual countries. Empirically, many papers found a positive relationship (Bejan, 2006 and Bugamelli and Paternò, 2011). Similar to trade openness, the effects of foreign direct investment on volatility is also controversial. For example,

[3] Although Theil Index is mainly used to measure inequality, it has several applications on other fields on economics.

Ćorić and Pugh (2013) found a negative relationship, whereas Mirdala, Svrceková and Semancıková (2015) argued that FDI increases volatility.

Another control variable used in the regression is the volatility of exchange rate. After the collapse of Bretton Woods, many countries started to follow a flexible exchange rate regime. Although it has several advantages in macroeconomic policies of countries, it also could be harmful if results in uncertainty. High and sudden changes in exchange rates might cause reallocation of resources (Grydaki and Fountas, 2009) and thus increase volatility.

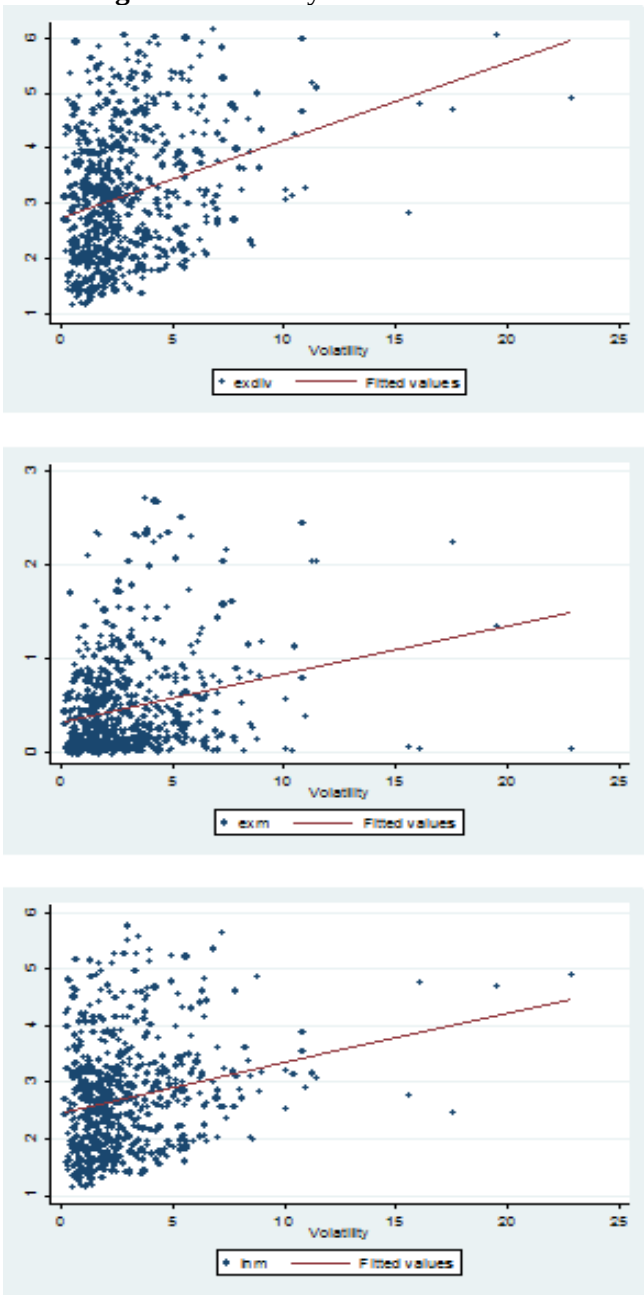
Inflation is also a key determinant of growth volatility. A high inflation or an unstable inflation rate increases the uncertainty and thus lowers the confidence in an economy. Moreover, it is also an important indicator of a monetary policy, and thus seen as the effectiveness of the central bank. Instability or high rates of inflation imply that the monetary policies of the central bank are not credible. Therefore, it is expected to affect volatility positively.

In addition to these monetary, financial and trade variables, it is chosen to use government consumption to examine the effects of fiscal policy on volatility. Koskela and Viren (2003) argued that an effective fiscal policy could lower the volatility by stabilizing the business cycles. Nonetheless, Pisani-Ferry, Debrun and Sapir (2008) claimed that it has two conflicting effects: Government consumption increases the non-volatile element of GDP, but it also stimulates volatility of consumption and investment, which in turn increases growth volatility. Since fiscal policy might have controversial effects, following Blanchard and Simon (2001), who argued that a decrease in growth volatility could occur through a decrease in government consumption volatility, volatility of government consumption is used as another control variable.

Last but not least, investment rate enters into the regression as another control variable. Blanchard and Simon (2001) and Irvine and Schuh (2005) argued that inventory investment is an important component in decreasing output volatility in the US. Moreover, Aizenman and Marion (1999) found that there exists a negative relationship between private investment and output volatility. According to the Federal Bank of St. Louis[4], the most volatile component part of the GDP is investment and net exports. Hence, investment rate is also considered as an important determinant of volatility.

[4] https://fredblog.stlouisfed.org/2015/08/gdp-components-volatility/ (Retrieved: 20.09.2019).

Figure 1. Volatility and Diversification



While a detailed analysis for the key question will be done in the next section, it would be beneficial to check the validity of the hypothesis by

descriptively analyzing the link between export diversification and growth volatility. For this purpose, three different diversification measures are plotted against volatility and these plots can be found in figure 1 above, where exdiv is the export diversification, and inm and exm represent intensive margin and extensive margin, respectively. Although an econometric verification is required, the initial indicators about the plots below confirm the hypothesis. Since a higher value shows less diversification on exports, all 3 indicators are negatively related with growth volatility.

Methodology and Estimation Strategy

To estimate the empirical relationship between export diversification and volatility, the benchmark model used in this paper can be written as:

$$VOL_{i,t}=\beta_0 + \beta_1 DIV_{i,t} + \beta_2 Xi_{,t} + \Omega_i + u_{i,t} \quad (1)$$

Where VOL is growth volatility, DIV is an export diversity index, X is a vector of control variables, Ω stands for the individual fixed effects and u is the disturbance term. Subscripts i and t represent countries and time, respectively, β0 is the constant and β1 and β2 are the coefficients to be estimated. Control variables include trade openness, volatility of inflation, Foreign Direct Investment (FDI), volatility of exchange rate, volatility of government consumption and investment rate, respectively. Initially, the above model will be estimated in a panel data setting. Thus, checking whether fixed effects or random effects are the suitable model using a Hausman test, the results will be presented.

Although panel data models have its merits, it might suffer from some econometric issues. For instance, Yalta and Yalta (2012) states that possible problems about endogeneity of control variables might produce inconsistent and biased results. Furthermore, possible correlation among time invariant and control variables could also arise as another important issue (Yalta and Yalta, 2012).

To deal with these issues, dynamic panel data methodology proposed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) will also be applied to the above equation. Dynamic panel data consist of two different techniques, difference and system GMM. Difference GMM, developed by Arellano and Bond (1991), solves the endogeneity issue, however creates some weaknesses since it requires differencing of the model. System GMM, on the other hand, merges the regression in differences with levels to overcome this issue. In addition, as Bond,

Hoeffler, and Temple (2001) argue, in the case of weak instruments, difference GMM might produce biased estimates. Furthermore, they also stated that difference GMM generates biased estimators when the number of time periods is small, which might be problematic for the purpose of this paper since there are only seven time periods. However, as explained by Bond, Hoeffler, and Temple (2001) system GMM allows gains in precision because of extra moment conditions it includes. Moreover, Sarafidis, Yamagata and Robertson (2009) claimed that system GMM is a more reliable estimator in the presence of heterogeneous error cross sectional dependence. Due to all these advantages, the preferred model is the system GMM. Roodman (2009) states that system GMM works best in linear models that include a dynamic lagged dependent variable with small T and large N, and it is also very effective in solving the endogeneity problem.

To express the model in dynamic panel data form, first, the lagged dependent variable should be added into the model. Thus, the above equation can be written as:

$$VOL_{i,t}=\beta_0 + \alpha\, VOL_{i,t-1} + \beta_1 DIV_{i,t} + \beta_2 Xi_{,t} + \mu_i + u_{i,t} \quad (2)$$

Then, by taking the first differences to rule out fixed effects, this can be written as:

$$\Delta VOL_{i,t}=\beta_0 + \alpha\, \Delta VOL_{i,t-1} + \beta_1 \Delta DIV_{i,t} + \beta_2 \Delta X_{i,t} + \Delta u_{i,t} \quad (3)$$

To obtain consistent estimate from a system GMM regression, two specification tests must be checked. The first one, AR (2) test, is for serial correlation and the second one, Hansen test, checks the validity of instruments. For Hansen test, the null hypothesis suggests that independence among error terms exists, and for AR (2) test, the null hypothesis suggests no serial correlation (Yalta and Yalta, 2012). Hence, after completing the estimation of models, these two tests will be checked to control the validity of estimations.

Estimation Results

This section discusses about both panel data and system GMM estimation results. At first, panel data methodology is applied to estimate the regression. There are mainly two reasons for presenting random effects. First of all, the results of Hausman test showed that random effect is the more suitable model compared to fixed effects. These results can be found in the appendix. Second of all, as Haddad et al. (2013) states fixed effects take no account of between group variation but it might be more trustworthy in the case of relative differences in diversification measures, in contrast to within

variation. Table below shows the estimation results of the one-way random effects model. As Hoechle (2007) argues, one way to avoid potential heteroscedasticity and autocorrelation problem in panel data regression is to use robust standard errors and estimations are done according to this specification.

Table 1. Random Effect Regression Results

VARIABLES	(1) Volatility	(2) Volatility	(3) Volatility	(4) Volatility	(5) Volatility
Trade Open.	0.150***	0.126***	0.132***	0.134***	0.135***
	(0.038)	(0.034)	(0.034)	(0.034)	(0.035)
Vol. Inflation	0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FDI	-0.024***	-0.020**	-0.020***	-0.021***	-0.020***
	(0.009)	(0.008)	(0.007)	(0.008)	(0.007)
Vol. Exchange Rate	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Export Div.	0.508***	0.375***	0.372***		
	(0.125)	(0.118)	(0.117)		
Vol. Gov. Cons		0.518***	0.493**	0.532***	0.507**
		(0.198)	(0.198)	(0.204)	(0.205)
Investment			-0.033	-0.035	-0.028
			(0.022)	(0.023)	(0.023)
Intensive Margin				0.311**	
				(0.155)	
Extensive Margin					0.757**
					(0.294)
Constant	0.522	0.523	1.269**	1.603**	1.965***
	(0.382)	(0.359)	(0.610)	(0.644)	(0.591)
R^2	0.1585	0.2058	0.2139	0.2010	0.2100
F statistic	42.98***	46.31***	48.46***	31.01***	59.42***
Observations	642	636	635	635	636
Number of countries	94	94	94	94	94

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The first column includes the variables of trade openness, volatility of inflation, foreign direct investment, volatility of exchange rate and export diversification index. That is, the estimation is done by only including the monetary, financial and trade variables, since these are the ones that the volatility literature mostly emphasizes on explaining the variation in GDP growth. The second and third columns add volatility of government consumption and investment to the regression, respectively. Lastly, fourth and fifth columns replace export diversification index with intensive margin or extensive margin variables, to further analyze the diversification and volatility relationship.

In all columns, export diversification has a negative effect on volatility, as expected. Furthermore, both intensive and extensive margins also lower growth volatility. These initial results confirm the hypothesis that more diversified countries have less volatility. In addition to these variables, trade openness and volatility of government consumption increase volatility, whereas FDI lowers volatility.

Table 2. System GMM Results

VARIABLES	(1) Volatility	(2) Volatility	(3) Volatility	(4) Volatility	(5) Volatility
Lagged Volatility	0.283***	0.257***	0.221***	0.216***	0.245***
	(0.088)	(0.085)	(0.083)	(0.075)	(0.083)
Trade Open.	0.223***	0.179***	0.187***	0.187***	0.193***
	(0.049)	(0.039)	(0.036)	(0.036)	(0.038)
Vol. Inflation	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
FDI	-0.033***	-0.026***	-0.026***	-0.026***	-0.026***
	(0.008)	(0.007)	(0.005)	(0.006)	(0.006)
Vol. Exchange Rate	0.000**	0.000**	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Export Div.	0.596***	0.513***	0.456**		
	(0.208)	(0.186)	(0.178)		
Vol. Gov. Cons		0.299	0.256	0.262	0.317
		(0.209)	(0.196)	(0.186)	(0.217)
Investment			-0.056*	-0.059*	-0.055*
			(0.031)	(0.032)	(0.030)
Intensive Margin				0.571**	
				(0.240)	
Extensive Margin					0.406
					(0.510)
Constant	-1.169	-0.895	0.645	0.631	1.724***
	(0.745)	(0.572)	(0.776)	(0.799)	(0.669)
Hansen p value	0.245	0.258	0.222	0.230	0.338
AR(2) value	0.705	0.598	0.799	0.811	0.768
Number of inst.	67	78	89	89	89
Observations	554	550	550	550	551
Number of countries	94	94	94	94	94

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Although the random effects model validates the expectations, as discussed before, the preferred model for the purposes of this paper is the system GMM methodology since it helps avoiding possible problems about serial correlation and endogeneity. The table above shows the system GMM results. In contrast with the random effects model, system GMM includes

lagged volatility as a control variable by its construction. Columns are constructed same as random effects model.

In all 5 columns, lagged volatility has positive and significant impact on volatility as expected. In terms of diversification indices, export diversification has a negative and significant effect on volatility in all three regressions, as well as intensive margin in the fourth regression. However, extensive margin is also found to have negative effects, but this variable is insignificant. Intensive margin refers to the idea of exporting relatively balanced basket of goods. As discussed before, exporting few products might be harmful for countries in a case of a demand shock. Therefore, balancing the export basket among various goods reduces growth volatility, as expected. Extensive margin, on the other hand, refers to the idea of introducing new goods to current export basket. Although it is also expected to affect volatility negatively, the insignificance of this variable might come due to several reasons. For example, one of the significant weaknesses of these indices is that they do not separate whether new good introduced to export basket is a sophisticated one. Hence, new good that has been introduced to export basket might belong to a highly volatile sector, such as mining or agriculture. Assuming these goods have high demand volatility, due to their elasticities and supply technologies, this variable might turn out to be insignificant. It should also be noted that, the main variable of interest, export diversification, have a negative and significant impact on growth volatility. It should also be noted that both specification tests are valid in all five models.

In addition to diversification indices, trade openness and volatility of exchange rate is found to have positive effects on volatility, as consistent with the literature. As discussed before, the theoretical connections between these two variables looks controversial, therefore empirical results gains significant importance in analyzing this relationship. Similar to our empirical findings, many papers found a positive relationship (Bejan, 2006, Bugamelli and Paternò, 2011, Easterly, Islam and Stiglitz, 2000) between trade openness and growth volatility. In terms of exchange rate, similar to the findings of Anbarci, Hill and Kirmanoglu (2011), a positive relationship is found, which is consistent with expectations since volatility in exchange rates increases the risk among a country and creates a potential for investors to lose assets.

Moreover, according to the results, both foreign direct investment and investment rate lower growth volatility, mostly consistent with the literature. As Kose et al. (2009) states, FDI inflows do not rapidly change in contrast

with other financial openness measures, and therefore, these inflows are expected to have a negative impact on volatility. Similar to the findings of this paper, Ćorić and Pugh (2013) and Bejan (2006) have also found that FDI dampens growth volatility. In addition, an increase in the ratio of investment also reduces volatility. The investment decision is highly correlated to the risk perception of individuals. As Slade (2013) argues, an increase in uncertainty discourages individuals to invest due to possible risks and therefore countries with a higher investment rate are the ones where risks and uncertainty are relatively lower. Consistent with these explanations and the literature such as Aizenman and Marion (1999), and Blanchard and Simon (2001), a negative relationship is also found in this paper.

Conclusions and Policy Implications

Growth volatility has several negative impacts on an economy such as it increases the risk, negatively affects the expectations and thus lowers the investment, and also causes domestic funds to go abroad. Therefore, it is crucial to analyze the possible precautions against volatility. In this context, this study analyzed the mechanisms by which export diversification affects growth volatility. By using various diversification indices, a large number of countries, a wide time span and several control variables, the results showed that countries with a more diversified export baskets experience lower volatility. Among the diversification measures, intensive margin is found to be significant in both regressions (Random effects and system GMM), whereas extensive margin is found to be significant in random effects regression only. The combination of intensive and extensive margin, which is the export diversification index, is also found to be significant in both regressions. These results prove the importance of a diversified export basket in terms of growth volatility. In addition to export diversification, foreign direct investment and investment rate have also a negative impact on growth volatility.

The findings and the empirical analyses of this paper showed that diversification of exports is an important tool in terms of reducing volatility and having a stable economic atmosphere. These implications of diversification in terms of volatility in this study bring us to an important topic: How it is possible for countries to diversify their export baskets? There are several papers that have analyzed the determinants of export diversification such as Agosin, Alvarez and Bravo-Ortega (2012), Parteka and Tamberi (2013) and Amurgo-Pacheco and Pierola (2008), and their findings might point out important implications in terms of export diversification. Among these works, Amurgo-Pacheco and Pierola (2008)

distinct between intensive and extensive margins and suggests that the main export growth is mostly related with intensive margin. Therefore, they suggest that governments should channelize their resources mostly on export promotion activities, rather than innovation in exports, especially in developing countries. Moreover, reducing trade costs is also helpful for countries to diversify their exports. Parteka and Tamberi (2013) emphasizes the importance of trade barriers and eliminating these barriers could contribute significantly to countries to increase the diversification opportunities. However, Agosin et al. (2012) states that trade openness does not have an impact on export diversification, more importantly, it causes countries to specialize. Therefore, countries should act carefully in their relationship with foreign markets. Furthermore, Agosin et al. (2012) argues that human capital is an important factor in diversifying the exports, therefore investment in education and human capital could help countries to diversify their production and reduce growth volatility.

Apart from these studies, in recent years, Hausmann et al. (2014) discussed that economic development and growth is a path dependent process and countries can diversify their production by analyzing their current productive knowledge and resources. That is, countries cannot jump from producing simple goods, such as bread, to producing sophisticated goods, such as airplanes. The way countries should follow in diversification process is that they need to analyze current productive knowledge, or know how, and then by relying on their current status, they need to diversify into other products. Moreover, this process should also include jumping into higher productivity goods to exploit the advantages of these goods.

The results and implications of this paper provide valuable evidence, especially for countries that suffer a lot from growth volatility. The findings suggest that having a stable basket of exports, which mostly includes not primary products, but sophisticated goods, help countries to smooth the effects of growth volatility.

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Appendices

Appendix 1. Variables, Definitions and Sources

Variables	**Definition**	**Source**
Growth Volatility	Standard Deviation of GDP per capita growth	Author's construction using World Bank WDI
Trade Openness	The ratio of sum of exports plus imports to GDP	World Bank WDI
Volatility of Inflation	Standard Deviation of Inflation	Author's construction using World Bank WDI
Foreign Direct Investment	Foreign direct investment is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments.	World Bank WDI

Appendix 1. Variables, Definitions and Sources (contd.)

Variables	Definition	Source
Volatility of Exchange Rate	Standard Deviation of Exchange Rate	Author's construction using PWT 9.0
Export Diversification	A measure of export diversification constructed by Theil Index.	IMF, Export Diversification and Quality Database
Volatility of Government Consumption	Standard Deviation of Government Consumption	Author's construction using World Bank WDI
Investment	Investment consists of outlays on additions to the fixed assets and net changes in the level of inventories.	World Bank WDI
Intensive Margin	A measure of export diversification that reflects the concentration in export volumes constructed by Theil Index.	IMF, Export Diversification and Quality Database
Extensive Margin	A measure of export diversification that reflects the concentration in number of products constructed by Theil Index	IMF, Export Diversification and Quality Database

Appendix 2. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Volatility	658	2.95195	2.461327	.2247904	22.88643
Trade Open.	658	71.5844	51.90653	12.876	425.1579
Vol. Inflation	658	40.48895	353.0452	.1600521	5774.875
Vol. Exchange Rate	658	48.312	316.8661	0	6707.114
Export Div.	654	3.166962	1.175841	1.159366	6.139339
Vol. Gov. Cons	652	1.069782	1.079452	0	13.21506
Investment	657	23.03709	7.172189	3.958172	77.50387
Extensive Margin	655	.4566274	.5290813	-.0358914	2.706523
Intensive Margin	654	2.709636	.9439091	1.149468	5.753712

Appendix 3. Correlation Table

	Volatility	Trade Open.	Vol. Inflation	Vol. Exchange Rate	Export Div.	Vol. Gov. Cons.	Investment	Extensive Margin	Intensive Margin
Volatility	1.000								
Trade Open.	-0.015	1.000							
Vol. Inflation	0.0609	-0.056	1.000						
Vol. Exchange Rate	0.076	-0.049	-0.012	1.000					
Export Div.	0.295	-0.083	0.034	0.092	1.000				
Vol. Gov.Cons.	0.354	-0.034	0.210	-0.010	0.350	1.000			
Investment	-0.088	0.215	-0.060	0.084	-0.043	-0.133	1.000		
Extensive Margin	0.245	-0.117	0.048	0.067	0.619	0.271	-0.148	1.000	
Intensive Margin	0.230	-0.038	0.015	0.077	0.899	0.285	0.028	0.215	1.000

Appendix 4. List of Countries

Albania	Gabon	Niger
Algeria	Germany	Nigeria
Argentina	Ghana	Norway
Australia	Greece	Pakistan
Austria	Guatemala	Panama
Bahrain	Honduras	Paraguay
Bangladesh	Hong Kong SAR, China	Peru
Barbados	Iceland	Philippines
Belgium	India	Portugal
Benin	Indonesia	Rwanda
Bolivia	Iran, Islamic Rep.	Saudi Arabia
Botswana	Ireland	Senegal
Brazil	Israel	Sierra Leone
Bulgaria	Italy	Singapore
Burkina Faso	Jamaica	South Africa
Burundi	Japan	Spain
Cameroon	Jordan	Sri Lanka
Canada	Kenya	Sudan

Appendix 4. List of Countries (contd.)

Central African Republic	Korea, Rep.	Sweden
Chile	Madagascar	Switzerland
China	Malawi	Thailand
Colombia	Malaysia	Togo
Costa Rica	Mali	Tunisia
Cote d'Ivoire	Malta	Turkey
Cyprus	Mauritania	Uganda
Denmark	Mexico	United Kingdom
Dominican Republic	Morocco	United States
Ecuador	Mozambique	Uruguay
Egypt, Arab Rep.	Nepal	Venezuela, RB
El Salvador	Netherlands	Zimbabwe
Finland	New Zealand	
France	Nicaragua	

Appendix 5. Extensive and Intensive Margin

To calculate 3 different Theil diversification indices, IMF (2014) first groups goods as "Traditional," "New," or "Non-traded." Traditional goods have been exported since the beginning of the sample and non-traded goods are never exported for the whole sample. New goods, on the other hand, should not be exported for at least two years and then be exported by a country in at least two consecutive years. Following these explanations, IMF (2014) assigns a dummy for every product and then calculates the extensive margin as;

$EXM = \sum_n (M_n/M)\ (\mu k/\mu)\ \ln(\mu k/\mu)$,

Where n is a group and Mn represents total goods and $\mu k/\mu$ is the relative mean of exports in every group.

Intensive margin can be calculated as,

$INM = \sum_k (M_n/M)\ (\mu k/\mu)\ \{(1/Nk) \sum_{i \in Ik} (x_i/\mu_k) \ln(x_i/\mu_k)\}$

Where x shows export value.

Export diversification is calculated as the sum of these two measures.

Appendix 6. Hausman Test Results

	Model 1	Model 2	Model 3	Model 4	Model 5
Chi Square Stat.	5.80	9.12	8.61	11.18	9.71
Chi Square p value	0.3266	0.1670	0.2817	0.1310	0.2058
Conclusion	Random	Random	Random	Random	Random