

# THE RELATIONSHIP BETWEEN INTERNATIONAL TRADE AND EXCHANGE RATE VARIABILITY: A REVIEW STUDY

Huynh Thi Dieu Linh<sup>1\*</sup>

<sup>1</sup>*The University of Danang - University of Economics*

\*Corresponding author: linhhtd@due.edu.vn

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**Abstract** - The paper was conducted to survey and review the effects of exchange rate volatility on trade performance. Since the last review articles by McKenzie and Bahmani-Oskooe and Hegerty, the literature has experienced a surge in the number of articles. Many of the recent studies have been empirical in nature and these deserve specific attention. There is often more than one measure of volatility applied in a study, and some new measures of exchange rate volatility are introduced. Although there are relatively new econometric models being applied in this research area, the determinants of trade performance in recent studies are simple. In addition, the number of studies using bilateral trade data levels has increased over time. Although a large number of studies are reviewed in this study, existing empirical evidence on the trade effects of exchange rate volatility is generally inconclusive. These new contributions set the stage for this review.

**Key words** - Exchange rate volatility; international trade; review

## 1. Introduction

The main objective of this paper is to present a general review of empirical studies dealing with exchange rate volatility impacts on trade flows. There is a large amount of literature concerned with this research area accumulated over the last forty years. Two large and important reviews were implemented by McKenzie [1] and Bahmani-Oskooe and Hegerty [2]. These two articles reviewed literature about the relationship between exchange rate changes and international trade flows, and they concluded that there was no consensus on this research topic, due to different estimation techniques or varied assumptions leading to different results. Since the last review by Bahmani-Oskooe and Hegerty [2], the amount of literature about this research topic has increased considerably, with new volatility measures, new estimation methods and new models. Although executed in 2007, many of the main points from this review still apply to current conditions. Therefore, in this study, conclusions from this review will be indicated in detail.

## 2. Empirical studies with aggregate trade data level

Aggregate trade data level measures the trade performance between a country and all its trading partners or the rest of the world [2, 3]. Although time-series analysis became popular in investigating exchange rate volatility's impacts on trade flows, there are studies which have used panel data models to analyse this causal relationship. Similar to time series analysis, panel data estimation also showed mixed results. The following points are still relevant in the current literature although they were reviewed nearly ten years ago by Bahmani-Oskooe and Hegerty [2].

Bahmani-Oskooe and Hegerty [2] indicated that while

Ordinary Least Squares (OLS) was applied in early research to examine the relationship between the aggregate trade flows and exchange rate volatility, more recent and improved techniques have been employed in relatively newer papers, including methods of time-series and panel-data. The initial studies used basic regressions of trade performance on their elements. Although one may choose from different functional forms, the most basic structure is to model exports or imports as a function of income, relative prices, and exchange rate variability. However, early studies usually added more variables than recent papers. The authors also concluded that the widespread use of OLS has been replaced by modern and specific time-series analysis which has become the main econometric tool in this research area. These relatively new techniques help to avoid spurious regressions because they account for the integrating properties of the variables. The popular method to measure volatility is the Autoregressive Conditional Heteroskedastic (ARCH) model, and Vector Autoregressive (VAR), especially Vector Error Correction (VEC) models, are the most widely used to study impacts of exchange rate uncertainty on trade flows. "These methods, however, were not conclusive at first" [2].

The studies using the above-mentioned time series analysis [2] indicated mixed, but mostly harmful, impacts of exchange-rate variability on international trade performance. Similar to earlier studies, these models usually only specified trade flows as a function of income, relative prices, and volatility. In relatively newer research, these simple variables were also used with different measures of volatility to model trade performance in common time series analysis (either the Engle-Granger or the Johansen method of co-integration). Moreover, while early studies focus greatly on trade-volatility relationship of developed countries, developing countries began to be included in studies in recent papers [2]. This may be because the majority of international trade is from the developed world and there is a lack of data available in less-developed countries.

Schnabl [4] applied a generalised method of moment (GMM) and a generalised least squares (GLS) on a panel data estimation to examine the relationship between exchange rate instability and trade level of 41 small open economies at the European Monetary Union (EMU) periphery. Four measures of exchange rate uncertainty were used, namely annual exchange rate change, arithmetical average and standard deviation of per cent exchange rate changes, and their combination. A robust harmful effect of exchange rate instability on export

growth was indicated. Hondroyannis, et al. [5] also employed the GMM and other penal data estimation techniques to examine the relationship between exchange rate volatility and exports of 12 industrial economies. Three different methods of measuring volatility were used including moving standard deviation, Generalized Autoregressive Conditionally Heteroscedastic (GARCH) derived, and absolute percentage change in the exchange rate. They found little support for a negative relationship between the uncertainties in exchange rate and exports, no matter what exchange rate volatility measures were used.

Solakoglu, et al. [6] used panel data analysis to examine whether exchange rate variability affected exports at the firm level. Three estimation techniques were applied including GLS, fixed effects and random effects. They modelled export volume as a function of relative price, exchange rate variability, and a measure of economic activity in the importing country, such as GDP, CPI, and unit price index of exports. The standard deviation of the monthly exchange rate was employed to measure the exchange rate volatility. They concluded that exchange rate uncertainty does not play any significant role in influencing real exports.

Ozturk and Kalyoncu [7] applied the co-integration and error correction models to study the effects of exchange rate risks on export performance in six selected countries from 1980 to 2005. Real export values were determined by GDP, relative price, real exchange rate and volatility. The exchange rate volatility was calculated by the moving standard deviation of the growth of the real exchange rate. They found mixed results: while a volatile exchange rate hampered the export flows of South Korea, Pakistan, Poland and South Africa, it enhanced the exports of Turkey and Hungary. The findings also revealed that exchange rate instability had impacts on most countries in the short-run and on all selected countries in the long-run.

Aliyu [8] employed the Johansen procedure to investigate the exchange rate volatility effect on non-oil export flows in Nigeria. The author modelled non-oil exports as a function of terms of trade, index of openness, exchange rate variability in Naira and in USD. Exchange rate instability was measured by the standard deviation of each series of quarterly observations. Quarterly data from 1986 to 2006 was used; unit root tests and Johansen co-integration tests were applied. The results indicated that the Naira (Nigeria's currency) exchange rate uncertainty reduced the non-oil export performance in this country.

Olayungbo, et al. [9] used pooled ordinary least squares (OLS) and GMM approaches to analyse aggregate trade impacts of exchange rate variability in forty selected sub-Saharan African countries. Assessing trade volume as a function of GDP, real effective exchange rate (REER), population, distance, and exchange rate volatility calculated by the GARCH model, their findings indicated that exchange rate instability had a positive effect on international trade in selected countries over the period 1986-2005 in both econometric approaches. This result was opposite to that of a similar study done by Ghura and Grennes [10] who also investigated the trade – volatility

link of sub-Saharan Africa from 1972 to 1987.

Serenis [11] applied a multivariate co-integration error correction model to examine the effects of exchange rate changes on exports in Bolivia, Colombia, and Guyana from 1973 to 2010. Export quantity was specified as a function of relative price, GDP, volatility and seasonal dummies. The authors used two different exchange rate volatility measures: the first contained the standard deviation of the moving average of the logarithm of the real effective exchange rate, and the second contained a dummy variable capturing only high and low values of the exchange rate. The findings indicated that there was an inverse relationship between exchange rate uncertainty and export flows in three selected South American countries. The results also revealed that while exchange rate volatility measured by the first method had only a small effect on exports, trade impacts of volatility determined by the second method were stronger.

Poon and Hooy [12] tested the relationship between exchange rate uncertainty and trade performance in the Organisation of the Islamic Conference (OIC) countries between 1995 and 2008. The authors employed panel regression and controlled for random country and time effects. In this study, export and import series were determined by GDP, relative price, nominal exchange rate, exchange rate volatility, currency regime adopted by OIC countries, and other dummy variables. Exchange rate volatility was measured by the standard deviation of the monthly nominal exchange rate. They concluded that while exchange rate change had harmful effects on exports of small magnitude, its impacts on imports were positive. This finding about exports was in line with that by Hooper and Kohlhaagen [13] and Tenreyro [14].

Jiang [15] studied export flows impact of the RMB (currency of China) exchange rate variability in China from 1981 to 2012. Like other studies applying co-integration procedure for analysis, this paper employed the Engle-Granger test, unit root test, and the ADF (Augmented Dickey-Fuller) stationary test. The author concluded that there was a long-run stable relationship between exchange rate changes and international trade in China, and this was a positive relationship as a volatile currency could increase trade performance.

Senadza and Diaba [16] examined relationships between exchange rate variability and trade performance of eleven Sub-Saharan African economies over the period 1993 to 2014. The pooled mean-group estimator of dynamic heterogeneous panels technique to data was employed. Their findings indicated that there was no significant impact of exchange rate variability on imports. In the case of exports, however, the authors found a harmful influence of uncertainty of exchange rate in the short-run, consistent with the above view, but a positive effect in the long-run.

Upadhyaya, et al. [17] investigated the relationship between exchange rate instability and foreign trade for the ASEAN-5 group, which includes Thailand, Malaysia, Singapore, Indonesia and the Philippines. They modelled export volume as a function of domestic output, world

output, terms of trade and exchange rate volatility as explanatory variables. Exchange rate volatility is measured by GARCH model in real effective rate. The authors concluded that changes in exchange rate has a negative impact on the export performance of the ASEAN-5. The study also advised that governments should employ appropriate macroeconomic policies to minimize the volatility of their respective currencies. In particular, given that the ASEAN-5 countries have adopted floating exchange rate systems, their corresponding central banks can intervene in the market in order to minimize exchange rate volatility.

### 3. Empirical studies with bilateral trade data level

Although studies of trade-volatility relationships at aggregate trade data level indicated a significant conclusion that mostly indicated trade performance is discouraged by exchange rate uncertainty, there was still a probability that noteworthy results may be hidden. This potential issue may be because bilateral trade performance of a country with different trading partners delivered positive and negative impacts that offset one another at the aggregate trade data level. Therefore, analysis at bilateral trade data level may produce more accurate results as this can avoid the above problem. Although newer and more complex empirical methods are being used in bilateral studies, the results are still consistent with aggregate research, as they show mixed conclusions. Compared to aggregate trade data level, on the one hand bilateral studies are similar to when the recent papers employed fewer variables than the earlier counterparts; on the other hand, they are different from when bilateral studies included an extensive variety of explanatory variables. In addition, there are some studies that estimated growth rate rather than levels of independent variables in order to avoid non-stationary problems in time-series analysis. While some other bilateral models employed third-country effects to estimate both direct and indirect impacts, recent models in this research area skipped the third-country risk. Moreover, a few of the newer studies also considered proximity between a country and its trading partners such as border configurations, languages and currency rather than only focusing on purely economic variables as in the early papers. As with those studies they used aggregate trade data level, co-integration and error-correction models which are also the most popular estimation methods applied in bilateral studies. This methodology revealed not only the short run-effects but also the long-run effects of one variable on the other. However, conclusions resulting from these methods are mixed [2].

Baak, et al. [18] tested the sensitivity of export volumes to the U.S and Japan to exchange rate uncertainty by applying a co-integration and error correction model on four selected East Asian countries, using quarterly data from 1981 to 2004. Real exports were determined by real GDP, real exchange rate and volatility. Exchange rate volatility was measured by the standard deviation of the logarithm of the monthly real exchange rate within a year. Their findings were in line with that by Baak [19] as exchange rate instability has deteriorating impacts on exports except for the case of exports from Hong Kong to Japan.

Tenreyro [14] used Poisson pseudo-maximum likelihood-instrumental variable estimator (PPML-IV) to address four problems in previous studies regarding the relationship of nominal exchange rate volatility and trade. Export performance was specified as a function of per capita GDP, distance, population, area, volatility, and dummies. The author applied the standard deviation of the logarithm of the monthly bilateral exchange rate to a proxy for volatility. Various methods of estimation were employed on a sample of many countries using yearly data from 1970 to 1997. She concluded that exchange rate instability did not play any significant role on trade, regardless whether PPML-IV, PML or OLS was used.

Hayakawa and Kimura [20] applied a gravity model to investigate the impact of exchange rate instability on the trade of sixty economies, especially focusing on East Asia. They used OLS estimation using annual data from between 1992 and 2005. Export value was modelled as a function of GDP, distance, languages, volatility and a dummy variable. Exchange rate volatility was measured by the standard deviation of the first difference of the monthly natural logarithm of bilateral real exchange rates in the five year preceding period. The result indicated that exchange rate risk had a deteriorating impact on trade, especially for the intermediate goods trade, and this negative effect was more serious in intra-East Asian trade than in other areas.

Baum and Caglayan [21] employed distributed lag structure to examine the effect on exports of exchange rate variability in thirteen selected countries. Monthly data of bilateral trade from 1980 to 1998 was analysed, and a bivariate GARCH model was applied to measure real exchange rate volatility. They found that while the relationship between foreign exchange changes and exports was insignificant, a rise in exchange rate uncertainty resulted in a significant volatility of bilateral trade flows.

Chit, et al. [22] investigated the relationship between bilateral real exchange rates and real exports of five emerging East Asian economies among themselves and to thirteen developed nations using quarterly data over the period of 1982-2006. The research used generalised gravity methods to model long run export demand. They applied panel unit root and co-integration tests, as well as various estimation methods such as fixed effects, random effects, GMM, and G2SLS estimations. In addition, the standard deviation, the moving average standard deviation and the GARCH model were employed to measure exchange rate volatility. They concluded that the exchange rate volatility had robust harmful effects on exports no matter what estimation techniques and exchange rate instability measures were chosen.

Fogarasi [23] used a gravity model and panel data to investigate the influence of nominal exchange rate instability on the agriculture exports of Hungary to eighty-one trading partners from 1999 to 2008. Export flows were modelled as a function of per capita GDP, population, distance, tariff, and volatility. The estimate of volatility used was the moving standard deviation of the first differences in the monthly nominal exchange rate over the forty-eight months. He found that nominal exchange rate

volatility has a positive effect on the agricultural trade of Hungary over the period. This finding was similar to that by Erdal, et al. [24] who concluded that exchange rate uncertainty affected Turkish agricultural exports in a positive way although they used different methods of estimation and datasets.

Yusoff and Sabit [25] employed GMM to study the relationship between exchange rate changes and bilateral trade between China and ASEAN countries. Export performance was determined by income, real exchange rate and volatility. The moving average of the standard deviation of the nominal exchange rate was used as a proxy for volatility. The panel unit root test was applied to test for the existence of unit root in the panel data series before applying GMM. The result from GMM estimates showed that exchange rate risk caused negative effects on exports from ASEAN members to China.

Sharma and Pal [26] tested the sensitivity of India's imports of 73 commodities to exchange rate variability over the period from April 2013 to October 2016. The authors apply a pooled mean group estimator for simultaneously assessing long- and short-run association between nominal exchange rate volatility and import volume. Exchange rate volatility was measured by Generalized autoregressive conditional heteroscedasticity model with monthly data. The findings suggest that exchange rate instability has deteriorating impacts on most India's imported commodities, either in the short-run or long-run. The results also indicate that imports in the agricultural and allied sector are found to be relatively more sensitive to exchange rate volatility as compared to the manufacturing sector.

Sugiharti, et al. [27] apply both ARDL and NARDL models to estimate the effects of exchange rate volatility on Indonesia's primary export commodities to its top five export destination countries. They use monthly data covering from 2006 to 2018 and a GARCH model to obtain an estimated value of exchange rate volatility. The estimated results suggest that exchange rate volatility has a significant impact on exports of 4 commodities to India, Japan, South Korea, and the United States, both in short or long-run, while it only affects plastics goods exports to China. The findings also confirm that Indonesian main exported commodities are negatively affected by exchange rate uncertainty.

#### 4. Concluding Remarks

This study reviews the relationship between trade and exchange rate volatility with different measures for exchange rate volatility, various models and estimation methods used in the investigation of this relationship. In this review, the empirical studies are classified into two categories. The first includes studies that employed aggregate trade data level between a country and the rest of the world. The second category includes researches that applied bilateral trade data level between one country and its trading partners.

Firstly, there is often more than one measure of volatility applied in a study, and some new measures of

exchange rate volatility are introduced beside the relatively old measures still being used. By using different measures of exchange rate variability, authors can examine whether using different measures give different results. Among the measures reviewed, the two most popularly used measures are moving standard deviation and conditional variance from ARCH/GARCH models. They are followed by the within-period standard deviation of exchange rate (or its change or percentage change or their logarithms). Next comes a group of four types of measures, including those based on absolute/squared/percentage change of the exchange rate or its change. All the other measures appear separately in individual research. Although applying different measures of exchange rate volatility to check the robustness of the results, it seems that there is no optimal measure of instability; hence it is likely that authors choose one or two measures and focus on the results given by the measures used.

While the most popular measures are relatively old, some new measures are still being introduced into the field. Solakoglu [28]; Cotter and Bredin [29]; Hayakawa and Kimura [30] all introduced new measures. Solakoglu [28] calculated the conditional variance from an autoregressive model including a recursive variance or non-parametric estimation. Cotter and Bredin [29] introduced an aggregated absolute/squared exchange rate change, taken from any given month with some daily intervals. Hayakawa and Kimura [30] looked at the problem of unexpected exchange rate volatility, including it as the absolute residual of a regression model. They used the within-period standard deviation of the bilateral exchange rate as the dependent variable. The independent variables included the five-period-ahead country risk for each of two countries. A new instrument variable is also introduced by Tenreyro [14], based on the probability that two countries will use the same anchor to stabilise their currencies. It is expected that many more new measures and refining of existing measures will appear in future studies.

Secondly, although there are relatively new econometric models being applied in this research area, the determinants of trade performance in recent studies are simple. While co-integration analysis, VAR and especially ECM are still the most popular techniques used for the purpose of avoiding spurious results, many studies employ the techniques based on panel data. They include panel unit tests, fixed effects and random effects estimation which can take advantage of the unobservable cross-sectional effects. Instrumental variable and GMM estimation are also frequently used in order to avoid the simultaneity problem and endogeneity problem respectively. In terms of trade determinants, compared to early research, the relatively newer research incorporates simple determinants of trade flows rather than focusing on specification and certain modifications. Authors have recently modelled trade flows as a function of income, relative price and exchange rate instability. It is therefore expected that more and more new estimation methods will emerge in this research area in the future.

In addition, the number of studies using bilateral trade

data levels has increased over time. This is because the use of disaggregate trade data is assumed to avoid aggregation bias, an error associated with aggregate trade data may occur when offsetting positive and negative impacts of bilateral trade with different trading partners that cancelled each other. Also, more studies use disaggregate trade data levels to help discover specific effects that may be hidden in existing research.

Although a large number of studies are reviewed in this study, existing empirical evidence on the trade effects of exchange rate volatility is generally inconclusive. While some research indicated a harmful relationship between exchange rate variability and trade, others claim the opposite. Therefore, there exists an ambiguity about the relationship between exchange rate volatility and foreign trade performance which requires more study, perhaps using a greater variety of different methods and data sets.

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## REFERENCES

- [1] M. McKenzie, "The impact of exchange rate volatility on international trade flows", *Journal of Economic Surveys*, vol. 13, pp. 71-106, 1999.
- [2] M. Bahmani-Oskooe and S. W. Hegerty, "Exchange rate volatility and trade flows: a review article", *Journal of Economic Studies*, vol. 34, pp. 211-255, 2007.
- [3] M. Bahmani-Oskooe and M. Kovyryalova, "Impact of exchange rate uncertainty on trade flows: Evidence from commodity trade between the United States and the United Kingdom", *The World Economy*, vol. 31, pp. 1097-1128, 2008.
- [4] G. Schnabl, "Exchange rate volatility and growth in small open economies at the EMU periphery", *Economic Systems*, vol. 32 (2008), pp. 70-91, 2008.
- [5] G. Hondroyannis, P. A. V. B. Swamy, G. Tavlas, and M. Ulan, "Some further evidence on exchange rate volatility and exports", *Review of World Economics*, vol. 144, pp. 151-179, 2008.
- [6] M. N. Solakoglu, E. G. Solakoglu, and T. Demirağ, "Exchange rate volatility and exports: A firm-level analysis", *Applied Economics*, vol. 40, pp. 921-929, 2008.
- [7] I. Ozturk and H. Kalyoncu, "Exchange rate volatility and trade: an empirical investigation from cross-country comparison", *African Development Review*, vol. 21, pp. 499-513, 2009.
- [8] S. U. R. Aliyu, "Exchange rate volatility and export trade in Nigeria: an empirical investigation", *Applied Financial Economics*, vol. 20, pp. 1071-1084, 2010.
- [9] D. Olayungbo, O. Yinisa, and A. Akinlo, "Effects of exchange rate volatility on trade in some selected Sub-Saharan African Countries", *Modern Economy*, vol. 2011, pp. 538-545, 2011.
- [10] D. Ghura and T. J. Grennes, "The real exchange rate and macroeconomic performance in sub-Saharan Africa", *Journal of Development Economics*, vol. 43, pp. 155-174, 1993.
- [11] D. Serenis, "Does exchange rate volatility hinder export flows for South American countries?", *Applied Economics Letters*, vol. 20, pp. 436-439, 2012.
- [12] W.-C. Poon and C.-W. Hooy, "Exchange rate volatility, exchange rate regime and trade in OIC countries", *Journal of Asia-Pacific Business*, vol. 14, pp. 182-201, 2013.
- [13] P. Hooper and S. W. Kohlhagen, "The effects of exchange rate uncertainty on the prices and volume of international trade", *Journal of International Economics*, vol. 8, pp. 483-511, 1978.
- [14] S. Tenreyro, "On the trade impact of nominal exchange rate volatility", *Journal of Development Economics*, vol. 82, pp. 485-508, 2007.
- [15] W. Jiang, "The effect of RMB exchange rate volatility on import and export trade in China", *International Journal of Academic Research in Business and Social Sciences*, vol. 4, pp. 615-625, 2014.
- [16] B. Senadza and D. D. Diaba, "Effect of exchange rate volatility on trade in Sub-Saharan Africa", *Journal of African Trade*, vol. 4, pp. 20-36, 2017.
- [17] K. P. Upadhyaya, D. Dhakal, and F. G. Mixon Jr, "Exchange Rate Volatility and Exports: Some New Estimates from the Asean-5", *The Journal of Developing Areas*, vol. 54, pp. 64-73, 2020.
- [18] S. J. Baak, M. A. Al-Mahmood, and S. Vixathep, "Exchange rate volatility and exports from East Asian countries to Japan and the USA", *Applied Economics*, vol. 39, pp. 947-959, 2007.
- [19] S. J. Baak, "Exchange rate volatility and trade among the Asia Pacific countries", *Econometric Society*, vol. 724, pp. 93-116, 2004.
- [20] K. Hayakawa and F. Kimura, "The effect of exchange rate volatility on international trade in East Asia", *Journal of the Japanese and International Economics*, vol. 23, pp. 395-406, 2009.
- [21] C. F. Baum and M. Caglayan, "On the sensitivity of the volume and volatility of bilateral trade flows to exchange rate uncertainty", *Journal of International Money and Finance*, vol. 29, pp. 79-93, 2010.
- [22] M. M. Chit, M. Rizov, and D. Willenbockel, "Exchange rate volatility and exports: New empirical evidence from the emerging East Asian Economies", *The World Economy*, vol. 33, pp. 239-263, 2010.
- [23] J. Fogarasi, "The Effect of Exchange Rate Volatility upon Foreign Trade of Hungarian Agricultural Products", Research Institute of Agriculture Economics, Committee on Agricultural Economics, Hungarian Academy of Sciences, Budapest 2011.
- [24] G. Erdal, H. Erdal, and K. Esengun, "The effect of exchange rate volatility on trade: evidence from Turkish agricultural trade", *Applied Economics Letters*, vol. 19, pp. 297-303, 2012.
- [25] M. B. Yusoff and A. H. Sabit, "The effects of exchange rate volatility on Asean-china Bilateral Exports", *Journal of Economics, Business and Management*, vol. 3, pp. 479-482, 2015.
- [26] C. Sharma and D. Pal, "Does Exchange Rate Volatility Dampen Imports? Commodity-Level Evidence From India", *International Economic Journal*, vol. 33, pp. 696-718, 2019.
- [27] L. Sugiharti, M. A. Esquivias, and B. Setyorani, "The impact of exchange rate volatility on Indonesia's top exports to the five main export markets", *Heliyon*, vol. 6, p. e03141, 2020.
- [28] M. N. Solakoglu, "Exchange rate volatility and real exports: A sensitivity analysis", *Journal of Economic and Social Research*, vol. 7, pp. 1-30, 2005.
- [29] J. Cotter and D. Bredin, "Volatility and Irish exports", *Economic Enquiry*, vol. 46, pp. 540-560, 2008.
- [30] K. Hayakawa and F. Kimura, "The effect of exchange rate volatility on international trade: The implication for production networks in East Asia", 2008.