THE EFFECTS OF ECONOMIC POLICY UNCERTAINTY ON EXPORT: A GRAVITY MODEL APPROACH*

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Abstract

We use a gravity model that accounts for multilateral resistance terms (MRT) to examine the impact of economic policy uncertainty (EPU) on a country's export. Empirical analysis based on data from 20 countries that traded with one another (creating 380 pairs of importing-exporting countries) over the period 2002–2016 shows that the export of a country is negatively associated with the EPU of its corresponding importing country, but not with the EPU of the exporting country itself. This effect remains qualitatively unchanged regardless whether the exporting country is a developed or a developing economy and whether it focuses on commodities or non-commodities, but the effect is smaller for commodity exporters. Furthermore, the observed negative effect is more pronounced when the unemployment rate in the importing country is high, whilst GDP growth in the importing country does not influence the focal relationship. These findings advance the literature by highlighting the importance of accounting for the differential effects of policy uncertainty in importing and exporting countries and of taking into consideration country and product heterogeneity when analysing the effects of EPU on exports.

Keywords: Economic policy uncertainty, international trade, importing, exporting
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1. Introduction

The role of economic policy uncertainty (EPU) in influencing global trade flows has emerged as one of the core research topics among trade scholars. The topic has assumed

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particular relevance in the wake of the sluggish global trade growth after the financial crisis in 2008 and the subsequent large contraction (Boz *et al.*, 2015). Standard trade models suggest that cyclical and structural factors, rising protectionism, and the ineffectiveness of currency depreciations in promoting export account for this trade slowdown (Handley and Limão, 2015; Taglioni and Zavacka, 2013; Tam, 2018). Nevertheless, the financial crisis has also revamped a growing debate about the effects of EPU on economic activity. In this paper, we develop and test the premise that EPU – defined as a lack of clarity about future macroeconomic policies, such as taxes, regulatory, fiscal and monetary policies (Baker *et al.*, 2016) – affects a country's export.

Previous work has explored how policy uncertainty depresses industrial production (Wind and Grabska 2016), output and employment (Stock and Watson, 2012) and economic recovery (Caggiano *et al.*, 2017). A key mechanism underlying this negative effect is that firms tend to delay decisions about investments that are irreversible and incur significant sunk costs during periods of elevated uncertainty (Bernanke, 1983; Dixit, 1989; Roberts and Tybout, 1997). International trade literature has focused on the effect of trade policy uncertainty (TPU) – defined as the degree of flexibility that both multilateral and preferential trade agreements provide (Osnago *et al.*, 2005) – on trade flows. Studies show that TPU discourages export (Handley, 2014; Handley and Limão, 2017), import (Imbruno, 2018) as well as firms' entry on foreign markets (Handley and Limão, 2015).

While these studies have provided valuable insights regarding the association between policy uncertainty and trade flows, the assumptions and findings that have informed the subject largely focus on the role of EPU in a single country. As a result, the issue of whether the export of a country is influenced by the EPU of its corresponding importing country has been under-studied. This is surprising because uncertainty shocks in one country may spill over to others (Han *et al.*, 2016; Yin and Han, 2014) and therefore affect their trade performance (Osnago *et al.*, 2005) through global value chain and trade linkages (Tam, 2018). Furthermore, although it is well acknowledged that EPU has a negative relation to a wide array of macroeconomic factors, such as GDP growth, industrial production, employment and economic sentiment, little is known about whether and how the effects of EPU on trade flows vary depending on the macroeconomic conditions of the countries under investigation.

This study seeks to address these gaps. It contributes to the literature in several notable ways. Firstly, we build on the global trade models of previous studies (Anderson, 2011; Anderson and van Wincoop, 2003; Bussière *et al.*, 2012) and consider whether the export of a country is influenced not only by EPU in the country but also by EPU in the corresponding importing countries. The role of EPU in importing countries deserves particular attention because sunk costs and opportunity costs associated with exporting

may lead firms to choose countries with a lower level of EPU to export. Our approach of considering EPU in both importing and exporting countries is also justifiable because import and export in related trading partners' countries co-move (Bussière *et al.*, 2012) and global value chains transmit uncertainty across borders (Osnago *et al.*, 2005). We provide theoretical and empirical evidence that complements prior studies, which focus largely on the effects of EPU on export in a single country only (*e.g.*, Baker *et al.*, 2016).

Secondly, we investigate how macroeconomic conditions, such as unemployment rate and GDP growth in importing and/or exporting countries, reinforce or weaken the effects of EPU. Previous studies typically considered how uncertainty influences key macroeconomic variables (Caggiano *et al.*, 2017; Leduc and Liu, 2016; Stock and Watson, 2012; Wind and Grabska, 2016). For example, Leduc and Liu (2016) showed that high uncertainty increases unemployment. We depart from this approach and consider how certain macroeconomic variables join policy uncertainty to influence a country's export. We also examine how the focal effect varies depending whether the exporting country is a developed or developing economy and whether it focuses on commodities or non-commodities. In this way we extend previous studies that implicitly assumed a deterministic role of uncertainty (Handley, 2014) regardless of macroeconomic economic conditions in the trading (importing and exporting) countries, and we also advance the literature by taking into consideration country and product heterogeneity, which has been largely ignored in the prior research into the effects of EPU on exports.

Finally, this study focuses on the overall level of economic policy uncertainty and its aggregate effects on trade flows. We do so by relying on the EPU index constructed by Baker *et al.* (2016), which uses newspaper coverage frequency to indicate the nature and intensity of economic policy uncertainty. This index can "track well major political developments and shocks in the world, and mattered for economic outcomes" (Tam, 2018) and is broader than TPU adopted in the previous trade studies (Handley and Limão, 2015; Imbruno, 2018) and other uncertainty indices proposed in the literature (Jurado *et al.*, 2015; Leduc and Liu, 2016). Our study therefore enriches prior findings that rely on TPU to examine the effects of policy uncertainty on trade flows (Handley, 2014; Handley and Limão, 2015; Imbruno, 2018).

We employ a dataset that comprises 20 countries that were exporting-importing partners to one another over the period 2002–2016 to test our theoretical predictions. Our findings show that a country's export is negatively associated with the EPU of its partner (importing) country, but interestingly it is not affected by the EPU of the exporting country itself. Furthermore, we find that the observed negative effect of EPU is smaller for commodity exporters and is stronger when the unemployment rate in the importing country is high. These findings enrich the literature on the relationship between policy uncertainty and trade flows and carry important policy implications.

The remainder of the paper is organized as follows: Section 2 reviews the literature. Section 3 discusses the econometric methods and data. Section 4 presents the empirical results. The final section discusses the findings and concludes.

2. Literature Review

The theoretical literature on the effects of policy uncertainty on trade flows has been well established (Dixit, 1989; Handley, 2014; Handley and Limão, 2017; Tam 2018), but has generated conflicting predictions. The majority of trade scholars contend that EPU depresses trade flows. Firstly, from the "real option" perspective, high irreversibility increases the real option value of investment during periods of elevated uncertainty (Dixit and Pindyck, 1994; McDonald and Siegel, 1986). When investment costs associated with trade activities are sunk or at least partially irreversible, the likelihood of "wait and see" increases with rising policy uncertainty. In such situations, entrepreneurs will delay investments for market entry and reduce trade-related activities (Dixit, 1989; Krol, 2018). In this vein, Handley and Limão (2015) build a sunk-cost-based dynamic model and show that trade policy uncertainty limits firms' entry on export markets. According to the same logic, high policy uncertainty may also lead consumers to adopt an "option to defer" strategy and delay purchases of goods, hampering trade flows (Dixit, 1989; Tam, 2018).

Secondly, from the "expectation" perspective, EPU may depress trade flows by influencing entrepreneurs' expectations. A rise in EPU may trigger pessimistic expectations from entrepreneurs about the future market demand of their trading partner countries (Nguyen, 2012). This in turn may induce them to adjust their trade plans and reduce trade-related investments. In a similar vein, Tam (2018) suggested that policy uncertainty influences expectations about changes in exchange rate, which, in turn, lead to trade forecast errors (Beckmann and Czudaj, 2017). A rise in policy uncertainty may also strengthen entrepreneurs' risk expectations. For instance, volatility in formulation and implementation of policies in a country may increase the risk expectations of the entrepreneurs in its trading partner countries. In certain cases, such fluctuations can lead entrepreneurs to form "adaptive" expectations about uncertainty, believing that policy risk will only increase in the future. This in turn will discourage trade-related investment and impede trade growth.

However, a smaller number of scholars also argue that uncertainty may stimulate investment and therefore expand trade activity. The "growth option" theory, for example, posits that uncertainty is positively associated with investment (Bar-Ilan and Strange, 1996; Paddock *et al.*, 1988) and therefore encourages trade flows. In this vein, the "Qi-Hartman-Abel" theory suggests that risk-averse firms have flexibility to change

production output in line with elevated uncertainty (Abel, 1983; Hartman, 1972; Oi, 1961) or take more risk and increase investment in order to compensate for the loss caused by increased uncertainty (Arellano *et al.*, 2010; Gilchrist *et al.*, 2014). This in turn may produce a trade-enhancing effect. The two opposing views imply that the effects of policy uncertainty on trade flows may be uncertain and are influenced by the trade-off between risk aversion and flexibility (Limão and Maggi, 2015).

Despite the contradictory theoretical predictions, prior empirical work has provided evidence that largely supports the negative causal link between policy uncertainty and trade flows (Handley and Limão, 2017; Tam, 2018). Imbruno (2018), for example, examined how TPU influences a country's importing behaviour. The study finds that Chinese imports increased in response to the tariff binding related to China's accession to the WTO in 2002, which reduced the policy uncertainty. Other studies have investigated the link between policy uncertainty and export. Handley (2014) finds that TPU depresses exporters' entry on new markets and makes them less responsive to tariff reductions. Handley and Limão (2015) provide similar evidence, showing that Portugal's accession to the European Community in 1986 removed policy uncertainty about future market prospect, which led to increased exports by Portuguese firms to the European market. Handley and Limão (2017) show that China's WTO accession in 2002 significantly contributed to the country's export to the US because of the reduced trade policy uncertainty. Tam (2018) provided evidence that policy uncertainty in China and the United States influence global trade flows (export and import) through trade linkages and global value chain linkages.

Overall, previous studies have provided valuable theoretical and empirical insights regarding the effects of EPU on trade flows. Despite the multitude of theoretical foundations, empirical work has largely focused on the effects of policy uncertainty on export in a single country and has neglected the role of policy uncertainty in trading partner countries, as well as the macroeconomic conditions under which the effects of uncertainty on trade flows may be large, small or negligible. The current study aims to address these research gaps and improve our understanding of the effects of policy uncertainty on trade flows. The next section presents the methodology.

3. Methodology

3.1 Models

We follow previous studies (Anderson, 2011; Anderson and van Wincoop, 2003; Bergstrand, 1985; Janda *et al.*, 2013) and set up a model in a gravity form to examine the relationship between EPU and export. The gravity model suits our study particularly because it provides a good fit for bilateral trade flows (Tinbergen, 1962). We followed

Anderson and van Wincoop (2003) and included multilateral-resistance terms (MRT) in our model. According to Anderson and van Wincoop (2003), including MRT in a gravity model can account for "bilateral resistance", such as the barriers to trade between trade partners including physical remoteness from a market, tariff barriers or other trade-related costs. We start by setting up a gravity model as follows:

$$\ln(export_{ij,t}) = \alpha_0 + \beta_1 \ln(gdp_{i,t}) + \beta_2 \ln(gdp_{j,t}) + \beta_3 \ln(rex_{ij,t-1}) + \beta_4 fta_{ij,t} + \beta_5 currency_{ij} + \beta_6 \ln(Dis_{ij}) + \beta_7 border_{ij} + \beta_8 language_{ij} + \beta_9 colony_{ij} + MRT_{ij,t} + \varepsilon_{ij,t} \quad (1)$$

Where $export_{ij,t}$ denotes the amount of export from the country *i* to the country *j*. The variables on the right side of the equation are those that, according to previous studies (Anderson, 2011; Anderson and van Wincoop, 2003; Janda *et al.*, 2013; Silva and Tenreyro, 2006), are important antecedents of trade flows. Specifically, $\ln(gdp_{i,t})$ and $\ln(gdp_{j,t})$ are the real GDP of the exporting and importing countries, respectively, $\ln(rex_{i,t-1})$ is real exchange rate, defined as $rex_{ij,t-1} = ex_{ij,t-1} * (cpi_{j,t-1} / cpi_{i,t-1})$, where $ex_{i,t-1}$ is nominal exchange rate, calculated as the quarterly average of the exchange rate between a pair of exporting-importing countries, whilst $cpi_{i,t-1}$ and $cpi_{j,t-1}$ are the CPI of exporting and importing countries, respectively. $fta_{ij,t}$ is a dummy for free trade agreement and it equals 1 if a pair of exporting-importing countries have a free trade agreement, $currency_{ij}$ is a dummy for currency and equals 1 if a pair of exporting-importing countries use the same currency. $Dist_{ij}$ is calculated using the great circle formula, which uses latitudes and longitudes of the most important cities/agglomerations (in terms of population) between a pair of exporting-importing countries, is a dummy for border and it equals 1 if a pair of exporting-importing countries share a border, $language_{ij}$ is a dummy for language and equals 1 if a pair of exporting-importing countries use the same language[1], $colony_{ij}$ is a dummy for colonial history and equals 1 if a pair of exporting-importing countries had a colonial relationship in history. Finally, MRT_{ij} refers to multilateral-resistance factors.

As the paper focuses on the role of EPU on trade flows, we add the EPU variable into model (1):

$$\ln(export_{ij,t}) = \alpha_0 + \alpha_1 \ln(epu_{i,t-1}) + \alpha_2 \ln(epu_{j,t-1}) + \psi controls + MRT_{ij.t} + \varepsilon_{ij,t} \quad (2)$$

where $epu_{i,t}$ and $epu_{j,t}$ represent economic policy uncertainty of exporting and importing countries, respectively. *Controls* include all the control variables, as shown in Equation 1, as well as exporter-, importer-, pair- and year-fixed effects. α_1 and α_2 can be interpreted as the elasticity of EPU impact (including exporting and importing countries) on trade flows.

1 According to the data source that this study uses (CEPII; see Section 3.3), common language is defined as an official or national language that is spoken by at least 20% of the population of the country.

We follow previous studies (*e.g.*, Gulen and Ion, 2015; Tam, 2018) and use the economic uncertainty index constructed by Baker *et al.* (2016), which is available at *http://www.policyuncertainty.com*, to define the EPU variable. Since 1985, this newspaper-based index has been built by counting the number of articles containing terms related to the economy (E), policy (P), and uncertainty (U). Specifically, it covers areas, such as fiscal policy, monetary policy, national security, governance, sovereign debt, currency crisis, welfare and trade policy, allowing us to observe the nature and magnitude of economic policy uncertainty in a country (Nguyen *et al.*, 2018). We lagged the two EPU variables by one quarter because their effects take some time to materialize. The use of this lag structure also helps us to reduce the concerns of endogeneity.

We further suggest that the effects of EPU on export may vary depending upon the macroeconomic conditions in the importing and/or exporting countries. This moderation effect of macroeconomic conditions may occur via two channels. The first is the "expectation" channel. Persistence of poor macroeconomic conditions may trigger pessimistic expectations from entrepreneurs about future market demands and price and induce them to delay decisions about trade-related investments. This in turn will further increase uncertainty and strengthen its negative effect on trade flows. The second is the trade protection channel. Trade protection policy is typically countercyclical. Governments in many countries tend to respond to high unemployment rate and decreased GDP growth by erecting tariff and non-tariff barriers. This, similarly to the "expectation" channel, will elevate the level of uncertainty and reinforce its negative effect on trade flows.

Building on this reasoning, we consider how two of the most important macroeconomic variables, namely unemployment rate and GDP growth in the importing and exporting countries, influence the effects of EPU on trade flows. In a simple Okun-law type relation GDP and unemployment could be correlated. However, there can be a cyclical lag with respect to the effect of employment relative to that of GDP over a business cycle. Unemployment can also be considered a measure of economic potential in the long run that GDP cannot capture. We therefore consider its effect by implementing the following model specifications:

$$\begin{aligned}\ln(export_{ij,t}) = {} & \alpha + \beta_0 \ln(epu_{j,t-1}) + \beta_1 unemp_{j,t-1} + \beta_2 \ln(epu_{j,t-1}) \times unemp_{j,t-1} \\ & \delta_0 \ln(epu_{i,t-1}) + \delta_1 unemp_{i,t-1} + \delta_2 \ln(epu_{i,t-1}) \times unemp_{i,t-1} + \psi controls + MRT_{ij.t} + \varepsilon_{ijt}\end{aligned} \tag{3}$$

$$\begin{aligned}\ln(export_{ij,t}) = {} & \alpha + \varphi_0 \ln(epu_{j,t-1}) + \varphi_1 gdpg_{j,t-1} + \varphi_2 \ln(epu_{j,t-1}) \times gdpg_{j,t-1} \\ & \lambda_0 \ln(epu_{i,t-1}) + + \lambda_1 gdpg_{i,t-1} + \lambda_2 \ln(epu_{i,t-1}) \times gdpg_{i,t-1} + \psi controls + MRT_{ij.t} + \varepsilon_{ijt}\end{aligned} \tag{4}$$

where $unemp_{j,t-1}$ and $gdpg_{i,t-1}$ in Equations 3 and 4 denote the unemployment rate and GDP growth of importing countries, respectively, whereas $unemp_{j,t-1}$ and $gdpg_{i,t-1}$ denote

the unemployment rate and GDP growth of exporting countries, respectively. Following the practice of standard gravity models, all the equations above take a log-linear version when they are estimated. Table 1 provides descriptive statistics for all the variables.

Table 1: Descriptive statistics of variables

Variable	Mean	Min	Max	Std. dev.	No. of observations
ln ($export_{ij,t}$)	7.014	–1.469	11.615	1.688	22,100
ln ($epu_{i,t-1}$)	4.690	3.413	6.318	0.431	21,485
ln ($epu_{j,t-1}$)	4.690	3.413	6.318	0.431	21,485
ln ($gdp_{i,t}$)	14.704	11.587	16.669	1.237	21,348
ln ($gdp_{j,t}$)	14.705	11.587	16.669	1.237	21,348
ln ($rex_{ij,t-1}$)	0.000	–8.071	8.071	3.243	20,652
$fta_{ij,t}$	0.294	0.000	1.000	0.456	22,100
$currency_{ij,t}$	0.079	0.000	1.000	0.269	22,100
ln($Dist_{ij}$)	8.666	5.156	9.856	0.958	22,100
$border_{ij}$	0.042	0.000	1.000	0.201	22,100
$language_{ij}$	0.179	0.000	1.000	0.383	22,100
$colony_{ij}$	0.069	0.000	1.000	0.253	22,100

Source: www.policyuncertainty.com, IMF, CEPII, Pacific Exchange Rate Service, own calculations.

3.2 Estimation methods

We use the least squares dummy variable (LSDV) panel data method with a standard OLS approach to estimate our models. While various methods are suggested in the literature to deal with MRT which emerges as an unobservable effect, we use two approaches that have been adopted by previous studies. Firstly, Head and Mayer (2014) and Heid and Larch (2016) include exporter- and importer-fixed effects and time-specific effects in the model to approximate the effect of MRT but in the meantime keep time-invariant variables such as geographic distance and language in the model. In the approach, exporter-, importer-, and time-specific effects are supposed to be able to capture all the effects that time-invariant variables, such as geographic distance and language, cannot capture. Head and Mayer (2014) suggested that this approach produces consistent estimates.

Secondly, we follow Anderson and van Wincoop (2003) and Baltagi *et al.* (2003) and include a full set of dummy variables, including importer- and exporter-specific

effects and time-specific effects that affect bilateral trade flows, but drop time-invariant variables such as geographic distance and language. These fixed effects may help mitigate misspecification concerns and reduce the bias associated with using distance to measure the costs of information flows and transport, and therefore produces less biased estimates. However, this specification might hamper the estimation of any exporter/partner-invariant variable such as the EPU. We therefore adopt a softer version of this approach by also adding pair-specific fixed effects in order to control for potential inconsistency due to the non-stationarity of the regressors. This is somehow similar to the estimation of a heterogeneous DOLS in Mark and Sul (2003).

3.3 Data and sample

We confront our econometric models with data from several sources. The data on policy uncertainty were obtained from the website *www.policyuncertainty.com*. This website provides monthly data on EPU index for 20 countries and regions, including the US, China, Australia, Brazil, Canada, France, Germany, Chile, Ireland, India, Italy, Korea, Japan, the Netherlands, Sweden, Russia, Spain, the United Kingdom, Singapore and Hong Kong over the period 2002Q1–2016Q2. These economies are trade partners to one another, creating 380 pairs of importing-exporting countries in the sample. We converted the monthly data on EPU into quarterly data because GDP (which is an important control variable) is published quarterly. The quarter may also be regarded as a more suitable time frame than the month or the year to gauge changes in economic policy uncertainty. We chose 2002 as the starting year of our sample because China[2], one of the largest countries in terms of the volume of import and export, joined the WTO in that year.

The data on export denominated in US dollars come from IMF DOTS (at *http://data.imf.org/?sk=9D6028D4-F14A-464C-A2F2-59B2CD424B85*). The data for GDP of each economy in its own currency come from IMF IFS (at *http://data.imf.org/IFS*), in order to keep consistence with export, we convert each economy's GDP into US dollars using its real exchange rate against US dollars. To calculate $rex_{ij,t}$, we need data on nominal exchange rate and CPI of each country. The data on nominal exchange rate are obtained from Pacific Exchange Rate Service (*http://fx.sauder.ubc.ca/*), whilst the data on CPI come from IMF IFS. The data on unemployment rate also come from IMF IFS. Data regarding whether two countries have free trade agreements are obtained from the website *http://jdesousa.univ.free.fr/data.htm*. While data on $currency_{ij,t}$ are collected manually, data on all other variables including $border_{ij}$, $Dist_{ij}$ $language_{ij}$ and $colony_{ij}$ come from the dist_cepii dataset of CEPII (*http://www.cepii.fr/CEPII/en/welcome.asp.*).

2 For some of these countries (*e.g.*, India and the Netherlands), the data on EPU are available from the years after 2002, creating an unbalanced panel dataset.

Our sample consists of countries and regions which share a common feature in that international trade plays a key role in their economic growth. Nevertheless, these countries are also heterogeneous in terms of their size of economy (*i.e.*, large economies such as the US, China and Japan and small economies such as Singapore and Hong Kong) and the level of economic development (*i.e.*, developed and emerging countries). These variations mean that the role of EPU, which is arguably exogenous to exporters or importers, may vary across these countries, depending on country-specific macroeconomic conditions.

4. Results

4.1 Baseline results

Table 2 shows the results estimated from Equation 2. Models 1–2 show the results for the full sample. Models 1 are estimated using the approach of Head and Mayer (2014) and Heid and Larch (2016) to deal with MRT by including dummies for importer-, exporter- and time-specific effects, but keeping time-invariant variables such as geographic distance and language in the model. By comparison, Model 2 is estimated using the approach of Anderson and van Wincoop (2003) and Baltagi *et al.* (2003) to deal with MRT by including dummies for importer-, exporter- pair- and time-specific effects, but dropping time-invariant variables such as distance and language.

The coefficient of the EPU variable for importing countries is negative and highly statistically significant in Model 1. This negative effect of EPU indicates that greater uncertainty in economic policy in an importing country increases business exposure to risks, thus decreasing export of its trade partner countries. The coefficient of the EPU variable in Model 1 shows that a 1 percent increase in the value of EPU in an importing country leads to a decrease of 0.041 percent in export by its trading partner countries. By contrast, the coefficient of the EPU variable for the exporting countries in Model 1 is not statistically significant. This suggests that EPU in an exporting country does not depress the country's export. This finding looks counterintuitive on the surface, but it is not surprising. While EPU in both exporting and importing countries influences export by increasing sunk costs and opportunity costs, which decreases willingness and scale of exporting, the impact of EPU in exporting countries is likely to be less important. This is because exporters have better understanding of how economic policy uncertainty may change in their own countries and, as such, they may have already calculated it into their exporting strategy. For this and other reasons, previous studies focused mainly on the effects of EPU of the importing countries on trade and investment (Feng *et al.*, 2017; Handley, 2014; Handley and Limão, 2015, 2017).

Table 2: Baseline and country heterogeneity analysis

			Developed country exporters	Developing country exporters	Commodity focused exporters	Non-commodity focused exporters
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
ln (*epu*$_{j,t-1}$)	−0.041*** (0.014)	−0.035*** (0.006)	−0.030** (0.013)	−0.032** (0.013)	−0.032** (0.013)	−0.053** (0.023)
ln (*epu*$_{i,t-1}$)	0.001 (0.014)	−0.001 (0.006)	−0.013 (0.015)	0.028 (0.028)	0.029 (0.022)	−0.005 (0.014)
ln (*gdp*$_{j,t}$)	0.597*** (0.016)	0.601*** (0.008)	0.651*** (0.019)	0.700*** (0.047)	0.673*** (0.038)	0.559*** (0.015)
ln (*gdp*$_{i,t}$)	0.421*** (0.020)	0.446*** (0.010)	0.180*** (0.032)	0.460*** (0.025)	0.434*** (0.026)	0.413*** (0.019)
ln (*rex*$_{ij,t-1}$)	−0.030*** (0.003)	−0.060*** (0.011)	−0.011*** (0.003)	−0.017 (0.033)	0.064** (0.031)	−0.028*** (0.003)
***fta*$_{ij,t}$**	0.278*** (0.016)	0.079*** (0.012)	0.374*** (0.017)	0.188*** (0.040)	−0.074** (0.036)	0.409*** (0.016)
***currency*$_{ij,t}$**	0.213*** (0.024)	–	0.354*** (0.023)	–	–	0.242*** (0.023)
ln(*Dist*$_{ij}$)	−0.745*** (0.008)	–	−0.729*** (0.009)	−0.851*** (0.024)	−1.451*** (0.021)	−0.674*** (0.008)
***border*$_{ij}$**	0.274*** (0.026)	–	0.323*** (0.032)	0.272*** (0.051)	0.603*** (0.048)	0.313*** (0.026)
***language*$_{ij}$**	0.583*** (0.019)	–	0.401*** (0.019)	1.069*** (0.043)	0.733*** (0.042)	0.465*** (0.019)
***colony*$_{ij}$**	−0.132*** (0.020)	–	−0.061*** (0.021)	−0.364*** (0.060)	−0.110** (0.055)	−0.092*** (0.020)
Exporter fixed effects	YES	YES	YES	YES	YES	YES
Importer fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES
Pair-specific fixed effects	–	YES	–	–	–	–
Adj R^2	0.848	0.973	0.872	0.861	0.873	0.883
No. of observations	20,068	20,068	15,477	4,591	4,698	15,370

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust p-values are in parentheses.

Source: Author's own calculations.

Model 2 shows that the results are qualitatively the same as those in Model 1. While the coefficient of the EPU variable for importing countries remains negative and significant, the coefficient of the EPU variable for exporting countries is still not significant. Since the two approaches dealing with MRT produce qualitatively similar results, for the remaining analyses in the paper we only show results for models using the approach of Head and Mayer (2014) and Heid and Larch (2016) to deal with MRT by including dummies for importer-, exporter- and time-specific effects, but keeping time-invariant variables such as geographic distance and language in the model.

The results regarding control variables are well in line with the predictions in standard trade models. The GDP variable for both importing and exporting countries is positive and significant in all the models, indicating that market demands are positively associated with trade flows. By contrast, the real exchange rate variable is negative and significant in all the models. The variable for geographic distance is negative and significant, suggesting that large distance reduces trade flows. In addition, the coefficients for free trade agreement, common currency, border and language are all positive and significant, which is consistent with the previous findings using the gravity trade models.

4.2 Country heterogeneity

An important way to exploit the richness of the gravity model is to estimate the model by using different groups of exporters. We first follow IMF (2016) to break our sample of exporters into developed and developing country groups. In our sample, all exporters are developed countries except China, India, Brazil, Russia and Chile. We re-estimated Equation 2 and the results are shown in Models 3 and 4 of Table 2. The key results related to the EPU variables do not differ between the two groups and are qualitatively the same as those of the baseline analysis for the full sample. For example, the coefficient of the EPU variable for importing countries is negative and highly statistically significant for both developing and developed countries, indicating that a greater economic policy uncertainty increment of an importing country decreases export of its trade partner countries. This finding is not surprising because a country's import will decrease when economic policy uncertainty in the country is high. This is the case regardless where the country imports – developing or developed countries. Therefore, greater economic policy uncertainty does not affect exports of developing and developed countries differentially.

To further examine the heterogeneity with respect to the effect of EPU in importing countries, we also break the sample of exporters into two groups: one focuses on commodities and the other on non-commodities. We follow Cashin *et al.* (2004) and Ma *et al.* (2018) to make the distinction. Australia, Canada, Russia and Chile are commodity exporters

and the rest are non-commodity exporters. We re-estimated Equation 2 and the results are shown in Models 5 and 6. The patterns of the results pertaining to ln ($epu_{j,t-1}$) and ln ($epu_{i,t-1}$) remain qualitatively unchanged. The coefficient of ln ($epu_{j,t-1}$) in the commodity exporter group is smaller than that in the non−commodity exporter groups. Our explanation is that commodity trade is less sensitive to changes in economic policy because many commodities are necessities and are less demand−elastic. Moreover, commodity trade often uses long−term agreement prices which reduce its sensitivity to external shocks, including policy changes.

4.3 Moderating effects of unemployment and GDP growth

As discussed in Section 3, the unemployment rate and GDP growth of an importing or exporting country may influence the relationship between EPU and export.

Table 3: Moderating role of unemployment rate and GDP growth

	Model 1	Model 2	Model 3	Model 4
ln ($epu_{j,t-1}$)	−0.038** (0.015)	−0.050*** (0.017)	−0.041*** (0.015)	−0.042*** (0.015)
ln ($epu_{i,t-1}$)	0.014 (0.015)	0.021 (0.015)	0.006 (0.014)	0.007 (0.014)
$unemp_{j,t-1}$	−0.030*** (0.002)	−0.030*** (0.002)	–	–
ln ($epu_{j,t-1}$) × $unemp_{j,t-1}$	–	−0.004** (0.001)	–	–
$gdpg_{j,t-1}$	–	–	0.115** (0.003)	0.101** (0.004)
ln ($epu_{j,t-1}$) × $gdpg_{j,t-1}$	–	–	–	0.000 (0.000)
Other control variables	YES	YES	YES	YES
Exporter fixed effects	YES	YES	YES	YES
Importer fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Adj R^2	0.854	0.854	0.848	0.849
No. of observations	17,038	16,821	19,771	19,718

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust p−values are in parentheses.

Source: Author's own calculations.

Table 3 shows the results estimated from Equations 3 and 4. Both unemployment rate (Models 1 and 2) and GDP growth (Models 3 and 4) are correctly signed and statistically significant. These results are well in line with theoretical predictions in macroeconomic and trade models. Model 2 shows that the coefficient of the interaction between the EPU and unemployment rate in an importing country is negative and significant. This result indicates that the higher the unemployment rate in an importing country, the stronger the negative effects of EPU in the country on the export of its trading partner countries. By contrast, the coefficient of the interaction term in Model 4 is not statistically significant, indicating that GDP growth in an importing country does not influence the negative effects of EPU in the country on the export of its trading partner countries.

4.4 Robustness checks

First, export from the country to the country is influenced not only by policy uncertainty of the country but also by policy uncertainty in other potential (competing) importing countries. Therefore, what matters for exporters might be the level of uncertainty in an importing country relative to other importing countries. Exporters are likely to export more to countries with a lower level of EPU than to countries with a higher level of EPU, holding other factors constant. We therefore redefine the EPU variable as the ratio of the EPU in the importing country to the average EPU of all other importing countries using the share of GDP of the importing country $k(k \neq j)$ in the total GDP of all countries that import from the country i ($\sum_{k \neq j} gdp_{k,t}$) as the weight:

$$relative\_epu_{j,t-1} = epu_{j,t-1} / epu\_other_{i,t} \tag{5}$$

where

$$epu\_other_{i,t} = \frac{\sum_{k \neq j} epu_{k,t} * gdp_{k,t}}{\sum_{k=j}^{n} gdp_{ik,t}} \tag{6}$$

In a bilateral trade context, a significant coefficient of this variable would mean that the larger the EPU gap between importer and exporter, the lower the amount of trade because the importer selects partners which feature a lower level of policy uncertainty. The estimated results are displayed in Table 4. The EPU variable remains negative and significant across all three models. The results suggest that an increase in the EPU value in an importing country relative to other potential (competing) importing countries decreases the export of its trading partner countries to the country. This indicates that exporters tend to choose a market with the lowest level of uncertainty among all potential markets, holding other factors constant. This finding mirrors Nguyen *et al.* (2018), who show that the difference in EPU between home and host countries influences the flow of foreign direct investment (FDI).

Table 4: Results using relative level of EPU in importing countries as the key explanatory variable

	Model 1	Model 2	Model 3
ln (*relative_epu*$_{j,t-1}$)	−0.019** (0.016)	−0.024** (0.018)	−0.015** (0.016)
***unemp*$_{j,t-1}$**	–	−0.030*** (0.002)	–
ln (*relative_epu*$_{j,t-1}$) × *unemp*$_{j,t-1}$	–	−0.001 (0.000)	–
***gdpgrowth*$_{j,t-1}$**	–	–	0.156** (0.071)
ln (*relative_epu*$_{j,t-1}$) × *gdpgrowth*$_{j,t-1}$	–	–	0.000 (0.000)
Control variables	YES	YES	YES
Exporter fixed effects	YES	YES	YES
Importer fixed effects	YES	YES	YES
Time fixed effects	YES	YES	YES
Adj R^2	0.848	0.854	0.848
No. of observations	20,179	16,909	19,812

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust p–values are in parentheses; results for control variables are not shown to save space.

Source: Author's own calculations.

While the coefficient of the interaction between EPU and GDP growth remains insignificant (Model 3), the coefficient of the interaction between EPU and unemployment (Model 2) is correctly signed, but turns to be insignificant. The insignificance of the EPU variable defined in relative terms might be caused by the fact that the value of EPU in the log form will turn to be negative when it is increasing slowly in the importing country relative to other countries. In such cases, the coefficient of the interaction term between EPU and unemployment is less likely to be negative and significant because it would mean that higher unemployment rate stimulates imports from other countries, which is inconsistent with theory. Indeed, Nguyen *et al.* (2018) used the absolute value rather than the relative value of EPU when they examined whether the interaction between EPU and corporate derivative use influences firm performance. Similar results were obtained

when we experimented with another weighted EPU variable using the share of the export of the country to the country $k(k \neq j)$ in the total export of the country i as the weight.

Secondly, Silva and Tenreyro (2006) suggest that because E(ln y) ≠ ln E(y), heteroskedasticity exists in the log−form gravity model even if various exporting and importing country−specific effects and time−specific effects are controlled for. The existence of heteroskedasticity will lead to biased estimation results. In addition, the gravity model in the log form cannot deal with situations where the volume of trade is zero. To mitigate these concerns, we follow previous studies (Anderson *et al.*, 2016; Fally, 2015; Silva and Tenreyro, 2006) and use the Poisson pseudo maximum likelihood (PPML) method to estimate our model. The PPML is often used for gravity models that belong to generalized linear models (GLM). It estimates GLM using the quasi−Poisson distribution and a log−link. Although our dependent variable for the Poisson regression is specified in levels rather than logarithms, the coefficients of the independent variables which are taken in the logarithmic form can still be interpreted as elasticities (Shepherd, 2012). The model is set up as follows:

$$export_{ij,t} = exp\left\{a_0 + b_0 ln(epu_{j,t-1}) + b_1 ln(epu_{i,t-1}) + \psi controls_{ij,t} + MRT_{ij,t}\right\} + e_{ij,t} \qquad (7)$$

We can estimate Equation 7 using a fixed−effects or a random−effects method. The overwhelming majority of studies on trade use the fixed−effects model because it provides consistent and efficient results, whilst the random−effects model assumes random distribution of the unobserved heterogeneity, which is too strong to uphold (Wooldridge, 2009). In our models, since the country−specific effects may be correlated with explanatory variables, the fixed−effects model is preferable to avoid biases (Westerlund and Wilhelmsson, 2011). The estimated results in Table 5 show that the key results regarding the EPU variable and its interactions with unemployment rate and with GDP growth are highly consistent with those in Table 2, indicating that our main results are robust to the PPML model.

Table 5: Results using the PPML method

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
ln ($epu_{j,t-1}$)	−0.040*** (0.015)	−0.038*** (0.007)	−0.040** (0.006)	−0.038** (0.007)	−0.038** (0.016)	−0.042*** (0.016)
ln ($epu_{i,t-1}$)	−0.002 (0.016)	−0.006 (0.007)	−0.023 (0.017)	−0.019 (0.017)	0.003 (0.016)	0.004 (0.016)
***unemp*$_{j,t-1}$**	–	–	−0.017*** (0.002)	−0.017*** (0.002)	–	–
ln ($epu_{j,t-1}$) × *unemp*$_{j,t-1}$	–	–	–	−0.004** (0.001)	–	–
***gdpgrowth*$_{j,t-1}$**	–	–	–	–	0.140* (0.081)	0.118 (0.082)
ln ($epu_{j,t-1}$) × *gdpgrowth*$_{j,t-1}$	–	–	–	–	–	0.001 (0.000)
Control variables	YES	YES	YES	YES	YES	YES
Exporter fixed effects	YES	YES	YES	YES	YES	YES
Importer fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES
Pair−specific fixed effects	–	YES	–	–	–	–
R^2	0.900	0.982	0.911	0.911	0.900	0.900
No. of observations	20,068	20,068	17,038	16,821	19,771	19,718

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust p−values are in parentheses; results for control variables are not shown to save space.

Source: Author's own calculations.

Finally, we have to convert each country GDP in local currency into US dollars using market exchange rates, which can cause significant bias particularly when nominal exchange rate fluctuates dramatically or when there is a currency crisis. For this and other reasons, many studies use PPP−adjusted GDP using the Penn World Table (*e.g.*, Baier *et al.*, 2019; Egger and Tarlea, 2015) in their gravity models. Furthermore, we cannot use the GDP data from the World Bank and the Penn World Table because these are yearly data which are not consistent with our study which uses seasonal data. Therefore, the paper uses data from OECD Statistics (at https://stats.oecd.org/) which provide seasonal GDP data in US dollars which are PPP−adjusted with the reference year 2010. However, since China, Russia, Hong Kong and Singapore were not included in the OECD source, we re−estimated Equation 2 using a sample excluding those four countries and regions. The results are

shown in Table 6. As can be seen, the results remain qualitatively unchanged from those in Table 2, indicating that using solely the OECD data or using the OECD data and IMF data together generates qualitatively identical results.

Table 6: Results using the sample excluding Russia, China, Singapore and Hong Kong

	Model 1	Model 2	Model 3	Model 4
ln ($epu_{j,t-1}$)	−0.041*** (0.015)	−0.018** (0.008)	−0.052*** (0.012)	−0.034*** (0.006)
ln ($epu_{i,t-1}$)	−0.0128 (0.017)	−0.022 (0.018)	–	–
ln ($gdp_{j,t}$)	1.372*** (0.058)	1.584*** (0.041)	1.366*** (0.058)	1.573*** (0.040)
ln ($gdp_{i,t}$)	0.779*** (0.053)	0.700*** (0.036)	0.864*** (0.049)	0.771*** (0.034)
Other controls	YES	YES	YES	YES
Exporter fixed effects	YES	YES	YES	YES
Importer fixed effects	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES
Pair−specific fixed effects	–	YES	–	YES
Adj R^2	0.872	0.972	0.873	0.972
No. of observations	12,674	12,674	12,780	12,780

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; robust p−values are in parentheses; results for control variables except for the two GDP growth variables are not shown to save space.

Source: Author's own calculations.

5. Discussion and Conclusion

The study finds that a country's is negatively associated with the EPU of its corresponding importing country. This finding accords well with the theoretical and empirical literature on uncertainty, trade and irreversible investment (Roberts and Tybout, 1997; Tam, 2018). It also corroborates the sunk−cost−based model of exporting behaviour that states that sunk cost concerns delay investments in uncertain environments (Dixit, 1989; Krol, 2018). By considering how EPU in an importing country negatively affects the export of its trading partner countries, our study extends prior studies that typically focused on the role of policy uncertainty in a single country (Feng *et al.*, 2017; Handley and Limão, 2015, 2017). We also find that the negative effect of the EPU in importing countries remains

qualitatively unchanged regardless whether the exporter is a developed or a developing country and whether the exporter focuses on commodities or non−commodities. However, it appears that the negative effect is smaller for developed country exporters than for developing country exporter and for commodity exporters than for non−commodity exporters, highlighting the importance of accounting for the role of country and product heterogeneity when analysing the effects of EPU on export.

It is interesting to observe that the EPU of a country does not affect the same country' export. Our tentative explanation relates to the role of government policy incentives such as tax rebates that are used in many emerging countries to encourage export. Such incentives enhance the ability of exporters to overcome fluctuations in EPU and maintain their dynamics in the international markets. This result, together with the finding of the significant effect of EPU in importing countries, highlights the importance of accounting for the differential effects of policy uncertainty in importing and exporting countries. To our knowledge, this study is the first to link policy uncertainty in both exporting and importing countries with trade flows and thus provide an alternative approach to studying the uncertainty−trade nexus.

Furthermore, we find that the negative effect of EPU is more pronounced when the unemployment rate in the importing country is high. Our explanation is that a high unemployment rate in the importing country can trigger government policy intervention that aims to reduce imports in order to create more jobs. This in turn may further increase uncertainty from the exporter point of view and hence reinforce its effect on export. By contrast, GDP growth in the importing country does not influence the relationship between EPU and export. This finding suggests that although GDP growth in an importing country signals increased market demand that may stimulate the export of its trading partner countries to the country, it cannot "compensate" for the negative effects of EPU in the country. These findings demonstrate that unemployment rate has a greater (negative) intervening effect on the relationship between EPU and export than GDP growth.

A notable policy implication derived from our findings is that policymakers should take more decisive action to reduce high policy uncertainty in order to promote trade flows. Previous studies indicate that commitments under the WTO and multilateral trade agreements reduce uncertainty and promote trade growth (Imbruno, 2018). Our findings underscore the importance of following the WTO rules and of establishing free trade agreements between countries to further open markets and reduce policy uncertainty. Furthermore, the finding regarding the moderating effect of unemployment rate begs for governments to consider a portfolio of macroeconomic variables, paying particular attention to their interactions with policy uncertainty. Since our view focuses on the conditions under which the effects of EPU

might be strong or weak, it differs from conventional prescriptions that emphasize merely how to reduce economic policy uncertainty.

This study has several limitations. Firstly, our sample consists of 20 countries and regions only due to data constraints. Care should therefore be exercised when generalizing the findings to other countries and regions. Secondly, although our study considers the impact of EPU in an importing country on the export of other countries, it does not take fully into account the spillover effects of policy uncertainty that arise from growing interactions between governments and intensifying global trade linkages across countries (Tam, 2018). Finally, this study has examined the role of EPU at a country level. Future work can extend this analysis by considering the effects of EPU on trade flows at a firm level. Despite these limitations, our study helps to explain why and how economic policy uncertainty impacts on trade flows. It also provides insights that open the way to account for the role of country heterogeneity in shaping the causal link between policy uncertainty and trade flows.

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