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# ABSTRACT

# On the Impact of Oil Prices on Sectoral Inflation: Evidence from World's Top Oil Exporters and Importers*

This paper investigates the impact of oil price variations on sectoral inflation for a sample of 10 top oil importing and exporting countries. Specifically, we analyze the effects of oil prices on the consumer price index using monthly data spanning the July 2009 to February 2021 period. Two nonlinear techniques are used to this end: The nonlinear autoregressive distributed lag approach (NARDL), and the Hansen's model (2000). Our econometric results first indicate that the effect of oil price on inflation tends to change across sectors and countries. Second, the inflationary effects of variations in oil prices are likely to affect the energy sector, such as transport and equipment, which are the most dependent on oil. Third, the effect of oil price exists for all countries, but it is stronger in oil-importing than in oil-exporting ones. Besides, the country most sensitive to the oil price level is China.

**JEL Classification:** C5, Q4, Q43

**Keywords:** oil price, sectoral inflation, NARDL, panel threshold model, oil-importing countries, oil-exporting countries

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## 1- Introduction

Crude oil is an extremely strategically important commodity for all countries in the world. In recent years, the oil market has gone through an intense period of change in a volatile international economic environment. High variations of oil price can have bad consequences on economic activity and on inflation. Indeed, an increase of the crude oil price is followed by an increase in the prices of petroleum products, such as the gasoline and heating oil used by consumers. This increase affects all sectors that use it as a source of energy (*e.g.,* transport) or as raw materials (*e.g.,* chemicals, or plastics). The result will therefore be an increase in all prices, which will lead to high inflation rates [Dogrul and Soytas (2010), Cunado and Gracia (2003)]. The most recent crisis of the Russian-led war in Ukraine has roiled global markets, causing stock market turmoil, sending oil prices higher, and injecting even more uncertainty into an already off-balance worldwide economy. According to an UBS analyst interviewed by the New York Times, if oil prices are expected to rise to 120 dollars per barrel, the effect of this increase could cause inflation to reach 9% in the coming months, which could heighten the concerns about the potential harm to economies that are heavily dependent on oil as well as the effects on their monetary policies[2]. The increase in oil prices has made it more difficult to control inflation and has made the backdrop of the world inflation rate worrying. Thus, the inflationary effects of oil price are of crucial importance as it may help governments to make decisions to ease inflationary pressures.

Since the first oil crisis erupted in 1973, the relationship between oil price and inflation has been widely discussed [See Hamilton (1983), Ghalayini (2011), Sek (2017), Zivkov *et al.* (2019), Adekoya and Adebiyi (2020)]. However, the results obtained are mixed and inconclusive. While some studies support the view that oil price has a very important impact on inflation [See Alsaedi (2015), Long and Liang (2018),…], others report evidence of a very low effect [See Zivkov *et al.* (2019), Conflitti and Luciani (2019),…], and some of them found no impact [See Anjanaraju and Marathe (2017), Rafiq and Salim (2014),…].

Third of the potential reasons for the inconclusiveness of the above-mentioned studies might be that: **Firstly**, the effect of oil price on inflation depends on the oil-importing or exporting country. Indeed, the increases in the price of oil have differentiated impacts on an importing or exporting country. Rising oil prices might be viewed as beneficial in nations that export oil and harmful in nations that import oil. When these prices decrease, the opposite is to be expected [See Filis and Chatziantoniou (2014), Ghalayini (2011)]. In fact, the rise in oil price, in the case

[2] https://www.vox.com/the-goods/22949683/russia-ukraine-gas-prices-oil-inflation-stock-market.

of oil-exporting countries, leads to an increase in government revenue and expenditure, which tends to push up domestic demand, leading to inflation. Oil revenues boost inflationary pressures due to higher credit and higher aggregate spending. In the case of oil-importing countries, when oil prices rise, inflation also increases: a higher oil price will lead to higher production costs. Unlike in oil-exporting countries, rising oil prices lead to lower revenues due to lower production. Rising production costs will affect consumer prices. However, lower oil price may also cause inflation because of higher demand. Thus, the main mechanism explaining the oil price effect on prices is through a shift in aggregate supply, which should work in both cases of higher and lower oil prices. In this paper, we distinguish the effect of oil prices on inflation for oil importing and exporting countries.

**Secondly**, most studies have assumed that the effects of oil price on inflation are linear [See Lu et al. (2010), Sek et al. (2015), Gao et al. (2014), Mukhtarov et al. (2020), Cavalcanti and Jalles (2013), Basnet and Upadhyaya (2015), Valcarcel and Wohar (2013)]. However, assuming a linear relationship when the true one is non-linear could impact the results. Therefore, one should be cautious about the appropriate econometric technique to use. Nonlinearity can arise from the presence of a rigidity toward nominal wage decreases. When the cost of production increases in response to the rise of oil prices, industries have the option of either reducing the production or increasing the consumer prices for goods. Indeed, when the cost of production decreases in response to falling oil prices, this should result in a drop in the price of goods. Yet, if nominal wages are rigid, a drop in the price of oil may not result in a drop in the cost of goods [Ibrahim (2015)]. Public regulations, such as subsidies and fixed price policy, are another cause of nonlinearity. To guarantee low and constant prices for fundamental food products and petroleum items several governments especially in countries highly dependent on oil have provided subsidies. Due to their restrictions on how far prices may shift, these policies have the potential to lead to nonlinearity in oil prices behavior [Lachheb and Siraj (2019)].

Recently, new empirical evidence suggests that the effects of oil price on inflation are likely to be asymmetric [Salisu *et al.* (2017), Long and Liang (2018), Adekoya and Adebiyi (2020),..]. Their argument was based on changes in inflation' expectation when the oil price increases versus when it decreases. Thus, the response of inflation to oil price changes could be asymmetric. The impacts of oil shocks can vary over time due to changes in the macroeconomic structure. Due to the failure of linear models to adequately explain the transmission of oil price shocks into inflation rates, this paper accounts for asymmetric issues and the NARDL approach is implemented to examine the potential asymmetries between oil price and inflation.

Another possible reliable explanation for divergent findings in literature could be that previous studies so far neglect the possibility of threshold effects in the relationship between oil prices and inflation. In this paper, we consider a more relevant and realistic framework allowing such a relationship to be nonlinear, and subject to threshold effects. To this end, we employ the threshold regression approach proposed by Hansen (2000). To our knowledge, the threshold model has not been applied yet when modeling the relationship between oil price and inflation.

**Thirdly,** the effect of oil price on inflation may differ from one sector to another since certain sectors are more sensitive and influenced by changes in oil prices. Indeed, as oil is a major input in the economy and used in critical activities, some sectors that fully depend on this energy source are more sensitive to oil price changes [Dillon and Barrett (2013)].

Therefore, our main goal in this paper is to consider sectoral inflation and assess the asymmetric and the presence of a threshold effect at the level of the relationship between oil price and inflation of 6 sectors: transport, health, fuel, food, equipment, and clothing, for the case of 5 oil-exporting countries (Russia, Canada, Norway, Brazil and Mexico) and 5 oil-importing countries (China, United States, South Korea, Germany and the Netherlands).

Specifically, this study makes three main contributions. First, we determine the effect of oil prices on the inflation of each sector. Second, a distinction is made between the effect of oil prices on the inflation of importing and exporting countries. Third, we contribute to the existing literature by assuming that the effects of oil prices on inflation might be nonlinear. We start our analysis by exploring the short- and long-run asymmetric effects of oil prices on inflation by implementing the asymmetric (nonlinear) ARDL approach of Shin *et al.* (2014). The major feature of the NARDL model is its capacity to deal with asymmetries and various cointegration patterns amongst series simultaneously [See Kisswani (2021), Lacheheb et Sirag (2019)]. Then, we investigate the possible threshold impact of oil prices on the inflation using the Hansen's threshold model (2000), which to our knowledge, represents the first attempt to model the relationship between oil prices and sectoral inflation using this approach. We believe that such an exercise with recent data is important as it permits to better understand how a rise in oil price affects global, as well as sectoral inflation of a country. It also provides crucial policy implications to lessen the inflationary effect of high oil prices.

The remainder of the paper is organized as follows: Section 2 is devoted to econometric issues, while Section 3 discusses the estimation results. The last section summarizes the main findings and offers some concluding remarks.

## 2- Methodology

The literature includes a number of diverse inflation models, with one of the most popular being the Phillips curve, which suggests a stable and inverse relationship between inflation and unemployment. Central banks and monetary authorities often use this model to formulate and evaluate their monetary policies. The investigation of the structure of the Phillips curve and its repercussions for monetary policy has become one of the most prominent fields of economics research. Philips (1958) was the first to introduce this model by investigating the inflation in the UK according to past shocks and by establishing a relationship between the rise of money wages and unemployment.

However, the persistent shortfall in inflation from the target has led some to question the traditional relationship between inflation and the unemployment rate. One major limitation and drawback of the Phillips curve is that it assumes inflation is solely an internal problem of a country related to the domestic labor market and ignores the fact that inflation in the present modern times is not only associated with the country but is an international phenomenon. Thus, other international variables must be integrated as determinants of inflation, such as the exchange rate. Exchange rate fluctuations can significantly affect the general level of prices [Dornbuch (1976)]. According to Dornbuch, when the exchange rate falls, that is, when the domestic currency appreciates, prices are expected to fall at the general level. Dornbusch's work has been the basis for other works [Brooks (2002), Usman and Musa (2018), Ha et al (2020), Pham et al (2020), Husaini *et al.* (2019b), Husaini and Lean (2021), and Zhu and Chen (2019)]. In fact, globalization has expanded international trade to include raw goods, as well as input products. When an economy is heavily dependent on imported products, the exchange rate is essential and plays a critical role regarding the costs of imported products. A sharp rise in the cost of import inputs followed by a decrease in the exchange rate will lead prices to rise (the import price becomes more expensive), and then cause inflation to rise too. Since most international trade is conducted in US dollars, exchange rate variations have an important impact on inflation. Pham *et al.* (2020) examined the main determinants of inflation in the ASEAN-5 countries and confirmed the presence of considerable variations in inflation and asymmetric effects caused by exchange rate movements. Furthermore, Husaini and Lean (2021), Nasir *et al.* (2020a), Nasir *et al.* (2020b), and Nasir and Vo (2020) found that inflation is strongly influenced by the exchange rate in the short and long term, and that exchange rate strengthens the pressure on inflation. According to their results, they argued that the exchange rate is a crucial determinant of inflation. Correa and Minella (2010) confirmed the existence of a nonlinear relationship that ensures the exchange rate affects inflation in Brazil under the Philips curve model.

It should be noted that the relationship between inflation and the exchange rate could be in both directions. Indeed, inflation can be thought of as a decline in the value of money. When inflation is high, the value of a country's currency weakens[3].

Many other explanatory variables have been put forward as potential determinants of inflation. Interest rate is another factor that can affect inflation rates [See *e.g.,* Tillmann (2008), Adu and Marbuah (2011)]. Indeed, Interest rates have a significant impact on what consumers, industries, and governments decide to buy and consume. This is because people rely their consumption choices on the current interest rate. According to Tillmann (2008) rising interest rates lead to the increase of marginal costs of production, and ultimately to higher inflation, demonstrating then that the interest rate is an important factor that affects inflation by the cost channel. Jaradat and Al-Hhosban (2014) show that rising oil prices accompanied with monetary policy such as interest rates lead to higher inflation rates. As interest rates are the major instrument used by central banks to regulate inflation, an increase in interest rates is a way to fight against excessive inflation. Recently, Nasir (2021) identified empirical evidence about the presence of a strong relationship between inflation and interest rate and found that an increase in real interest rates leads to an increase in inflation in the UK. Bernanke et al (1997) showed that monetary policy reacts to oil price shocks by increasing interest rates to reduce inflation, which in turn affects GDP and employment negatively and unemployment positively.

Sek et al (2015) used the producer price index (PPI) as a proxy for cost production to investigate the factors affecting consumer prices[4]. Clark (1995) also found that the PPI impacts the consumer price index (CPI) via the production chain. When the cost of inputs increases, the cost of final products should also increase [See Salisu et al. (2017), Arouri and Nguyen (2010), L'Oeillet and Licheron (2008)]. Indeed, a rise in the price of products leads to an increase in production costs, which increases the price of final goods, decreases the buying power of wages, and pushes producer inflation (PPI) higher. Accordingly, this will intensify consumer inflation [Clark (1995)].

Following the literature, we assume that oil price, exchange rate, interest rate, producer price index as a proxy for cost production, and unemployment rate are the main determinants

[3]Prior to the estimation, we conducted a causality test, which revealed strong evidence of unidirectional causality running from the exchange rate to inflation for the majority of countries.

[4] Indeed, the producer price index (PPI) measures variations in the price that producers are paid to sell their goods. It includes manufactured, mining, and agricultural products. In fact, the cost production constitutes an important element in the PPI.

of inflation in our empirical research. There are other determinants of inflation, including a measure of fiscal policy, such as the real government spending, GDP,…, but, the unavailability of the data prevented us from adding them to the estimated model. Therefore, we consider the following model:

$$LCPI_{it} = \alpha_0 + \alpha_1 LEXCH_t + \alpha_2 LINT_t + \alpha_3 LPPI_t + \alpha_4 LUMP_t + \alpha_5 LOP_t + \varepsilon_t \qquad (1)$$

, where $LCP_{it}$ is the log of the consumer price index for sector i. It represents the measure of inflation and reflects the variations in percent of the cost for the consumer to purchase a set of services and goods. $LOP_t$ is the log of oil price. We consider the spot price of West Texas Intermediate crude oil (WTI). $LEXCH_t$, $LINT_t$ , LPPI and LUMP are respectively the log of the real exchange rate, the log of the interest rate, the log of the producer price index, and the log of the unemployment rate for each country, and $\varepsilon_t$ is a white noise error term.

Throughout the analysis, we start first with the global CPI inflation rate "Global"[5] before moving on to the CPI for each sector (transport, health, fuel, food, equipment, and clothing). Indeed, "Global" CPI is the average inflation of all sectors in an economy.

As discussed in the introduction, oil price could have a positive effect on inflation in both oil-exporting and oil-importing countries, depending on the mechanism of the inflationary effect in the two groups of countries. For importing countries, the expected sign of these variables is positive: this relationship is positively correlated between crude oil prices and the inflation rate. When the price of this resource increases, inflation follows in the same direction [Anandan *et al.* (2013), Sharma *et al.* (2012)]. For oil-exporting countries, since these nations significantly rely on oil revenues for their projects, and GDP, oil is seen as the principal engine of economic activity in these nations. Changes in oil prices will have a big impact on government revenues, government spending and economic expansion, which will eventually have an impact on the total demand for goods and services and consumer pricing in these nations. The rise in oil prices leads to an increase in government revenue and expenditure, which tends to push up domestic demand and then lead to high inflation [Morsy and Kandil (2009)].

As discussed in the introduction, the effects of oil prices on inflation can be asymmetric and the short-term effects of oil prices might be different from their long-term effects. For this reason, we follow Shin *et al.* (2014) in decomposing the variables into positive changes and

[5] The "global" cpi inflation also denoted "total" refers to the average of the cpi of all sectors in a country.

negative changes. Following that, new time-series are created utilizing the partial sum approach as illustrated in (2):

$$LOP_t^+ = \sum_{i=1}^{t} \Delta LOP_t^+ = \sum_{i=1}^{t} max(\Delta LOP_i, 0)\,;\; LOP_t^- = \sum_{i=1}^{t} \Delta LOP_t^- = \sum_{i=1}^{t} min(\Delta LOP_i, 0) \quad (2)$$

, where $LOP^+$ ($LOP^-$) is the partial sum of positive (negative) changes in oil price.

Each explanatory variable in Equation (2) is then substituted with its two partial sums to get:

$$\Delta LCPI_t = c + \sum_{i=1}^{n} \varphi_{1i} \Delta LCPI_{t-i} + \sum_{i=0}^{n} \varphi'_{2i} \Delta LOP_{t-i}^+ + \sum_{i=0}^{n} \varphi''_{2i} \Delta LOP_{t-i}^- + \sum_{i=0}^{n} \varphi_{3i} \Delta LEXCH_{t-i} + \sum_{i=0}^{n} \varphi_{4i} \Delta LINT_{t-i} + \sum_{i=0}^{n} \varphi_{5i} \Delta LPPI_{t-i} + \sum_{i=0}^{n} \varphi_{6i} \Delta LUMP_{t-i} + \lambda_1 LCPI_{t-1} + \lambda'_2\, LOP_{t-1}^+ + \lambda''_2\, LOP_{t-1}^- + \lambda_3 LEXCH_{t-1} + \lambda_4 LINT_{t-1} + \lambda_5 LPPI_{t-1} + \lambda_6 LUMP_{t-1} + u_t \quad (3)$$

After estimating the nonlinear ARDL model in Equation (3), several asymmetric hypotheses may be put to a rigorous test. First, the short-term effects of the explanatory variables on the CPI will be asymmetric if for a particular lag order $i$ the estimate of $\varphi'_{2i}$ is different from $\varphi''_{2i}$ in Equation (3). Nevertheless, if the null hypothesis of $\sum_{i=0}^{n} \varphi'_{2i} = \sum_{i=0}^{n} \varphi''_{2i}$ is rejected by the Wald test, then there will be established short-term or cumulative effect asymmetries. Second, if the Wald test rejects the zero values of $\frac{\lambda'_2}{-\lambda_1} = \frac{\lambda''_2}{-\lambda_1}$, these explanatory factors will have long-term asymmetric impacts on inflation. Shin *et al.* (2014), and Pesaran *et al.* (2001), suggest two tests. An F test to establish joint significance of the lagged level variables, and the t-test to establish significance of $\lambda_1$which must also be negative. According to Bahmani and Nouira (2021), by meaningful estimate, we mean cointegration is supported either by the F-test or by the t-test.

To establish a more thorough and rigorous methodology and in addition to the nonlinear ARDL model, we adopt another suitable framework that allows for the presence of potentially nonlinear threshold effects using the Hansen's threshold model (2000). This modelling approach has at least two interesting features. First, in contrast to quadratic specifications frequently used in the related literature, it can capture the potentially non-monotonic impacts of oil price on inflation without imposing a priori any specific non-linear functional form. Second, both the number and position of turning points are not predetermined and they are endogenously extracted from the data.

To assess the possibility of threshold effects of oil price on inflation, following Hansen (2000) equation (1) can be specified as follows:

$$LCP_{it} = \theta_{0L} + \theta_{1L}LEXCH_t + \theta_{2L}LINT_t + \theta_{3L}LPPI_t + \theta_{4L}LUMP_t + \theta_{5L}LOP_t \quad \text{if } LOP_t \leq \tau \qquad (4)$$

$$LCP_{it} = \theta_{0U} + \theta_{1U}LEXCH_t + \theta_{2U}LINT_t + \theta_{3U}LPPI_t + \theta_{4U}LUMP_t + \theta_{5U}LOP_t \quad \text{if } LOP_t > \tau \qquad (4)'$$

In equation (4) and (4)', oil price (LOP) is the threshold variable used to split the data into different regimes or groups and $\delta$ denotes the threshold parameters. This type of modelling framework allows the impact of oil price to differ depending on whether it is below or above a specific threshold value. According to Hansen (2000), equation (4) and (4)' can be separately estimated using the ordinary least squares method (OLS). Roughly, the Hansen procedure involves three essential steps. First, the estimated threshold values of $\hat{\tau}$ is chosen by minimizing the sum of squared errors of equation 4. In a second step, Hansen (2000) suggests applying a *F*-statistic to determine whether the threshold effect is statistically significant. The null and alternative hypotheses in (4) is as follows: i) $H_0\colon \theta_{jL} = \theta_{jU}$ versus $H_1\colon \theta_{jL} \neq \theta_{jU}$.

However, under $H_0$, the asymptotic distributions of the *F*-statistics associated with each of the above hypotheses are non-standard due the presence of the nuisance parameter $\delta$. That's why Hansen (2000) recommends the use of the bootstrapping approach to compute the *p*-value and the related confidence interval for this statistic. In a third step, given the estimate $\hat{\delta}$ of the threshold variable, the slope coefficients of each of the models under consideration can be estimated by OLS.

## 3- Empirical results and discussion

One of the main objectives of this paper is to assess whether oil prices have a nonlinear asymmetric effect on sectoral inflation. The nonlinear models (3) are estimated using monthly data that covers the period July 2009-February 2021 for each of the ten countries: five oil-importing countries (China, United States, South Korea, Germany, and the Netherlands) and five oil-exporting ones (Russia, Canada, Norway, Brazil and Mexico). The five importing countries selected are among the top 7 importing countries in the world[6]. Based on total cost, these five countries purchased 49.7% of all crude oil imported in 2021. Although the United

[6] Crude Oil Imports by Country 2021 Plus Average Unit Prices (worldstopexports.com).

States is classified as an oil importing and exporting country, in our paper we preferred to put it in the group of oil importing ones given that this country is ranked as the second-largest oil importer. It should be noted that we attempted to include countries from the Gulf Cooperation Council (GCC) in our sample, as they are among the major oil-exporting nations. For instance, Saudi Arabia, the world's largest oil exporter, and Iraq and the United Arab Emirates, respectively, the fourth and fifth largest oil exporters in the world. However, variables such as the CPI or unemployment rate are not available at the sectoral level for Saudi Arabia, Iraq, the United Arab Emirates, Qatar, and Kuwait. Additionally, Oman's PPI and unemployment rate data are missing. Therefore, these countries were not included in our sample. Nevertheless, the five exporting countries selected for our study (Russia, Canada, Norway, Brazil, and Mexico) are among the top 14 exporting countries in the world[7]. Together, these five countries accounted for 25.1% of globally exported crude oil in 2021. All data sources and definitions are detailed in Appendix A[8].

### 3.1- Results of the NARDL model

We proceed to determine the long-term and short-term dynamics of the relationship between the oil price and inflation. Therefore, first, we estimate the nonlinear autoregressive model with distributed lags (NARDL) in Equation (3). A maximum of 8 lags are imposed on each first-differenced variable and Akaike's Information Criterion (AIC) is applied to determine the optimum number of lags. Furthermore, since our sample period includes the COVID-19 pandemic, we add a dummy variable in all models to account for this disturbance. We start our analysis with the presentation of the short-term results. As they are voluminous, short-term estimates are not reported here[9] but are summarized in Table 1.

*Table 1:* Number of sectors with at least one significant lagged coefficient of $\Delta LOP^{+}$ or $\Delta LOP^{-}$

| Countries | *number of sectors* | Sector | | | | | | | Number of sectors with a positive effect | Number of sectors with a negative effect |
|---|---|---|---|---|---|---|---|---|---|---|
| | | global | transport | health | fuels | food | equipment | clothing | | |
| **Exporting countries** | | | | | | | | | | |
| Russia | 7/7 | * | * | * | * | * | * | * | **0** | **7** |

[7] Crude Oil Exports by Country 2021 (worldstopexports.com).
[8] The data of this study is available from the corresponding author.
[9] The short-run coefficient estimates are available from the corresponding author.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Canada | 6/7 | | * | * | * | * | * | * | **5** | **1** |
| Norway | 6/7 | | * | * | * | * | * | * | **2** | **4** |
| Brazil | 4/7 | * | * | * | | * | | | **2** | **2** |
| Mexico | 6/7 | * | * | * | * | * | * | | **4** | **3** |
| **Importing countries** | | | | | | | | | | |
| China | 7/7 | * | * | * | * | * | * | * | **5** | **2** |
| US | 6/7 | * | * | * | * | | * | * | **3** | **3** |
| Korea | 6/7 | * | * | * | * | * | | * | **4** | **2** |
| Germany | 6/7 | * | * | | * | * | * | * | **2** | **4** |
| Netherlands | 7/7 | * | * | * | * | * | * | * | **5** | **2** |

Table 1 provides by country and by sector a synthesis of the short-term results. This summary table reports for each country the total number of sectors having at least one significant lagged coefficient of $\Delta LOP^{+}$ or $\Delta LOP^{-}$. It can be observed that in the aggregate bilateral model (first column), at least one of the two variables carry at least one significant lagged coefficient in nine countries (four oil-exporting countries and five importing ones), supporting short-run effects of oil price changes on global inflation.

From Table 1 we notice that the transport, fuel, and equipment sectors are the most affected by variations in the oil price in the short term in both oil-exporting and importing countries, confirming the results of Dogrul and Soytas (2010) and Dillon and Barrett (2013). As oil is used as a raw material in a variety of products, including equipment, gasoline and diesel, the cost of producing these commodities increases along with the rise in oil price. In other words, as transport is the primary user of oil (IEO 2016)[10] all goods that are transported are subject to higher transportation costs because of rising oil prices.

The countries with the highest number of sectors having at least one significant lagged coefficient of $\Delta LOP^{+}$ or $\Delta LOP^{-}$ are Russia, China, and the Netherlands (7 /7). These last two countries are mainly the top oil-importing nations. This inflationary impact can be explained by higher costs. An increase in oil prices leads to greater production costs, which in turn cause higher consumer prices and lower wage purchasing power, driving up inflation (and conversely for an oil price decrease) [See Finn (2000) and Clark (1995)]. Besides, the sector most affected by oil price variations in the short term in importing countries is the «global» sector. In addition, we notice that the different sectors of the importing countries are more affected by the positive variations of oil price than the negative variations. In other words, a variation in oil prices is

[10] The International Energy Outlook, 2016.

followed by an increase in inflation for most nations, confirming the result of Lacheheb and Sirag (2019), who found a significant positive link between rising oil prices and high inflation.

For oil-exporting countries, Canada has the highest number of sectors whose short-term oil price effects $\Delta LOP^{+}$ have a positive effect on inflation in all 7 sectors. Moving to negative variations of $\Delta LOP^{-}$, Canada has the smallest number of sectors in the exporting countries with negative variations of the oil price in the short term, negatively impacting inflation (0 sectors), and Russia has the highest number of sectors in the exporting countries whose short-term variations of oil prices negatively impact inflation (7 sectors). Thus, we notice that the different sectors of the exporting countries are more affected by the negative variations than the positive variations. Similarly, Ito (2010) found that short-term variations in oil prices have a negative impact on inflation in Russia due to the structure of the Russian economy, which is very sensitive to oil price fluctuations.

Moving on to the top oil-importing countries, those with the highest number of sectors having at least one significant lagged coefficient of $\Delta LOP^{+}$ or $\Delta LOP^{-}$ are China and the Netherlands (7 of 7). In addition, these two countries also have the largest number of sectors where positive short-term variations of oil prices $\Delta LOP^{+}$ have a positive impact on inflation (5 sectors). The negative inflationary effect of oil prices in the short term for importing countries is found especially in Germany (4 sectors). The importing countries are more affected by the positive variations of oil price than the negative variations confirming then the nonlinear (asymmetric) relationship of the inflationary effect of oil price changes.

According to Chang and Wong (2003) a decrease in oil prices is not harmful for importing countries. In fact, when oil prices decline, transportation costs in importing countries also decrease. The reduction in transportation and energy costs is beneficial for consumers as it increases their disposable income. Falling oil prices, along with the decrease in product costs contribute to lower inflation, allowing central banks to maintain lower interest rates without worrying about overall inflation.

The short-term effects of oil price for the food sector exist for all 5 exporting countries and 4 of the 5 importing ones, confirming the result of Baffes (2007), who found a causal relationship between food prices and crude oil prices, and explained that food costs have increased for most oil-exporting nations because of rising oil prices. This result also confirms the findings of Obadi (2014) who revealed that oil price increases are associated with the rise of food prices due to the importance of oil as an input in the food sector. Oil products are used in agriculture for farming equipment and machinery (tractors), transport of other resources to farms, and delivery of farm output to the final customer. Therefore, oil price variations lead to variations in food prices [Bloomberg (2011)].

The next step is to study the inflationary effect of the long-term oil price using the nonlinear ARDL model proposed by Shin *et al.* (2014). The results of the long-term estimates and diagnostic statistics are reported, by country, in Appendix (B1 to B14). The impact of changes of oil prices varies from one sector to another, and depending on the country (oil-exporting, or oil-importing). Table 2 below summarizes our results. We analyze these effects by country, and by sector.

***Table 2: Summary Table***

| | **Cointegration holds** | $LOP^{+}$ | | $LOP^{-}$ | | **Long-run asymmetric effects supported** | **Short-run asymmetric effects supported** |
|---|---|---|---|---|---|---|---|
| | | **Positive effects** | **Negative effects** | **Positive effects** | **Negative effects** | | |
| **Exporting countries** | | | | | | | |
| Russia | *fuels* | *fuels* | | | | | |
| Canada | | | | | | | |
| Norway# | *transport, food clothing* | *transport food* | | | | *transport, food* | |
| Brazil# | *food* | *food* | | | | *food* | |
| Mexico# | *fuels, clothing* | *fuels* | | | | *fuels* | *clothing* |
| **Importing countries** | | | | | | | |
| China# | *transport* | *transport* | | *transport* | | *transport* | |
| US# | *global, transport, health* | *global, transport* | | | | *global, transport* | |
| South Korea | *health, clothing* | | | | *health* | *health* | |
| Germany | *global, transport, equipment* | *transport* | | | | *global, transport, equipment* | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| The Netherlands # | *global, transport* | *global, transport* | | | | *global, transport* | *global, transport* |

Note: # indicates significance of the Covid dummy variable

We start by analyzing the results by country. The second column of Table 2 indicates for each country the sectors for which the long-term estimates are valid (*i.e.,* the F test for cointegration or the $ECM_{t-1}$ test is significant). The US and Germany have the highest number of sectors where the F test or the $ECM_{t-1}$ test are statistically significant (3 out of 7). These are the top oil-importing countries. Among all sectors, transport is the one where cointegration holds most often (5 out of 10), followed by global (3 out of 10). Due to the importance of oil as a vital source in social and economic life (transport vehicles, machinery) in both exporting and importing countries, a variation in oil prices indirectly impacts global inflation and especially in the transport sector. Oil prices and the inflation index are often linked. Any change in the price of oil affects the inflation rate, and the inflationary effects of changes in oil prices are likely to affect the prices of the sectors most dependent on oil, such as transport.

The asymmetric short-term effects of oil price are supported, for at least one sector, only in Mexico and the Netherlands. However, the asymmetric long-term effects of the oil price are supported, for at least one sector, in 8 countries. The impact of the long-term asymmetry of the oil price is important in all 5 oil-importing nations. Like the finding in Table 1, we notice from Table 2 that the inflationary effect of long-term oil prices for the transport sector is important for most countries. The economy is heavily dependent on oil. It is utilized in vital processes including transportation [Salisu *et al.* (2017)]. Thus, the price of outputs and final goods rises in accordance. For instance, a rise in the price of oil increases the cost of energy products (gasoline) and leads to a rise in the inflation rate of the transport sector.

According to the summary table, the increase in oil price leads to an increase in most sectoral inflation. In the case of oil-importing countries, when oil prices rise, inflation also rises: a higher oil price leads to higher production costs, which in turn cause higher consumer prices and lower wage purchasing power, then driving up inflation [See Finn (2000)]. Thus, if an oil-importing nation strongly depends on importing inputs, a rise in imported products puts more pressure on the domestic currency and causes it to depreciate. As a result, exchange rate depreciation causes an increase in the inflation rate [Terra (1998), Husaini *et al.* (2019a), and Husaini *et al.* (2019b)].

For nations that export oil, higher government revenue from selling oil will result in higher consumption, which will raise demand for products and services. All other things being equal, prices for the products and services will rise as a result of the rise in demand, leading then to higher inflation [Morsy and Kandil (2009),…].

On the other hand, and according to the summary table, in the case where oil prices decline (for both oil-exporting and oil-importing countries), the effect on the consumer inflation is weak for almost all countries and sectors confirming that the inflationary effect of oil price is nonlinear. The impacts of rising oil prices differ from those of falling prices, and the effects of falling oil prices are either not statistically significant or have a little impact, confirming the results of Nusair (2019) which justify the choice of using a nonlinear framework.

From the results in Appendix B1-B14, and in Table 2, it can be noted that the dummy Covid variable "d" is significant for 3 importing countries and 3 exporting ones. This shows that the global Covid pandemic has amplified the inflationary effects of oil prices for both oil-importing and oil- exporting countries, due to the dependence of these countries on this source of energy, and that the damage caused by this pandemic (economic slowdown linked to the closing of markets) amplified the inflationary effects in these countries, confirming the findings of Arezki and Nguyen (2020). The dummy variable is significant especially for the transport sector. The pandemic has led to the closure of factories and caused a drop in intermediate inputs due to disruptions in the transport network [Algamdi *et al.* (2021), Albulescu (2020)]. In other words, due to the restrictions imposed in the different countries of the world, the transport sector is the most affected by this pandemic.

For the transport sector, the asymmetric effects (short-term or long-term) are supported for 4 of the 5 oil- importing countries, whereas the global sector is supported for 3 nations. The sector most affected by the increase in the oil price ($LOP^+$) is transport. However, this sector also benefits the most from the decrease of the oil price ($LOP^-$), confirming the results of Choi *et al.* (2018). Working on a panel of 72 countries, they found that the transport sector is dependent on oil prices and demonstrated that the CPI's transportation component is the most reliable determinant of how inflation will behave globally.

According to the NARDL short and long-term estimates and in addition to interpreting the asymmetries, it is obvious that transport is the sector most dependent on oil price variations. Due the use of oil in a variety of products including plastics, petrochemicals, cosmetics, equipment, and clothing, the cost of producing these commodities increases along with the rise of oil price. Then, as transport is an oil-dependent sector, all the produced goods that are transported will be subject to higher transportation costs, which will be reflected in consumer prices because of rising oil prices. The increase in oil prices mostly affects air travel and road transportation but the cost of oil has a direct impact on every type and mode of transportation. An increase in oil prices raises the cost of flights, boats, cars, taxis, and tractors; in other words, as the transport sector is the most vital sector, it will in turn have repercussions on all other sectors related to transportation [Solaymani and Kari (2013), Choi *et al.* (2018)].

To summarize the long-term estimate results of all tables discussed in this section, we notice that overall, for most sectors, a higher oil price leads to higher consumer prices, confirming the results of Salisu *et al.* (2017). Regardless of whether a country is an exporter or an importer, the oil price and inflation index are frequently linked. Any change in the price of oil affects the price of production, and the inflationary effects of crude oil price fluctuations are likely to be reflected in consumer prices [Kalthum and Masih (2017), *Li et al*. (2019)]. In fact, an increased in PPI inflation drives up CPI inflation across oil exporting and importing countries. Theoretically, this can be explained by the "cost-push inflation" [see Clark (1995), Sek et al (2015)]: producer pricing reflects any changes in the cost of raw materials. As such, a rise in the cost of production due to an increase in the price of raw materials (for example, oil), may impact the pricing of a range of goods and services, and therefore transfer along the product's cost to consumers. Hence, a rise in producer good prices would result in an increase in the producer price index, which would then lead to an increase in consumer price index.

According to the Appendix (B1 to B14), the exchange and interest rates act as leading indicators for CPI. When an economy is heavily dependent on imported products, the exchange rate is essential and plays a critical role in the costs of those products. A sharp rise in the cost of inputs followed by a depreciation in the exchange rate causes prices to rise (import prices become more expensive) and then leads to a higher inflation rate. On the other hand, Lachebeh and Sirag (2019), Husaini *et al.* (2019b), Zhu and Chen (2019) and Mpofu (2011) also found that rising oil prices accompanied with a monetary policy such as a decrease in the interest rate led to higher inflation rates. As interest rates are the major instrument used by central banks to regulate inflation, an increase in interest rates is a way to fight against excessive inflation.

The results could be best summarized as follows: First we found that oil prices affect the rate of inflation in both net oil-importing and exporting nations. Our results confirm those of Filis and Chatziantoniou (2014) but are in contrast with those of Blanchard and Gali (2007). Second, we found that the relationship between oil prices and the CPI tends to change depending on the country and the sector. In fact, an increase in oil prices leads to a rise in most of the sectoral inflation. However, the decrease in oil prices has had little impact on the majority of exporting and importing countries. Third, the impact of oil price seems to matter more when it comes to importing countries, confirming the findings of Salisu *et al.* (2017). Our results confirm in part the results of Arouri and Nguyen (2010), and Abel and Bernanke (2001), who found that in the case of oil price shock, an oil-importing nation immediately faces inflation, and the costs of production are expected to increase, given that oil is one of the most fundamental inputs of production. As a result of the higher cost, consumer prices will rise accordingly.

Fourth, our results revealed that the inflationary effects of changes in oil prices in the long and short term are likely to affect prices in the sectors most dependent on oil like the energy sector (transport), confirming the results of Beyer *et al.* (2009), who found that energy prices are the primary cause of rising inflation rates. Indeed, the producer price index has a stronger connection with production costs and input costs (like oil prices). All goods and products that are transported will be subject to high transportation costs as a result of rising oil prices.

Consumer prices are the prices of the final goods that are sold to consumers. Every change in the price of oil affects the price of production, and the inflationary effects of crude oil price fluctuations are likely to be reflected in consumer prices. The reason why oil price changes have an important effect on the sectors that use this energy source is that oil is a major input in the economy: it is used in critical activities such as refueling, transport and heating of houses and also in everything related to food products (food packaging and the transportation costs of these products) and if the cost of the inputs increases, the cost of the final products should increase too [See Salisu *et al.* (2017), L'Oeillet and Licheron (2008), and Clark (1995)].

### 3.2- Results of the panel threshold model

As mentioned in section 2, in addition to the nonlinear ARDL model, we consider the Hansen's model (2000), which is a suitable framework allowing for the presence of potentially nonlinear threshold effects. Based on the data of 10 importing and exporting countries for the period of July 2009 to February 2021, a preliminary investigation was conducted to examine the possibility of threshold effects in the relationship between oil price and inflation. Indeed, in the Appendix C, we plotted, for each country, the successive OLS coefficients of the OLS regression between inflation and oil price over different sub-samples sorted according to the oil price (from the lowest to the highest)[11]. This provides some preliminary visual evidence

[11] The same method is applied by Méon and Sekkat (2005) to assess whether the impact of corruption on growth depends on the quality of governance.

supporting our argument[12], namely, the presence of potentially nonlinear threshold effects on the relation between oil price and inflation. As can be seen, the curve switches from negative to positive beyond a certain level of the oil price.

Tables in Appendix (D1-D10) report empirical results of the effect of oil price on sectoral inflation for the 10 countries of our sample. In these tables, we provide the estimated coefficients with their standard deviation in parentheses. In addition, each table includes the result of F-statistics, threshold estimate $\tau$ and its confidence interval. In this tables, lower regime, *i.e.,* below than the threshold level, represents the effect on inflation when oil price is lower than the threshold level $\tau$, while, upper regime, *i.e.,* higher than the threshold level $\tau$, represents the effect on inflation when oil price is higher than the threshold level $\tau$.

As a preliminary step, we estimate the nonlinear model (4) using aggregate inflation (first column: Global). For all countries, from the F-test results, it can easily be seen that the null hypothesis of absence of a threshold effect is rejected by data at the 1% level, suggesting the presence of oil price effects on inflation. For oil-exporting countries, the oil price threshold level varies between 51.05 and 70.97. The average for the 5 countries is 62.70. Concerning oil-importing countries, the oil price threshold level varies between 59.81 and 84.28. The average for the 5 oil- importing countries is 70. Once it is established that the relationship between oil price and inflation is subject to threshold effects, the next relevant question is whether the magnitude of oil price affects differently inflation in the two detected regimes of high and low oil price level. From the oil price coefficient (OP), where oil price is greater than the threshold level, the estimated coefficient of OP is positive and significant at the 1% level. This result implies that when oil price is above the threshold it will lead to a rise of inflation.

The sectors' inflation may respond differently to oil price. Indeed, there might be sectors that are more sensitive to oil price than others. We use the test of Hansen (2000) to investigate the existence of a nonlinear effect between oil price and inflation at a sectoral level. The results of the threshold effect test are also shown in Appendix (D1-D10). The results of the F-test reveal that the nonlinear relationship between oil price and inflation holds for most cases except for the clothing sector in Germany, and Norway. The lowest threshold level for oil price is in China for the clothing sector. However, the highest threshold level is in the Netherlands for the clothing sector. According to these results, China, with the smallest average threshold level

[12] Further econometric analyses are needed to confirm the initial visual observations.

(59.74), is the country most sensitive to oil price levels. However, the sector most sensitive to oil prices is equipment with an average threshold level of 67.21.

Next, we turn to estimate the effect of oil price on the sectors ‘inflation. We first start with the lower regime, in which oil price is below the estimated threshold values. The coefficients are generally negative. For aggregate inflation (first column: Global), the coefficients are negative and significant for five out of ten countries. At the sectoral level, the coefficient of oil prices is negative and significant in 5 out of 10 cases for the transport sector, 4 out of 10 for the health sector, 6 out of 10 for the fuel sector, 6 out of 10 for the food sector, 7 out of 10 for the equipment sector , and 4 out of 10 for the clothing sector.

Passing to the upper regime, in which oil price is higher the estimated threshold values, the coefficients are generally positive. Indeed, for aggregate inflation (first column: Global), the coefficients are negative and significant for seven out of ten countries. At the sectoral level, the coefficient of oil prices is negative and significant in 5 out of 10 cases for the transport sector, 3 out of 10 for the health sector, 4 out of 10 for the fuel sector, 6 out of 10 for the food sector , 6 out of 10 for the equipment sector, and 4 out of 10 for the clothing sector.

On first glance, we thought that this result is contradictory with the NARDL result where we showed that the effect of oil prices on inflation is generally positive. However, the results are not contradictory since the effect of oil price is negative only when the oil price level is below the threshold. Nevertheless, in reality, the level of oil prices in recent years is well above the threshold level determined by the Hansen's model. Thus, these estimates are almost the same as those of the NARDL model. They confirm, in part, the findings of Salisu *et al.* (2017) and Kalthum and Masih (2017) and show that the relationship between oil price and inflation tends to change according to sectors and countries. Our results also have highlighted the role of energy intensity, which leads to different impacts of oil prices on inflation, depending on the sector. Sectors that are more dependent on oil in their production activities tend to be significantly affected by changes in oil prices.

Our research is a comprehensive and in-depth study that fills gaps of previous studies on different points: Firstly, we evaluated the impact of oil price shocks on determining inflation, considering the impact of previous shocks using a varied number of explanatory variables. This takes into account monetary policy, the exchange market, unemployment rate, PPI and the role of different channels in the transmission of the inflationary effect of oil prices. Secondly, we conducted comparative study depending on the country, sectors, and the most performant non-linear models able to examine the potential short and long-run asymmetries (NARDL model) and able to investigate the possible threshold impact of oil prices (Panel threshold model).

Thirdly, unlike most studies which use quarterly or annual data to investigate the relationship between the price of oil and inflation, our data includes a large number of monthly observations. In addition, this data covers the COVID-19 current pandemic period, which has affected all economic activities as well as the markets of raw materials such as the price of oil and vital sectors in an economy.

## 4- Conclusion and policy implications

In this paper, we have questioned the linear response of sectoral inflation to oil price variations, which has been a common assumption in the empirical literature. To do so, the asymmetric (nonlinear) ARDL approach of Shin *et al.* (2014) and the nonlinear Hansen's threshold model (2000) have been applied to monthly time-series data of 6 sectors: transport, health, fuel, food, equipment, and clothing, for 5 oil-exporting, and 5 oil-importing countries over the July 2009 to February 2021 period. With the use of this modeling strategy, we explored the asymmetric and the nonlinear effects of oil price variations on sectoral inflation.

Our findings can be summarized as follows: for the NARDL model, the inflationary effects of changes in oil prices are likely to affect prices in the sectors most dependent on oil as the energy sector (transport). Specifically, we found that that the effect of oil prices on inflation is generally positive: an increase in oil price leads to an increase in most of the sectoral inflation. However, the decrease in oil price has a weak effect on inflation.

The results of the implementation of the Hansen's threshold model (2000) that aims at investigating whether the relationship between oil prices and inflation exhibits a threshold effect clearly confirmed this characteristic for all countries. This result still holds at a sectoral level (with a few exceptions). Furthermore, we found that the country most sensitive to the oil price level is China, and that the sector most sensitive to the oil price is equipment.

The assumption that the inflationary effect of oil price is the same for all countries is certainly false. Therefore, nations would be affected differently by oil price variations due to their major economic activities, and their status (oil exporting/ oil importing nations). Thus, country-level heterogeneity should be considered. Our findings support this statement and demonstrate the originality of our study by highlighting the suitability and the flexibility of two powerful nonlinear models (NARDL and Hansen's threshold) in exploring the inflationary effects of oil prices across sectors and countries.

This study has important policy implications: to lessen the inflationary effect of high oil prices and to reduce the dependence on imported oil, governments should switch to other renewable energy sources and adopt energy-efficient and fuel-efficient technologies, namely substituting oil with other sources of energy such as biofuels, hydrocarbons, and nuclear power, which constitute real alternatives in the long term. Central banks too should also set inflation targets and act quickly to ease inflationary pressures. A robust monetary policy is necessary to moderate inflation. Moreover, policymakers have to diversify their economies and raise the proportion of non-oil sectors in their economic activities in order to reduce the shocks caused by changes in oil price. Consequently, those oil-dependent countries will maintain stability and remain resilient to unanticipated shocks.

On the other hand, to assist in making appropriate decisions, all the sources of an oil price shock, whether it originates on the supply side or demand side, should be carefully considered, and examined. As interest rates and inflation are linked, the Government may utilize them to efficiently manage the amount of money in circulation. The Central Bank may reduce inflation by raising interest rates and decreasing the amount of lending and credit.

Moreover, it is essential to establish an efficient monetary policy that is often associated with a fiscal policy: a monetary policy based on pricing control to achieve low inflation, combined with a fiscal policy based on subsidies, may be able to lessen shocks brought on by high oil prices and by the excessive influence of macroeconomic variables on domestic prices.

Additional research should be directed to incorporating several other determinants in the analysis such as the money supply and the wage rate, which also might have a significant impact on the relationship between oil price and inflation.

# Appendix

**Appendix A: Data presentation**

| Variables | Description | Definition | Source |
|---|---|---|---|
| OP | crude oil price (spot) | West Texas Intermediate oil per barrel in Dollars ($) | EIA (Energy Information Administration) |
| CPI | Consumer price index | a measure of the change in the average consumer prices of goods and services over a given period. | IMF (International Monetary Fund) |
| EXCH | The real exchange rate | The exchange rate refers to the ratio of currencies to each other. | IMF (International Monetary Fund) |
| INT | The interest rate | percentage that allows for the measurement of the bank's compensation for extending credit | IMF (International Monetary Fund) |
| PPI | Producer price index | a measure of the change in the average producer prices of goods and services by domestic producers over a given period. | IMF (International Monetary Fund) |
| UMP | The unemployment rate | represents the percentage of unemployed people among the active population | IMF (International Monetary Fund) |
| **Countries** | | | |
| Oil-exporting Countries | Russia, Canada, Norway, Brazil, Mexico. | | |
| Oil-Importing Countries | China, United States, South Korea, Germany, The Netherlands. | | |

**Appendix B: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model.**

| *Table B1: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for Russia* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
| | $LEXCH^i$ | $LINT^i$ | $LPPI^i$ | $LUMP^i$ | $POS^i$ | $NEG^i$ | $F$ | $ECM_{t-1}$ | $LM$ | **Wald-S** | **Wald-L** |
| ***global*** | -0.35(0.57) | 0.11(2.21) | -1.02 (0.69) | -0.1(0.15) | 0.32(0.99) | -0.005 (0.001) | 1.56 | -0.037(-1.17) | 0.15 | 0.17 | 2.40 |
| ***Transport #*** | 0.02(0.85) | 0.05(5.6)*** | 0.11 (0.54) | 0.02(0.86) | 0.08 (3.61)* | -0.04 (2.85)* | 0.91 | -0.18 (-2.01) | 1.61 | 1.12 | 18*** |
| ***health*** | 0.70(0.81) | 0.08(0.56) | 0.63 (0.48) | 0.63(0.98) | -0.27 (0.46) | -0.37 (1.41) | 1.31 | 0.02(1.00) | 45.46*** | 0.01 | 0.40 |
| ***fuel*** | 0.05(.13) | 0.15(13.1)*** | 0.03(0.14) | 0.15(1.23) | 0.17 (3.43)* | 0.009 (0.24) | 2.26 | -0.26 (-3.5)* | 21.5*** | 0.04 | 8.34*** |
| ***food*** | -0.43(0.46) | 0.07 (0.66) | -1.15 (0.57) | -0.23(0.2) | 0.32 (0.70) | -0.02 (0.31) | 1.58 | -0.05(-1.20) | 0.28 | 0.12 | 1.90 |
| ***Equipment #*** | -0.18 (1.9) | 0.07(11.2)*** | -0.29 (0.79) | -0.04(0.2) | 0.05 (0.62) | -0.1 (17.9)*** | 3.03 | -0.98 (-2.18) | 26.5*** | 1.89 | 9.16*** |
| ***Clothing*** | -0.22(0.83) | 0.07(3.79)** | -0.34 (0.54) | -0.24(1.4) | 0.001(0) | -0.1 (7.96)*** | 1.96 | -0.02 (-1.83) | 1.85 | 0.056 | 3.64*** |

| *Table B2: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for Canada* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | | ***Panel B: Diagnostics*** | | | |
| | $LEXCH^i$ | $LINT^i$ | $LPPI^i$ | $LUMP^i$ | $POS^i$ | $NEG^i$ | $F$ | $ECM_{t-1}$ | $LM$ | **Wald-S** | **Wald-L** |
| ***global*** | 0.41(1.14) | -0.01(0.05) | -0.71(0.02) | 0.49(0.56) | 0.19(0.401) | 0.04(0.20) | 11.99 | -0.50(-0.83) | 0.74 | 2.86* | 0.41 |
| ***Transport*** | -0.35 (0.30) | 0.05 (0.53) | -0.48(0.22) | 0.24(0.27) | 0.08(0.12) | 0.02(0.50) | 0.79 | -0.13(-0.92) | 4.26*** | 0.54 | 0.09 |
| ***health*** | 0.42 (0.15) | 0.07(0.54) | -4.89(0.73) | 1.84(0.25) | 0.43(0.14) | -0.02(-0.1) | 2.18 | -0.03(-0.56) | 20.76*** | 0.06 | 0.17 |
| ***Fuel #*** | 0.45(7.08)*** | -0.02(0.67) | 0.50 (0.18) | 0.19(1.08) | 0.05(0.60) | 0.003 (0.005) | 2.81 | -0.13(-2.66) | 0.93 | 0.05 | 0.69 |
| ***food*** | 1.40 (0.98) | -0.01 (0.13) | 0.32(0.002) | 0.44(0.26) | 0.07(0.05) | -0.10 (0.26) | 1.24 | -0.05(-0.81) | 2.88*** | 1.74 | 0.20 |
| ***Equipment*** | 0.20 (0.80) | -0.07 (3.56)* | 3.51(6.01)*** | 0.36(0.72) | 0.13(0.76) | 0.12(2.78) | 1.75 | -0.19(-2.01) | 6.9*** | 0.38 | 0.008 |
| ***Clothing #*** | 0.45 (7.08)** | -0.02 (0.67) | 0.50(0.18) | 0.19(1.08) | 0.05(0.60) | 0.003(0.05) | 2.81 | -0.13(-2.66) | 0.93 | 0.05 | 0.69 |

| Table B3: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for Norway | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
| | ***LEXCH$^i$*** | ***LINT$^i$*** | ***LPPI$^i$*** | ***LUMP$^i$*** | ***POS$^i$*** | ***NEG$^i$*** | ***F*** | ***ECM$_{t-1}$*** | ***LM*** | **Wald-S** | **Wald-L** |
| ***global*** | -0.16(0.49) | -0.009 (0.11) | -0.02 (0.09) | -0.02 (0.11) | 0.05(0.85) | -0.006 (0.16) | 1.03 | -0.17 (-1.48) | .079 | 0.42 | 11.8*** |
| ***Transport #*** | -0.04(0.22) | 0.001 (0.17) | 0.02 (0.59) | -0.01 (0.24) | 0.06(8.7)*** | 0.004 (0.82) | 1.54 | -0.84(-4.1) ** | 8.78*** | 0.88 | 12.1** |
| ***health*** | -0.40(2.25) | 0.04 (1.03) | -0.33 (2.26) | 0.03 (0.18) | 0.24(5.5)*** | 0.15(3.47)** | 1.97 | -0.18(-1.53) | 5.33*** | 3.01* | 12.98*** |
| ***Fuel #*** | -0.12(0.55) | -0.008 (0.17) | -0.36 (1.83) | -0.05 (0.73) | 0.16 (1.81) | 0.08(0.55) | 1.33 | -0.16(-2.11) | .08 | 0.008 | 7.69*** |
| ***Food #*** | 0.08(0.48) | -0.01 (1.37) | -0.03 (0.40) | 0.05 (1.99) | 0.05(2.96)* | 0(6.94) | 4.27* | -0.93(-4.55)** | 1.11 | 9.18*** | 51.91*** |
| ***Equipment*** | -0.29 (4.3)*** | 0.01 (1.27) | -0.04 (0.36) | 0.06 (2.79) | 0.02 (0.63) | -0.01 (0.48) | 3.25 | -0.79 (-3.09) | 6.76*** | 5.04*** | 14.59*** |
| ***Clothing*** | -0.43(0.55) | 0.11 (3.01)* | -0.16 (1.29) | 0.11 (0.64) | 0.006 (0.05) | -0.01 (0.18) | 4.01* | -0.48(-1.91) | 4.15*** | 0.84 | 0.55 |

| Table B4: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for Brazil | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
| | ***LEXCH$^i$*** | ***LINT$^i$*** | ***LPPI$^i$*** | ***LUMP$^i$*** | ***POS$^i$*** | ***NEG$^i$*** | ***F*** | ***ECM$_{t-1}$*** | ***LM*** | **Wald-S** | **Wald-L** |
| ***global*** | 0.05(0.40) | 0.02(0.13) | 0.25(0.45) | -0.05(0.48) | 0.2(8.10)*** | -0.10(3.18)* | 3.02 | -0.13(-2.90) | 13.28*** | 1.17 | 340.8*** |
| ***Transport*** | -0.03(0.13) | 0.07(0.84) | 0.84(2.04) | -0.08(0.62) | 0.14(2.55) | -0.12(2.85)* | 2.40 | -0.22(-2.41) | 0.08 | 0.57 | 117.1*** |
| ***health*** | 0.12 (0.23) | 0.009(0.004) | 0.32(0.18) | -0.07(0.01) | 0.15 (1.30) | -0.08 (0.47) | 0.83 | -0.10(-1.07) | 0.68 *** | 0.33 | 61.51*** |
| ***fuel*** | 0.03(1.85) | 0.02(2.64) | 0.12(2.16) | 0.01(1.43) | 0.03(6.1)*** | -0.005(0.20) | 1.91 | -0.23(-2.82) | 36.83*** | 0.76 | 106.3*** |
| ***Food #*** | 0.02(0.71) | -0.06 (1.18) | -0.29(0.97) | -0.01(0.37) | 0.3(32.0)*** | -0.04 (1.02) | 3.69* | -.18(-4.24) ** | 2.82* | 1.42 | 684.3*** |
| ***Equipment*** | -0.03(0.01) | 0.02 (0.14) | 0.43 (0.98) | -0.07(0.68) | 0.12 (0.23) | -0.11(0.27) | 0.35 | -0.09(-0.92) | 30.7*** | 0.02 | 13.28*** |
| ***Clothing*** | -0.13(0.32) | 0.10 (0.25) | 0.53 (0.20) | -0.09(0.17) | 0.16 (0.75) | -0.09(0.39) | 0.74 | -0.10(-1.38) | 16.4*** | 0.31 | 19.36*** |

| Table B5: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for Mexico | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
| | ***LEXCH$^i$*** | ***LINT$^i$*** | ***LPPI$^i$*** | ***LUMP$^i$*** | ***POS$^i$*** | ***NEG$^i$*** | ***F*** | ***ECM$_{t-1}$*** | ***LM*** | **Wald-S** | **Wald-L** |
| ***global*** | -0.87(0.11) | -0.14(0.12) | -1.79(0.80) | -0.05 (0.46) | 0.32(0.17) | 0.007(0.02) | 1.62 | -0.02(-0.35) | 032 | 13.28*** | .18 |
| ***Transport*** | -2.07(0.1) | -1.43(0.01) | -12.23(0.01) | -0.62 (0.01) | 3.19 (0.21) | 1.11(0.01) | 1.13 | -0.10(-0.14) | 44.24*** | 0.28 | 0.02 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***health*** | -0.95(0.39) | 0.14(0.03) | 3.41(0.03) | 0.05(0.02) | -0.41 (0.25) | -0.06(0.48) | 0.44 | -0.009(-0.2) | 2.03 | 0.001 | 0.02 |
| ***Fuel #*** | -0.06(2.16) | -0.02(4.31)*** | 0.20(4.30)*** | -0.01 (1.23) | 0.5(11.8)*** | 0(0.004) | 6.91** | -0.87(-6.6)** | 1.44 | 2.04 | 14.88*** |
| ***food*** | -1.01(0.77) | -0.01 (0.13) | -2.85(0.47) | 0.28(1.05) | 0.48(0.79) | 0.03(0.87) | 1.24 | -0.07(-0.93) | .02 | 1.38 | 0.95 |
| ***Equipment*** | -1.12(0.31) | 0.08 (0.21) | -0.16(0.14) | 0.14 (0.54) | 0.13(0.41) | 0.07(0.20) | 1.50 | -0.04(-0.05) | 6.17*** | 0.07 | 0.17 |
| ***Clothing*** | 11.49(0.008) | -3.81 (0.008) | -78.44 (0.008) | 3.62 (0.008) | 8.75(0) | -1.00(0) | 5.40** | -0.003(-0.03) | 0.16 | 5.51** | .0008 |

*Table B6: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for China*

| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***$LEXCH^i$*** | ***$LINT^i$*** | ***$LPPI^i$*** | ***$LUMP^i$*** | ***$POS^i$*** | ***$NEG^i$*** | ***F*** | ***$ECM_{t-1}$*** | ***LM*** | **Wald-S** | **Wald-L** |
| ***Global #*** | 0.21(2.13) | -0.05(4.14)** | 0.08(0.61) | 0.03(0.16) | 0.09(3.79)* | -0.01(0.74) | 0.99 | -0.33(-2.13) | 4.76*** | 4.84*** | 12.02*** |
| ***Transport #*** | 0.01(0.59) | -0.02(7.82)*** | 0.08(1.25) | -0.05(2.7) | 0.1(22.1)*** | 0.03(6.75)*** | 3.74 | -0.40(-3.78)** | 0.02 | 0.44 | 19.71*** |
| ***Health #*** | 0.10(0.78) | -0.02 (0.47) | -0.04(0.90) | 0.14(2.03) | 0.15(6.3)*** | 0.01(0.36) | 1.54 | 0.21(1.40) | 20.27*** | 2.05 | 9.37*** |
| ***Fuel #*** | 0.37(3.28)* | -0.05(2.48) | 0.27(1.22) | 0.15(1.87) | 0.11(2.74) | -0.01(0.93) | 1.52 | -0.57(-2.70) | 7.61*** | 1.90 | 8.16*** |
| ***food*** | 0.67(0.65) | -0.22(1.17) | -0.13 (0.35) | 0.15(0.12) | 0.59(1.23) | 0.35(0.68) | 2.63 | 0.10(0.77) | 9.09*** | 5.64*** | 2.30 |
| ***Equipment#*** | 0.26(7.19)*** | -0.02(1.73) | -0.19(2.27) | 0.06 (1.34) | 0.1(15.3)*** | 0.05(5.26)*** | 1.42 | -0.22(-2.30) | 21.52*** | 0.34 | 17.89*** |
| ***Clothing*** | 0.26(6.03)** | -0.04(6.83) | -0.20(2.63) | -0.15(6.5)* | 0.09(7.12)** | 0.06(6.84)** | 1.49 | -0.93(-3.11) | 0.15 | 0.54 | 2.13 |

| *Table B7: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for US* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
| | ***$LEXCH^i$*** | ***$LINT^i$*** | ***$LPPI^i$*** | ***$LUMP^i$*** | ***$POS^i$*** | ***$NEG^i$*** | ***F*** | ***$ECM_{t-1}$*** | ***LM*** | **Wald-S** | **Wald-L** |
| ***Global #*** | -0.13(3.95)* | 0.005(0.80) | 0.04(0.30) | 0.03(0.27) | 0.05(9.3)*** | -0.007(0.04) | 4.21* | -0.36(-2.95) | 0.004 | 0.50 | 12.92*** |
| ***Transport #*** | -1.20(5.67)*** | 0.01(0.16) | -1.73(0.90) | 0.71 (10.6) | 0.32(6.1)*** | -0.02(0.81) | 2.90 | -0.33(-3.66) * | 2.24 | .04 | 7.80*** |
| ***Health #*** | 1.53(0.68) | 0.08(0.53) | 6.64(0.83) | -0.03(0.01) | -0.53 (0.85) | -0.18(0.88) | 4.09* | -.03(-0.96) | 1.25 | .12 | .74 |
| ***Fuel #*** | 0.47(0.26) | 0.02(0.41) | 0.94 (0.16) | 0.02(0.10) | 0.06 (0.37) | 0.02(0.55) | 1.03 | -.02(-0.56) | 0.07 | 0.03 | .26 |
| ***food*** | -0.08(0.42) | -0.007(0.33) | -0.71 (0.15) | -0.23(1.72) | 0.10 (0.35) | 0.10(0.57) | 1.03 | -0.08(-1.51) | 9.21*** | 0.01 | 9.70 |
| ***Equipment#*** | -2.58(0.10) | 0.51(0.01) | 11.88(0.13) | 0.73 (0.16) | 0.03 (0.01) | -0.13(0.06) | 1.25 | -0.005(-0.11) | 0.05 | 0.34 | 0.10 |
| ***Clothing*** | 1.22(0.24) | -0.10(0.73) | 1.09 (0.77) | -0.94(0.48) | -0.05 (0.04) | 0.28(0.34) | 1.08 | 0.06(0.62) | 2.36 | 0.11 | 0.43 |

| *Table B8: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for South Korea* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
| | ***$LEXCH^i$*** | ***$LINT^i$*** | ***$LPPI^i$*** | ***$LUMP^i$*** | ***$POS^i$*** | ***$NEG^i$*** | ***F*** | ***$ECM_{t-1}$*** | ***LM*** | **Wald-S** | **Wald-L** |
| ***Global #*** | 0.02(0.15) | -0.09(5.32)*** | 0.84 (6.34)*** | 0.08 (0.25) | 0.01(0.25) | 0.01(0.16) | 1.80 | -0.11(-1.54) | 0.005 | 0.36 | 0.09 |
| ***Transport #*** | 0.07(1.48) | -0.04(1.31) | 0.75(6.12)*** | -0.03 (0.4) | 0.06 (1.63) | 0.06(2.25) | 2.13 | -0.27(-3.18) | 3* | .06 | 0.40 |
| ***Health #*** | 0.01(0.56) | -0.02(7.17)*** | 0.27(13.42)*** | -0.02 (2.3) | -0.01 (2.47) | -0.02(7.75) *** | 5.21** | -0.53(-4.8)** | 0.11 | 0.69 | 26.71*** |
| ***Fuel #*** | -0.04(0.22) | -0.13(6.17)** | 0.74(3.15)* | -0.07 (5.9) | 0.07 (1.46) | 0.05(1.05) | 0.93 | -0.16(-1.82) | 6.97*** | 0.008 | 1.08 |
| ***food*** | 0.09(0.66) | -0.15(3.83)* | 1.74 (6.76)** | 0.26 (1.85) | 0.02 (0.11) | 0.01(0.04) | 1.71 | -0.30(-1.71) | 9.64*** | 0.25 | 0.11 |
| ***Equipment#*** | -0.06(1.09) | -0.01(0.35) | 0.83 (6.70)** | 0.08(0.26) | -0.02 (0.25) | -0.05(2.00) | 1.91 | -0.29(-2.05) | 1.85 | 1.04 | 14.31*** |
| ***Clothing*** | -0.14(0.35) | -0.16(0.20) | 1.79 (0.73) | -1.35(0.10) | -0.11 (0.23) | -0.06(0.01) | 3.83* | -0.02(-0.33) | 11.55*** | 2.80 | 0.03 |

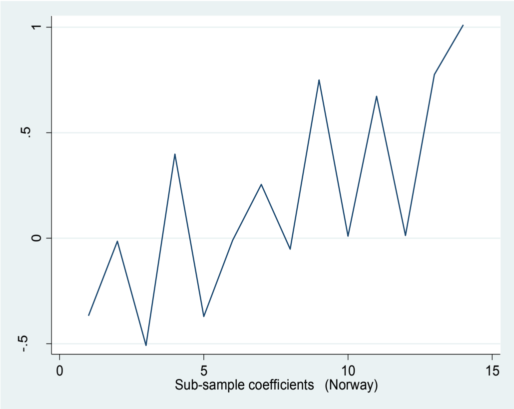
| *Table B9: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for Germany* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
| | ***$LEXCH^i$*** | ***$LINT^i$*** | ***$LPPI^i$*** | ***$LUMP^i$*** | ***$POS^i$*** | ***$NEG^i$*** | ***F*** | ***$ECM_{t-1}$*** | ***LM*** | **Wald-S** | **Wald-L** |
| ***Global #*** | -0.11(0.15) | -0.02(12.2)*** | 0.42 (3.36)* | 0.06(2.9)* | 0.03 (1.71) | 0.01(0.54) | 3.30 | -0.5(-4.4)** | 0.80 | 0.53 | 3.08* |
| ***Transport #*** | 0.01(0.31) | 0.01(3.86)* | 0.94(12.26)*** | -0.04(0.09) | 0.04 (2.80)* | 0.02(1.32) | 3.14 | -0.88(-3.9)** | 0.68 | 0.30 | 4.01** |
| ***Health #*** | 0.24(0.82) | 0.03(1.80) | -0.55(0.51) | -0.19(2.69) | -0.01(0.01) | -0.02(0.18) | 2.09 | -0.28(-2.67) | 50.1*** | 0.57 | 0. 68 |
| ***Fuel #*** | 0.61(0.48) | -0.008(0.36) | 3.46(1.34) | 0.19(0.95) | -0.15(0.49) | -0.15(0.68) | 2.06 | -0.05(-1.09) | 27.25*** | 6.78*** | 0.03 |
| ***food*** | 1.21(0.50) | -0.05(0.50) | 4.65 (0.36) | -0.59(0.72) | -0.60(0.68) | -0.35(0.61) | 2.20 | -0.10(-0.99) | 0.87 | 3.43 | 0.74 |
| ***Equipment#*** | -0.06(2.58) | -0.006(2.18) | 0.02(0.23) | 0.01(0.87) | 0.01(1.47) | -0.001(0.18) | 6.25** | -0.82 (-3.48)* | 5.89*** | 2.85* | 6.81*** |
| ***Clothing*** | -0.08(0.06) | 0.04(1.07) | 0.49(0.21) | -0.16(0.95) | -0.08(0.4) | -0.07(0.69) | 3.23 | -0.36(-1.68) | 0.85 | 0.93 | 0.01 |

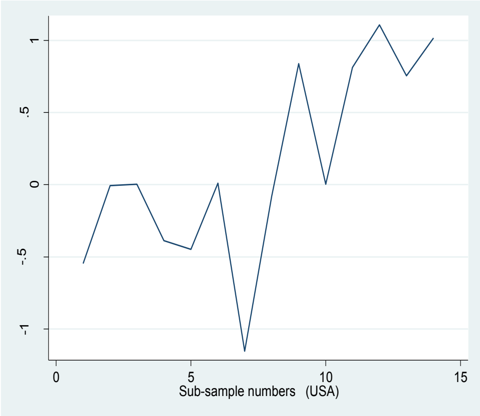
| *Table B10: Estimates of the long- term coefficients and diagnostics of the nonlinear ARDL model for the Netherlands* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***Panel A: Estimates of long- term coefficients*** | | | | | | ***Panel B: Diagnostics*** | | | | |
| | ***$LEXCH^i$*** | ***$LINT^i$*** | ***$LPPI^i$*** | ***$LUMP^i$*** | ***$POS^i$*** | ***$NEG^i$*** | ***F*** | ***$ECM_{t-1}$*** | ***LM*** | **Wald-S** | **Wald-L** |
| ***Global #*** | 0.32(6.38)*** | 0.04(5.08) | 0.24(4.34)*** | 0.06(3.5) | 0.05(5.0)*** | -0.009 (0.16) | 3.19 | -0.41(-3.54) * | 0.005 | 2.96* | 70.77*** |
| ***Transport #*** | 0.10(0.32) | 0.07(6.87)*** | 0.34(4.16)*** | 0.6(1.5)** | 0.1(12.1)*** | 0.04(2.06) | 3.92* | -0.66(-3.9)** | 0.77 | 6.20*** | 54.78*** |
| ***Health #*** | -2.14(0.31) | 0.19 (0.48) | -1.96 (0.37) | -0.11(0.27) | 0.64 (0.48) | 0.46(0.44) | 1.61 | -0.05(-0.71) | 0.14 | 1.02 | 0.57 |
| ***Fuel #*** | 0.36(0.90) | 0.06 (1.39) | 0.13(0.15) | 0.03(0.97) | 0.16(3.06)* | 0.06(0.70) | 3.38 | -0.16(-1.94) | 44.76*** | 4.84*** | 16.63*** |
| ***food*** | 0.26(1.85) | 0.02(1.25) | 0.33(3.66)* | 0.03(0.36) | 0.01(0.17) | -0.03(1.04) | 2.26 | -0.29(-2.96) | 0.007 | 1.43 | 20.78*** |
| ***Equipment#*** | 0.01(0.01) | 0.06(11.06)** | 0.17(2.76) | 0.01(3.7)* | -0.003(0.01) | -0.03(2.94)* | 2.29 | -0.39(-2.58) | 0.42 | 3.30* | 15.28*** |
| ***Clothing*** | 0.57(2.00) | 0.14(6.93)** | 0.76(4.36)** | 0.06(4.)** | -0.08 (1.07) | -0.11(2.60) | 2.72 | -0.98(-3.30) | 7.11*** | 1.17 | 2.00 |

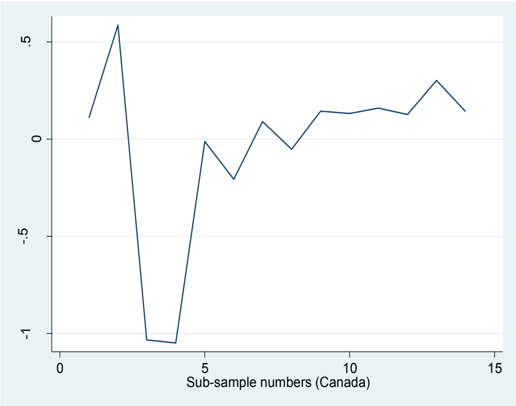
Notes :

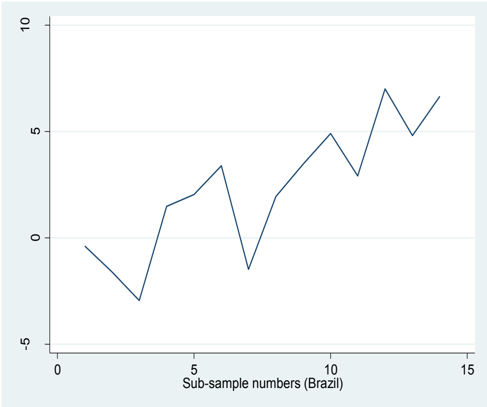
a. Number in brackets are absolute values of the t-ratios.
b. *. and ** indicate significance level at 10% and 5%, respectively.
c. Number in brackets next to ECMt-1 is the absolute value of the t-ratio. The upper bound critical value is −3.46 (−3.78) at the 10% (5%) significance level. It is derived from Pesaran *et al.* (2001. Table CII-Case III. page 303).
d. LM refers to the Lagrange Multiplier test of residual serial correlation. It has a $\chi^2$ distribution with one degree of freedom. The critical value is 2.70 (3.84) at the 10% (5%) significance level.
e. Wald tests have also the $\chi 2$ distribution with one degree of freedom. The critical values are 2.70 and 3.84 at 10% and 5% significance level respectively.
f. # Indicates significance of the covid dummy variable.

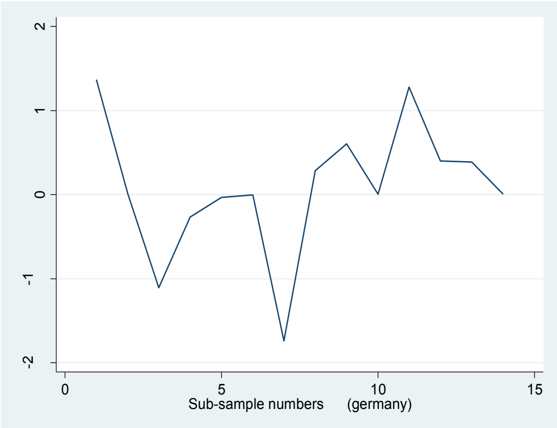
**Appendix C: Coefficients of the OLS regression between inflation and oil price for different levels of the oil price**

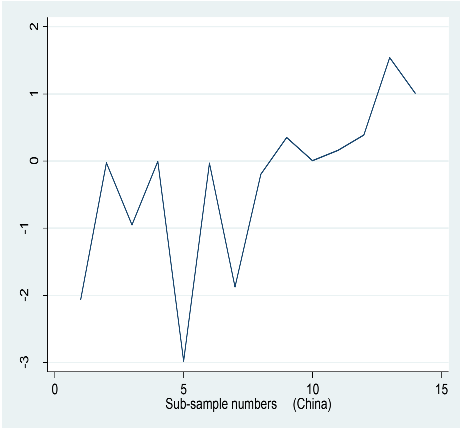


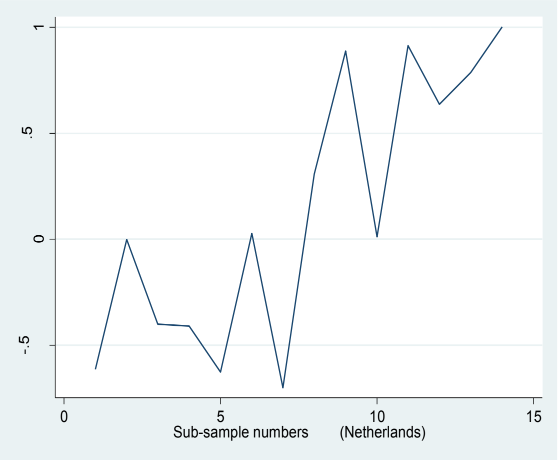



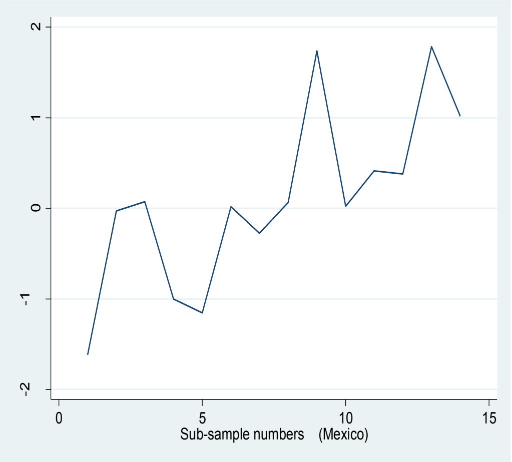



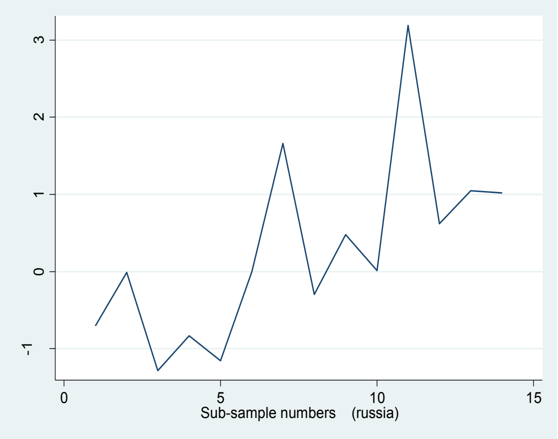



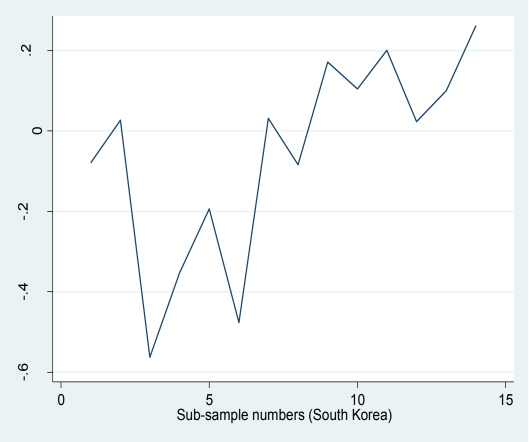




Sub-sample numbers (Netherlands)


Sub-sample numbers (Mexico)


Sub-sample numbers (russia)


Sub-sample numbers (South Korea)

**Appendix D: Estimates of the coefficients and diagnostics of the threshold model**

* = Significant at 10%, $ = Significant at 5%, # = Significant at 1%

*Table D1: Estimates of the coefficients and diagnostics of the threshold model for* Russia

| | *Global* | *Transport* | *Health* | *Fuel* | *Food* | *Equipment* | *Clothing* |
|---|---|---|---|---|---|---|---|
| **Threshold Test** | | | | | | | |
| ***F*** | 30.7# | 39.12# | 36.59# | 30.14# | 29.55# | 28.45# | 30.92# |
| ***P-value*** | 0 | 0 | 0 | 0 | 0 | 0.0003 | 0 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 63.81 | 59.87 | 63.85 | 63.69 | 63.85 | 59.03 | 63.69 |
| ***95%Confidence Interval*** | [63.68, 63.82] | [59.87, 60.82] | [59.87, 63.85] | [62.72, 63.85] | [63.69, 63.85] | [57.51, 63.85] | [56.95, 63.69] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | -0.05(0.01) # | -0.03(0.008) # | -0.06(0.01) # | -0.04(0.01) # | -0.051(0.01) # | -0.03(0.009) # | -0.05(0.01) # |
| ***LEXCH*** | 0.089(0.02) # | 0.05(0.03)* | 0.10(0.03) | 0.03(0.02) | 0.07(0.04)* | 0.09(0.02) # | 0.20(0.03) # |
| ***LINT*** | -0.12(0.01) # | -0.15(0.01) # | -0.15(0.01) # | -0.17(0.01) # | -0.08(0.02) # | -0.12(0.01) # | -0.12(0.01) # |
| ***LPPI*** | 0.33(0.06) # | 0.33(0.05) # | 0.32(0.07) # | 0.24(0.05) # | 0.42(0.08) | 0.21(0.05) # | 0.26(0.06) # |
| ***LUMP*** | -0.008(0.027) | -0.06(0.02) # | 0.04(0.03) | -0.13(0.03) # | 0.10(0.03) # | -0.003(0.03) | -0.06(0.04) |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | -0.02(0.03) | 0.10(0.02) # | -0.06(0.04) | 0.03(0.04) | 0.01(0.04) | .15(0.01) # | 0.04(0.02) $ |
| ***LEXCH*** | -0.18(0.07) # | -0.02(0.04) | -0.23(0.08) # | -0.13(0.09) | -0.23(0.08) # | 0.02(0.04) | -0.11(0.05) $ |
| ***LINT*** | 0.03(0.008) # | 0.03(0.006) # | 0.07(0.01) # | 0.02(0.01) $ | 0.01(0.009) | 0.01(0.006) # | 0.02(.007) # |
| ***LPPI*** | 0.69(0.03) # | 0.66(0.02) # | 0.68(0.03) # | 0.74(0.04) # | 0.76(0.04) # | 0.680(0.02) # | 0.63(0.02) # |
| ***LUMP*** | -0.04(0.02) $ | -0.02(0.02) | -0.03(0.03) | -0.09(0.04) $ | -0.02(0.03) | 0.05(0.02) # | -0.03(0.02) |

| *Table D2: Estimates of the coefficients and diagnostics of the threshold model for* Canada | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ***Global*** | ***Transport*** | ***Health*** | ***Fuel*** | ***Food*** | ***Equipment*** | ***Clothing*** |
| **Threshold Test** | | | | | | | |
| ***F*** | 61.98# | 43.86# | 70.42# | 69.28# | 60.50# | 44.74# | 69.28# |
| ***P-value*** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 63.85 | 70.97 | 63.85 | 63.85 | 70.97 | 70.97 | 63.85 |
| ***95%Confidence Interval*** | [63.85, 63.85] | [70.97, 71.04] | [63.69, 63.85] | [59.28, 73.73] | [70.97, 71.04] | [70.97, 74.46] | [59.28, 73.73] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | 0.006(0.005) | -0.08(0.02) # | 0.003(0.008) | -0.01(0.003) # | -0.07(0.01) # | -0.05(0.01) $ | 0.01(0.003) # |
| ***LEXCH*** | -0.08(0.03) # | -0.62(0.10) # | -0.06(0.05) | -0.100(0.01) # | 0.22(0.06) # | 0.10(0.05) $ | -.100(0.01) # |
| ***LINT*** | 0.004(.001) # | 0.01(0.007) | -0.01(0.002) # | 0.002(0.001) $ | 0.002(0.005) | 0.01(0.003) # | .002(0.001) $ |
| ***LPPI*** | 0.27(0.03) # | 0.45(0.11) # | -0.24(0.04) # | -0.46(0.02) # | 0.55(0.10) # | 1.24(0.05) # | -0.46(0.02) |
| ***LUMP*** | -0.007(0.005) | -0.009(0.02) | -0.03(0.009) # | 0.002(0.004) | -0.04(0.02) $ | -0.01(0.01) | .002(0.004) |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | 0.026(0.01) $ | 0.055(0.01) # | 0.08(0.01) # | 0.06(0.01) # | 0.01(0.02) # | 0.06(0.01) # | 0.06(0.01) # |
| ***LEXCH*** | 0.15(0.03) # | 0.28(0.03) # | -0.10(0.04) # | 0.10(0.05) # | -0.07(0.05) | -0.10(0.05) $ | 0.10(0.05) $ |
| ***LINT*** | -0.001(0.003) | -0.01(0.003) # | -0.01(0.004) # | -0.01(0.006) | 0.01(0.005) $ | -0.02(0.004) # | -0.01(0.006)* |
| ***LPPI*** | 1.15(0.07) # | 1.29(0.07) # | 0.90(0.09) # | 0.59(0.12) # | 1.14(0.11) # | 2.24(0.09) # | 0.59(0.12) # |
| ***LUMP*** | -0.04(0.01) # | 0.005(0.01) | -0.03(0.02) | -0.03(0.02) | -0.06(0.02) # | -0.01(0.01) | -0.03(0.02) |

| *Table D3: Estimates of the coefficients and diagnostics of the threshold model for* Norway | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ***Global*** | ***Transport*** | ***Health*** | ***Fuel*** | ***Food*** | ***Equipment*** | ***Clothing*** |
| **Threshold Test** | | | | | | | |
| ***F*** | 41.48# | 28.47# | 34.11 | 50.91# | 25.93# | 35.18# | 11.70 |
| ***P-value*** | 0 | 0 | 0 | 0 | 0 | 0 | 0.37 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 51.05 | 51.05 | 49.77 | 75.71 | 49.77 | 71.04 | 87.85 |
| ***95%Confidence Interval*** | [50.89, 51.05] | [50.89, 51.05] | [47.21, 66.24] | [70.97, 75.71] | [47.81, 81.88] | [71.04, 71.04] | [57.87, 87.85] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | 0.007(0.003) $ | 0.02(0.03) | -0.04(0.02) $ | 0.01(0.03) | -0.01(0.02) | -0.04(0.02) $ | 0.02(0.02) |
| ***LEXCH*** | -0.22(0.19) | -0.41(0.20) $ | -0.01(0.22) | -0.41(0.15) # | -0.06(0.22) | -0.70(0.13) # | 0.02(0.13) |
| ***LINT*** | -0.07(0.008) # | -0.08(0.009) # | -0.07(0.009) # | -0.03(0.01) # | -0.06(0.01) # | -0.05(0.008) # | -0.0008(0.01) |
| ***LPPI*** | 0.06(0.09) | 0.06(0.08) | 0.22(0.07) # | 0.45(0.04) # | -0.03(0.09) | 0.09(0.03) # | -0.21(0.05) # |
| ***LUMP*** | -0.15(051) | -0.16(0.04) # | -0.05(0.04) | -0.03(0.03) | -.012(0.05) $ | -0.01(0.03) | -0.07(0.03) $ |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | 0.07(0.01) $ | -0.05(.001) # | -0.01(0.01) | 0.04(0.03) | 0.02(0.01) $ | 0.02(0.02) | 0.07(0.09) |
| ***LEXCH*** | -0.51(0.06) $ | -0.58(0.06) # | -0.62(0.07) # | -0.33(0.08) # | -0.52(0.05) # | -0.34(0.08) # | 0.18(0.26) |
| ***LINT*** | -0.01(0.008) | -0.01(0.009) | -0.02(0.008) # | -0.03(0.01) # | -0.01(0.006)* | -0.01(0.01) | 0.07(0.04)* |
| ***LPPI*** | 0.23(0.02) $ | 0.28(0.02) # | 0.26(0.02) # | 0.06(0.05) | 0.11(0.02) # | -0.05(0.02) # | 0.04(0.30) |
| ***LUMP*** | 0.01(0.02) | -0.0003(0.02) | -0.004(0.02) | 0.11(0.03) # | -0.01(0.01) | 0.004(0.01) | 0.03(0.05) |

| *Table D4: Estimates of the coefficients and diagnostics of the threshold model for* Brazil | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ***Global*** | ***Transport*** | ***Health*** | ***Fuel*** | ***Food*** | ***Equipment*** | ***Clothing*** |
| **Threshold Test** | | | | | | | |
| ***F*** | 49.08# | 47.72# | 50.60# | 49.85# | 48.91# | 49.65# | 49.12# |
| ***P-value*** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 63.85 | 63.85 | 63.85 | 63.85 | 63.85 | 63.85 | 63.85 |
| ***95%Confidence Interval*** | [63.85, 63.85] | [63.69, 63.85] | [63.85, 63.85] | [63.69, 63.85] | [63.69, 63.85] | [63.85, 63.85] | [63.69, 63.85] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | 0.005(0.50) | 0.008(0.04) | 0.01(0.03) | 0.001(0.003) | 0.007(0.05) | 0.002(0.03) | -0.002(0.04) |
| ***LEXCH*** | 0.21(0.10) $ | 0.19(0.09) $ | 0.06(0.07) | 0.03(0.009) # | 0.18(0.10)* | 0.13(0.07) # | 0.22(0.09) $ |
| ***LINT*** | -0.28(0.02) # | -0.24(0.02) # | -0.21(0.02) # | -0.009(0.002) # | -0.32(0.30) | -0.21(0.02) # | -0.25(0.02) # |
| ***LPPI*** | -0.99(0.38) # | -1.12(0.35) # | -0.58(0.27) $ | -0.06(0.03) $ | -0.77(0.41)* | -0.55(0.29)* | -0.89(0.37) $ |
| ***LUMP*** | -0.36(0.03) # | -0.33(0.03) # | -0.26(0.02) # | -0.02(0.002) # | -0.39(0.03) # | -0.30(0.02) # | -0.35(0.03) # |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | 0.03(0.13) | 0.03(0.12) | 0.02(0.10) | 0.01(0.01) | 0.03(0.14) | 0.01(0.11) | 0.01(0.12) |
| ***LEXCH*** | -1.63(0.10) # | -1.52(0.09) # | -1.30(0.08) # | -0.18(0.01) # | -1.76(0.11) # | -1.40(0.08) # | -1.58(0.09) # |
| ***LINT*** | 0.67(0.12) # | 0.61(0.11) # | 0.55(0.09) # | 0.10(0.01) # | 0.74(0.13) # | 0.58(0.10) # | 0.61(0.11) # |
| ***LPPI*** | 2.64(0.34) # | 2.66(0.32) # | 2.15(0.25) # | 0.49(0.04) # | 2.63(0.37) # | 2.24(0.28) # | 2.51(0.32) # |
| ***LUMP*** | -0.44(0.05) # | -0.40(0.05) # | -0.34(0.04) # | -0.03(0.007) # | -0.48(0.06) # | -0.36(0.04) # | -0.41(0.05) # |

| *Table D5: Estimates of the coefficients and diagnostics of the threshold model for* Mexico | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ***Global*** | ***Transport*** | ***Health*** | ***Fuel*** | ***Food*** | ***Equipment*** | ***Clothing*** |
| **Threshold Test** | | | | | | | |
| ***F*** | 47.97# | 48.63# | 46.25# | 34.56# | 32.81# | 25.84# | 39.49# |
| ***P-value*** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 70.97 | 63.85 | 66.24 | 75.78 | 53.46 | 49.81 | 63.85 |
| ***95%Confidence Interval*** | [51.37, 81.88] | [62.72, 63.85] | [63.69, 66.24] | [75.78, 76.38] | [49.81, 71.04] | [49.51, 53.46] | [63.69,63.85] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | 0.001(0.009) | 0.07(0.01) # | -0.005(0.03) | 0.006(0.01) | -0.0001(0.01) | 0.03(0.008) | 0.10(.006) $ |
| ***LEXCH*** | 0.02(0.02) | 0.05(0.04) | -0.14(0.05) $ | 0.02(0.03) | 0.07(0.03) $ | 0.01(0.02) | -0.03(0.02) |
| ***LINT*** | 0.38(0.006) # | 0.07(0.01) # | 0.005(0.03) | 0.02(0.01) $ | 0.05(0.009) $ | 0.03(0.007) | 0.03(0.005) $ |
| ***LPPI*** | 0.92(0.01) # | 1.05(0.07) # | 0.84(0.99) | 0.71(0.02) # | 1.13(0.04) $ | 0.85(0.04) | 0.41(0.03) $ |
| ***LUMP*** | 0.05(0.008) # | 0.01(0.03) | 0.002(0.06) | 0.07(0.01) # | 0.04(0.01) $ | 0.02(0.02) | -0.009(0.01) |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | 0.02(0.01) $ | 0.01(0.01) | 0.01(0.01) | 0.05(0.02) $ | 0.51(0.01) # | -0.01(.007) | 0.01(0.01) |
| ***LEXCH*** | -0.08(0.02) # | -0.01(0.04) | -0.01(0.02) | -0.18(0.03) # | -0.14(0.05) # | -0.09(0.02) # | -0.05(0.01) # |
| ***LINT*** | -0.10(0.01) # | -0.03(0.01) # | -0.01(0.008) | -0.16(.002) # | -0.009(0.01) | 0.005(0.008) | 0.008(0.007) |
| ***LPPI*** | 0.50(0.04) # | 1.43(0.01) # | 0.97(0.01) # | -0.20(0.08) # | 1.19(0.01) # | 0.80(0.10) # | 0.61(0.1) # |
| ***LUMP*** | 0.09(0.01) # | -0.07(0.01) # | -0.04(0.006) # | 0.22(0.01) # | 0.05(0.01) # | 0.01(0.007) | -0.006(0.006) |

*Table D6: Estimates of the coefficients and diagnostics of the threshold model for* China

| | ***Global*** | ***Transport*** | ***Health*** | ***Fuel*** | ***Food*** | ***Equipment*** | ***Clothing*** |
|---|---|---|---|---|---|---|---|
| **Threshold Test** | | | | | | | |
| ***F*** | 43.49# | 46.87# | 44.69# | 15.90$ | 51.39# | 48.21# | 14.35* |
| ***P-value*** | 0 | 0 | 0 | 0.02 | 0 | 0 | 0.09 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 63.85 | 63.85 | 59.81 | 63.69 | 62.22 | 63.85 | 40.93 |
| ***95%Confidence Interval*** | [59.87, 63.85] | [59.87,71.04] | [59.03,63.85] | [59.28,74.46] | [62.22, 62.22] | [63.85,63.85] | [38.30,81.88] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | 0.02 (0.007) # | -0.003(0.005) | -0.005(0.01) | -0.03(0.01) # | -0.04(0.02) $ | -0.02 (0.006) # | -0.05(0.02) # |
| ***LEXCH*** | 0.11 (0.07) | -0.01(0.03) | 0.07(0.06) | -0.01(0.12) | 0.67(0.15) $ | 0.09 (0.06) | 2.18(0.41) # |
| ***LINT*** | 0.06 (0.003) # | 0.03(0.003) # | 0.08(0.007) # | 0.01(0.006)* | 0.03(0.02) | 0.05 (0.003) # | 0.06(0.01) # |
| ***LPPI*** | 0.1(0.2) | 0.20(0.03) # | 0.32(0.08) # | 0.52(0.06) # | 1.29(0.19) $ | 0.1(0.09) | -0.71(0.41)* |
| ***LUMP*** | 0.14 (0.007) # | 0.01(0.01) | 0.15(0.02) # | -0.04(0.02) $ | -0.003(0.07) | 0.13 (0.06) $ | 0.28(0.12) $ |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | 0.05(0.03)* | 0.05 (0.01) # | 0.02(0.01) | 0.04(0.06) | 0.09(0.02) # | 0.005(0.01) | 0.05(0.01) # |
| ***LEXCH*** | 0.77(0.05) # | 0.43 (0.04) # | 0.50(0.03) # | 0.71(0.13) $ | 0.87(0.08) # | 0.61(0.03) # | 0.24(0.09) # |
| ***LINT*** | 0.05(0.01) # | 0.02(0.004) | 0.08(0.004) # | 0.06(0.02) # | 0.06(0.01) # | 0.03(0.006) # | -0.03(0.008) # |
| ***LPPI*** | 0.14(0.1) | 0.12(0.03) # | 0.19(0.03) # | 0.39(0.14) # | 0.10(0.07) | 0.13(0.08) | 0.03(0.05) |
| ***LUMP*** | -0.06(0.02) # | -0.02(0.01) $ | -0.01(0.01) | -0.02(0.04) | -0.13(0.02) # | -0.005(0.17) | -0.18(0.02) # |

| *Table D7: Estimates of the coefficients and diagnostics of the threshold model for* US | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ***Global*** | ***Transport*** | ***Health*** | ***Fuel*** | ***Food*** | ***Equipment*** | ***Clothing*** |
| **Threshold Test** | | | | | | | |
| ***F*** | 30.79# | 18.78# | 41.09# | 50.92# | 51.61# | 44.30# | 30.50# |
| ***P-value*** | 0 | 0.005 | 0 | 0 | 0 | 0 | 0 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 70.97 | 84.28 | 59.03 | 59.81 | 59.87 | 60.82 | 59.87 |
| ***95%Confidence Interval*** | [59.03,74.46] | [84.28,85.51] | [51.99,75.23] | [59.03,62.22] | [59.81,62.22] | [59.87,63.85] | [57.51,68.05] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | 0.02(0.008) | 0.01(0.02) | 0.02(0.01) | 0.02(0.009) $ | 0.01(0.008) | 0.006(0.008) | 0.001(0.01) |
| ***LEXCH*** | 0.09(0.06) | -0.69(0.14) # | 0.31(0.08) # | 0.37(0.07) $ | -0.14(0.04) $ | -0.18(0.04) $ | -0.06(0.08) |
| ***LINT*** | -0.01(0.005)$ | 0.009(0.01) | -0.03(0.006) # | -0.03(0.006) $ | -0.02(0.006) $ | -0.02(0.004) $ | 0.01(0.01) |
| ***LPPI*** | 0.89(0.06) # | 0.92(0.01) # | 0.77(0.05) # | 1.28(0.05) $ | 0.48(0.06) $ | 0.45(0.04) $ | -0.47(0.10) $ |
| ***LUMP*** | 0.006(0.007) | 0.04(0.01) # | -0.02(0.01) | -0.01(0.01) | 0.007(0.008) | 0.01(0.006)* | -0.005(0.01) |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | 0.04(0.01) # | 0.10(0.07) | -0.02(0.01) | 0.03(0.01) # | 0.03(0.009) # | 0.02(0.01) $ | 0.07(0.02) # |
| ***LEXCH*** | -0.06(0.04) | 0.37(0.26) | 0.02(0.05) | 0.16(0.05) # | -0.28(0.03) # | 0.06(0.04) | -0.24(0.10) $ |
| ***LINT*** | -0.007(0.005) | -0.06(0.02) # | 0.01(0.004) # | 0.02(0.004) # | -0.001(0.005) | -0.02(0.003) # | -0.05(0.01) # |
| ***LPPI*** | 0.36(0.06) # | -1.32(0.46) # | 0.88(0.06) # | 0.67(0.07) # | 0.50(0.07) # | -0.29(0.05) # | -0.37(0.15) # |
| ***LUMP*** | -0.06(0.01) # | 0.01(0.07) | -0.08(0.01) # | -0.09(0.01) # | -0.07(0.01) # | 0.005(0.009) | -0.14(0.02) # |

| *Table D8: Estimates of the coefficients and diagnostics of the threshold model for* South Korea | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ***Global*** | ***Transport*** | ***Health*** | ***Fuel*** | ***Food*** | ***Equipment*** | ***Clothing*** |
| **Threshold Test** | | | | | | | |
| ***F*** | 51.00# | 44.08# | 43.36# | 36.58# | 33.62# | 56.30# | 43.08# |
| ***P-value*** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 59.81 | 81.88 | 59.81 | 63.85 | 60.82 | 59.81 | 62.72 |
| ***95%Confidence Interval*** | [59.81,63.69] | [81.19,81.88] | [59.26,63.85] | [59.81,63.85] | [59.03,63.85] | [59.81,63.85] | [59.81,63.85] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | -0.02(0.006) # | 0.03(0.009) # | -0.02(0.003) # | -0.03(0.006) $ | -0.046(0.01) $ | -0.04(0.009) $ | -0.02(0.007) $ |
| ***LEXCH*** | 0.16(0.02) # | -0.05(0.01) # | 0.09(0.01) # | -0.007(0.03) | 0.24(0.05) $ | 0.21(0.03) $ | 0.18(0.02) $ |
| ***LINT*** | -0.08(0.04) $ | 0.01(0.007) | -0.01(0.003) # | 0.004(0.005) | -0.07(0.01) $ | -0.006(0.008) | -0.003(0.005) |
| ***LPPI*** | 1.08(0.05) # | 0.64(0.07) # | 0.54(0.03) # | 0.77(0.07) $ | 2.09(0.14) $ | 1.41(0.09) $ | 0.88(0.07) $ |
| ***LUMP*** | -0.007(0.007) | -0.02(0.009) $ | 0.01(0.004) # | 0.001(0.006) | 0.007(0.01) | -0.004(0.01) | -0.01(0.007) |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | 0.07(0.01) # | 0.002(0.03) | 0.04(0.006) # | -0.001(0.02) | 0.12(0.03) # | 0.12(0.01) # | 0.08(0.02) # |
| ***LEXCH*** | -0.09(0.03) # | 0.04(0.03) | -0.04(0.01) # | -0.21(0.40) | -0.02(0.07) | -0.08(0.04) $ | -0.23(0.05) # |
| ***LINT*** | -0.063(0.02) # | -0.09(0.02) # | -0.02(0.009) $ | -0.07(0.02) # | -0.15(0.04) # | -0.08(0.02) # | -0.08(0.03) # |
| ***LPPI*** | 1.07(0.06) # | 1.39(1.17) | 0.56(0.03) # | 1.09(0.07) # | 2.07(0.15) # | 1.10(0.71) | 1.23(0.10) # |
| ***LUMP*** | 0.02(0.008) # | 0.0005(0.01) | 0.03(0.005) # | -0.02(0.01) $ | 0.05(0.01) # | 0.04(0.01) # | 3.32(0.01) # |

*Table D9: Estimates of the coefficients and diagnostics of the threshold model for* Germany

| | *Global* | *Transport* | *Health* | *Fuel* | *Food* | *Equipment* | *Clothing* |
|---|---|---|---|---|---|---|---|
| **Threshold Test** | | | | | | | |
| ***F*** | 30.95# | 23.85# | 48.05# | 40.24# | 45.10# | 22.27# | 13.61 |
| ***P-value*** | 0 | 0.0006 | 0 | 0 | 0 | 0.0006 | 0.17 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\tau$)*** | 84.28 | 81.19 | 81.88 | 84.28 | 84.28 | 51.96 | 71.04 |
| ***95%Confidence Interval*** | [81.19,86.52] | [78.32,89.16] | [76.59,86.52] | [84.28,84.28] | [84.28,86.52] | [49.51,88.57] | [16.54,109.51] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | -0.01(0.004) | 0.02(0.003) # | -0.01(0.002) # | -0.02(0.005) # | -0.03(0.006) # | -0.01(0.002) # | -0.02(0.01) $ |
| ***LEXCH*** | 0.16(0.02) # | 0.12(0.02) # | 0.21(0.01) # | 0.11(0.02) # | 0.15(0.04) # | -0.05(0.03)* | -0.06(0.10) |
| ***LINT*** | -0.03(0.004) # | -0.01(0.006)* | -0.03(0.003) # | -0.02(0.004) # | -0.07(0.10) | -0.03(0.005) # | 0.01(0.02) |
| ***LPPI*** | 0.67(0.06) # | 1.16(0.09) # | 0.29(0.04) # | 0.93(0.06) # | 1.05(0.14) # | 0.13(0.03) # | 0.24(0.33) |
| ***LUMP*** | 0.007(0.01) | 0.001(0.01) | 0.02(0.006) # | 0.01(0.01) | 0.06(0.01) # | 0.008(0.01) | -0.11(0.03) # |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | 0.01(0.006)* | 0.06(0.007) # | 0.01(0.02) | 0.006(0.007) | 0.01(0.01) | 0.02(0.005) # | -0.05(0.04) |
| ***LEXCH*** | -0.06(0.03) $ | -0.28(0.04) # | -0.46(0.08) # | -0.02(0.03) | 0.03(0.09) | 0.16(0.02) # | 0.24(0.19) |
| ***LINT*** | -0.04(0.002) # | -0.01(0.003) # | 0.01(0.005) $ | -0.05(0.002) # | -0.09(0.005) # | -0.01(0.001) # | -0.002(0.10) |
| ***LPPI*** | 0.91(0.10) # | 0.76(0.16) # | -0.41(0.21)* | 1.33(0.07) # | 2.15(0.25) # | 0.41(0.07) # | -0.22(0.48) |
| ***LUMP*** | -0.01(0.006)* | -0.04(0.01) # | -0.07(0.02) # | 0.006(0.007) | 0.05(0.01) # | 0.01(0.01) | -0.24(0.05) # |

*Table D10: Estimates of the coefficients and diagnostics of the threshold model for* the Netherlands

| | *Global* | *Transport* | *Health* | *Fuel* | *Food* | *Equipment* | *Clothing* |
|---|---|---|---|---|---|---|---|
| **Threshold Test** | | | | | | | |
| ***F*** | 27.27# | 28.28# | 45.19# | 40.34# | 30.84# | 43.06# | 8.47 |
| ***P-value*** | 0 | 0 | 0 | 0 | 0 | 0 | 0.86 |
| ***Critical value at 5%*** | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 | 14.8 |
| **Threshold Estimate ($\tau$)** | | | | | | | |
| ***Estimate ($\boldsymbol{\tau}$)*** | 71.04 | 73.73 | 60.82 | 60.82 | 74.46 | 70.97 | 94.50 |
| ***95%Confidence Interval*** | [71.04,84.39] | [71.04,73.73] | [60.82,60.82] | [60.82,60.82] | [71.04,77.98] | [70.97,81.88] | [51.37,102.85] |
| **Lower Regime($\leq \tau$)** | | | | | | | |
| ***LOP*** | -0.02(0.007) # | -0.008(0.006) | -0.007(0.005) | 0.0003(0.006) | -0.04(0.009) # | -0.01(0.004) # | 0.01(0.02) |
| ***LEXCH*** | 0.45(0.10) # | 0.21(0.13) | 0.91(0.13) # | 0.92(0.16) # | 0.50(0.10) # | 0.23(0.06) # | 0.58(0.33)* |
| ***LINT*** | -0.08(0.008) # | -0.07(0.01) # | 0.05(0.01) # | 0.02(0.01) $ | -0.08(0.008) # | -0.04(0.04) | -0.007(0.02) |
| ***LPPI*** | 0.30(0.06) # | 0.55(0.08) # | 0.28(0.08) # | 0.08(0.09) | 0.25(0.06) # | -0.01(0.03) | 0.31(0.16)* |
| ***LUMP*** | 0.01(0.01) | -0.005(0.01) | -0.01(0.02) | -0.10(0.02) # | -0.02(0.01) $ | -0.005(0.008) | 0.10(0.04) # |
| **Upper Regime($\geq \tau$)** | | | | | | | |
| ***LOP*** | -0.01(0.01) | 0.04 (0.02) $ | .008(0.009) # | 0.10(0.02) # | -0.009(0.01) | -0.008(0.008) | 0.72(0.32) $ |
| ***LEXCH*** | 0.007(0.08) | -0.24 (0.14)* | -0.01(0.03) | 0.31(0.17)* | 0.04(0.07) | 0.04(0.03) | 2.90(2.00) |
| ***LINT*** | -0.02(0.01) $ | -0.02 (0.01) $ | -0.02(0.003) # | -0.13(0.009) # | -0.009(.009) | 0.02(0.005) # | 0.37(0.23) |
| ***LPPI*** | 0.20(0.03) # | 0.32 (0.07) # | -0.03(0.03) | 0.22(0.09) $ | 0.23(0.04) # | 0.18(0.02) # | 1.57(2.19) |
| ***LUMP*** | 0.14(0.007) # | 0.18(0.01) # | 0.04(0.004) # | 0.08(0.01) # | 0.12(0.008) # | 0.05(0.004) # | 0.06(0.14) |

Note: number in brackets are standard errors of coefficients.

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