EXCHANGE VARIATION AND NON-LINEAR EFFECT ON EXPORTS: A SECTORAL ANALYSIS BY TECHNOLOGICAL INTENSITY

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RESUMO

Ainda se configura um importante problema entender os efeitos de variações cambiais sobre as exportações. Sendo assim, o presente estudo teve como objetivo avaliar o efeito assimétrico dessas variações da taxa de câmbio sobre as exportações setoriais brasileiras para os Estados Unidos, de 1999 a 2020. Contribui-se a literatura ao avaliar estes impactos observando a intensidade tecnológica dos setores analisados. O estudo aplicou o modelo Autorregressivo de Defasagem Distribuída Não Linear (NARDL) para 700 setores da economia brasileira. Os resultados mostraram que existe uma relação de longo prazo entre as exportações de determinados setores, a receita externa e a taxa de câmbio. Além disso, observou-se que as variações cambiais têm um efeito assimétrico sobre as exportações, que pode ser positivo ou negativo, dependendo do setor, mas que o efeito é principalmente assimétrico. Por fim, na maioria dos casos de assimetria, as desvalorizações cambiais afetam positivamente as exportações, independentemente da intensidade tecnológica dos setores. Observou-se também que quando há assimetria negativa (positiva), as valorizações (desvalorizações) tendem a beneficiar determinado setor e que setores maiores e com maior intensidade tecnológica tendem a se beneficiar da apreciação cambial.

Palavras-chave: Exportações. Taxa de câmbio. NARDL.

Códigos JEL: F14. F49. C32.

ABSTRACT

The effects of exchange rate variations on exports are still not understood. This paper aims to assess the asymmetric effect of these exchange rate variations on Brazilian sector exports to the United States, from 1999 to 2020. We assess these impacts by observing the technological intensity of the sectors analyzed. This study has applied the Non-linear Autoregressive Distributed Lag (NARDL) model to 700 sectors of the Brazilian economy. The results show that there was a long-term relationship between exports from certain sectors, foreign income, and the exchange rate. Furthermore, we observe that exchange rate variations have an asymmetric effect on exports, which can be positive or negative, depending on the sector, but that the effect is mostly asymmetric. Finally, in most cases of asymmetry, currency devaluations have a positive effect on exports, regardless of the technological intensity of the sectors. We

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also observe that when there is negative (positive) asymmetry, valuations (devaluations) tend to benefit a certain sector and that larger sectors with greater technological intensity tend to benefit from exchange rate appreciation.

Key words: Exports. Exchange rate. NARDL.

Jel Codes: F14. F49. C32.

1 INTRODUCTION

In a floating exchange rate regime and fierce competition in international trade, it is still important to study the effects of the exchange rate on the flow of international trade, as observed in the literature (see Baldwin 1990; Reinhart 2002; Verheyen 2013; Bahmani-Oskooe et al. 2017; Lourenço and Vasconcelos 2019; Wahab et al. 2020; among others).

The empirical literature, in practice, was based on the linear effect of the exchange rate on the components of the Trade Balance. However, as noted by Shin et al. (2014), asymmetry is endemic in human behavior. In particular, these authors argued that the assumption of linearity in the adjustment of macroeconomic variables may be insufficiently rich and overly restrictive. Thus, the asymmetry of the exchange rate effect on the flow of trade gained considerable impetus to be modeled in the international trade literature (see Cheung and Sengupta 2012; Verheyen 2013; Arize et al. 2017; Shekhawat 2018; Lourenço and Vasconselos 2019; Wahab et al. 2020; among others).

However, this discussion has barely touched upon its relationship with the technological intensity of the sectors. Lall (2000) has already pointed out that the slow change of the structure of exports has implications for growth and development, which shows the importance of studying by sector given its technological intensity. Consequently, it is hypothesized that the exchange rate has different effects on sectors, depending on their technological intensity. In fact, Colacelli (2009) had already shown that the real exchange rate (RER) has a more intense effect on differentiated goods than on homogeneous goods. Cimolli et al. (2013) justifies this fact because the devaluation makes exports more competitive in the production of goods, in which the difference in productivity is greater.

We contribute to this debate by analyzing, in the long run, the asymmetric effect of the exchange rate on exports. We also examine how this result differs due to the technological intensity of the sectors, which configures a gap in the literature. Therefore, we apply the NARDL methodology to bilateral exports from Brazil to the United States in 700 sectors, observing their inherent technological intensity, from 1999 to 2020. In fact, when disaggregating exports by sector, several patterns emerged. We note that asymmetry is the most frequent result. We also observe that when there is negative (positive) asymmetry, valuations (devaluations) tend to benefit a certain sector. We also found that larger sectors with greater technological intensity tend to benefit from exchange rate appreciation.

The rest of this paper is structured as follows. The second section reviews the literature and describes the empirical framework. The third section details the methodology and the data source. The fourth section gives the results. The last section will include our final considerations of the work.

2 LITERATURE REVIEW

The study of export demand equations is widely disseminated in the international trade literature. In a simplified way, the relationship between the exchange rate and the components

of the trade balance, such as exports, is based on the elasticity model (Bickerdike 1920; Marshall 1923; Lerner 1944; Robinson 1947; Metzler 1948). This model predicts that currency devaluations are associated with an increase in domestic supply. Consequently, appreciation (depreciation) makes exports more expensive.

In the opposite direction to the linear effect of the exchange rate, discussions about the asymmetry of this effect (i.e., cases in which the effect of devaluations or valuations is different) have been growing in the literature. As Shin et al. (2014) accused, it is obvious that these nonlinearities are endemic in human behavior; that is, economic agents have different responses to variations in the same variable. Specifically in relation to the exchange rate, there are several channels that can explain the asymmetries.

This phenomenon was justified for several reasons. The first is sunk costs in which, due to large initial investments, exporters do not react to the exchange rate (Baldwin 1990). The second is the fear of exchange rate fluctuation because exporters believe that governments have made devaluations temporary, behaving differently when compared to valuations (Calvo and Reinhart 2002).

Exchange rate asymmetry is also justified because exporters probably do not adjust prices to each change in the exchange rate. Instead, they incorporate these variations into profits so as not to incur losses in international market share. Thus, it is possible that there is a band of inaction, where exporters do not react to exchange rate fluctuations (Verheyen 2012, 2013). If exporters are trying to increase their market share, then they can absorb some of the valuations into their profit margins. However, in the face of devaluations, demand may increase, depending on capacity constraints (Verheyen 2013).

Cheung and Sengupta (2012) studied the effects of the RER on the share of Indian companies' exports in the non-financial sector in the period 2000–2010. They found that there is a negative relationship between valuation and exchange volatility in exports. They also found an asymmetric effect, in which exports react more to appreciations than to depreciations.

Cimolli et al. (2013) tested the hypothesis that the RER leads to an increase in diversification, which favors sectors of greater technological intensity. The authors analyzed how the exchange rate affects the diversification and structure of exports. They found signs that exchange devaluation tends to increase the participation of more technology-intensive sectors. The authors used the dynamic panel methodology for 111 countries in the period 1965–2005.

Verheyen (2013) studied the asymmetries of the exchange rate effect on bilateral US exports to 12 Economic and Monetary Union (EMU) countries from 1988–2012. The results suggested that linearities are restrictive. In particular, they showed that exports respond more intensively to depreciations than to appreciations. Analyzing the relationship between exchange rate movements and Indian export demand, from 1993–2013, Mathur and Shekhawat (2018) showed that exports reacted more intensively to appreciations than to depreciations. The authors used the approach that was developed by Verheyen (2013).

When evaluating the relationship between the exchange rate, and exports and imports in eight countries (i.e., China, Israel, Korea, Malaysia, Pakistan, Philippines, Russia, and Singapore) from 1980–2013, Arize et al. (2017) sought to understand the importance of the asymmetric effects of the exchange rate (appreciation and devaluation) on exports and imports. The authors used the NARDL approach and their results showed that the short and long-term evidence pointed to the existence of asymmetries in valuations and devaluations. Khachatryan and Grigoryan (2020) evaluated the relationship between the RER and Armenia's exports from 2001–2019. The authors found that there is a positive relationship between devaluations and exports, and that prolonged overvaluations may have caused a deterioration in the external

competitiveness of the Armenian economy. Wahab et al. (2020) studied the trade war between China and the US by evaluating the effect of devaluations on the trade balance between the two countries, from 2011–2018, using the NARDL approach. Their results show that devaluations of the Chinese currency had a positive effect on China's trade balance (valuations were not significant) and that competitiveness mattered more.

When analyzing the sectors by technological intensity, Melitz and Ottaviano (2008), and Berman et al. (2012) showed that high-productivity firms, with low elasticity of demand, increased export volumes in response to exchange rate devaluations. Meanwhile, Chatterjee et al. (2013) showed that high-productivity companies responded to currency devaluations by increasing product diversification and prices.

For the Brazilian case, several studies have analyzed the asymmetries of the exchange rate effect. Kannebley Jr. (2008) used a linear cointegration model to assess the possibility of hysteresis in Brazilian exports between 1985–2003. He noted that exports behave in a non-linear way in the long run. However, his specification only allowed for short-term analyzes. Gouvêa and Schettini (2011) assessed whether there was an asymmetric pattern of Brazilian imports, from 1996–2010, in a Markov-Switching (MS) structure, which was confirmed. However, the exchange rate effect was low. Schettini et al. (2012) also used a MS structure approach and showed that a change in cointegration occurred between 1995–2009. However, they did not find a significant relationship between the components of trade and the exchange rate.

De Prince and Kannebley Jr. (2013) evaluated the hypothesis of hysteresis in Brazilian imports. Through cointegration procedures, they validated the hysteresis hypothesis for 17 of the 29 sectors analyzed from 1996–2008, mainly in sectors that traditionally have high sunk costs. Furthermore, Lourenço and Vasconcelos (2019), using the NARDL approach for Brazil's five largest trading partners from 1999–2015, noted that overvaluations fostered exports in both the short and long term. They noted that depreciation discouraged imports. However, these results varied between countries. The authors also found evidence towards the hysteresis hypothesis.

This review shows that there was an evolution in the sophistication of the analysis of the effects of the exchange rate on components of the trade balance in empirical works on international trade focused on the subject. There was also an increase in the importance of evaluating the asymmetries of the exchange rate effect. However, for the Brazilian case, there are still few empirical works that are concerned with the topic, even more so when considering the sectorial characteristics of these exports. This paper seeks to contribute to filling this gap.

3 IDENTIFICATION STRATEGY

We follow the methodology proposed by Verheyen (2013) and Shin et al. (2014). Shin et al. (2014) highlighted that, so far, little effort has been made to capture non-linear cointegration, despite the contributions of Park and Phillips (2001), Saikkonen and Choi (2004), Escribano et al. (2006) and Bae and de Jong (2007).

This model can provide clues as to whether appreciations or devaluations of the real against the dollar have a distinct effect on Brazilian sector exports to the United States. Thus, the model starts with a demand equation for standard exports, that is:

$$x_t = \beta_0 + \eta\,(e_t + p_t^* - p_t) + \varepsilon\, y_t^* \qquad (1)$$
$$x_t = \beta_0 + \eta\, rer_t + \varepsilon\, y_t^*$$

where x_t, e_t, p_t^*, p_t, y_t^* and rer_t are, respectively, the demand for exports, the nominal exchange rate, the external prices, the domestic prices, the external income, and the real exchange rate, all measured in the period t. ε (η) represents the income-elasticity (price) of demand for exports ($\varepsilon > 0$, $\eta > 0$). This is the structural model, without the presence of asymmetries, which are to be estimated.

According to Pesaran et al. (2001), the verification of the long-term relationship, cointegration, in an ARDL(p, q_1, q_2) approach for the structural model of equation (1) can be represented by:

$$\Delta x_t = \beta_0 + \alpha_0 x_{t-1} + \alpha_1 rer_{t-1} + \alpha_2 y_{t-1}^* + \\ + \sum_{s=1}^{q} \gamma_1 \Delta x_{t-s} + \sum_{s=0}^{q_1} \pi_1 \Delta rer_{t-s} + \sum_{s=0}^{q_2} \pi_2 \Delta y_{t-s}^* + u_t \quad (2)$$

The advantage of the ARDL(p, q_1, q_2) model, presented in eq. (2) is that it allows us to analyze the cointegration between the demand for exports and its determinants; that is, a long-term relationship.[4] The level-lagged components capture the long-term relationship of the model and the variables in difference, which are the short-term relationships arising from the error correction term.

The limits test is used to verify the cointegration between the model variables. The null hypothesis of the test proposed by Pesaran et al. (2001) is the absence of a long-term relationship between exports and other variables; that is, ($\alpha_0 = \alpha_1 = \alpha_2 = 0$). Thus, if the calculated value is greater than the upper limit, then it implies cointegration. If it is less than the lower limit, then the absence of cointegration is inferred. However, it is not possible to draw conclusions if the test falls between the two limits. If this occurs, then there will be cointegration if the ECM coefficient is highly significant when compared to the critical values of Banerjee et al. (1998).

3.1 Nonlinearities

Note that equation (2) does not allow us to assess the asymmetries that possibly exist between the exchange rate and exports. To insert them, we extended, as suggested by Shin et al. (2014), by including the partial sum of positive and negative changes in the real exchange rate, as established by equation (2):

$$rer_t^+ = \sum_{s=1}^{t} \Delta rer_s [\Delta rer_s > 0] \\ rer_t^- = \sum_{s=1}^{t} \Delta rer_s [\Delta rer_s < 0] \quad (3)$$

[4] One of the limitations of the approach proposed by Pesaran et al. (2001), as the authors themselves suggest in the conclusion of their study, is that it captures only one eq. of cointegration and, "Consequently, it is inappropriate in situations where there may be more than one level relationship" (Pesaran et al., 2001, p. 315).

where I[.] is a dichotomous variable that takes a value of 1 if the condition in the indicator function is met, and is 0 otherwise. Thus, rer_t^+ (rer_t^-) refers to devaluations (appreciations) in the real exchange rate.

In this way, it would be possible to capture the distinct effects on exports of devaluations and appreciations. Here, the effect of devaluations on exports is expected to be distinct from valuations, depending on the sectoral characteristics.

Therefore, the analysis of the impact of the non-linearity of the real exchange rate on exports consists of inserting equation (3) in place of the ARDL model exchange rate presented in equation (2). The real exchange rate is now analyzed separately for its valuations and depreciations. The NARDL(p, q_1, q_2, q_3) model is formalized as follows:

$$\Delta x_t = \beta_0 + \alpha_0 x_{t-1} + \alpha_1 rer_{t-1}^- + \alpha_2 rer_{t-1}^+ + \alpha_3 y_{t-1}^* + \sum_{s=1}^{p} \gamma_1 \Delta x_{t-s} + \sum_{s=0}^{q_1} \pi_1 \Delta rer_{t-s}^- + \sum_{s=0}^{q_2} \pi_2 \Delta rer_{t-s}^+ + \sum_{s=0}^{q_3} \pi_3 \Delta y_{t-s}^* + u_t \quad (4)$$

Here, from eq. (4), the PSS boundary test has the null hypothesis $\alpha_0 = \alpha_1 = \alpha_2 = \alpha_3 = 0$. Note that currency asymmetries are tested, both in the short and in the long run, by evaluating the disaggregated exchange rate coefficients (α_1, α_2, π_1 e π_2) of equation (3).

It is worth noting that after the estimations, exchange asymmetries are classified by the magnitude of the coefficients of the disaggregated variable. We compare the coefficients of rer_t^+ and rer_t^-. If both variables are significant, then the Wald test is performed. If only one is significant, then asymmetry is proven. Table 1 describes the tests that we performed.

Table 1: Asymmetry analysis for a limit model

Significant	Not significant	Wald test	Asymmetry
α_2 (rer_{t-1}^+)	α_1 (rer_{t-1}^-)	-	Positive
α_1 (rer_{t-1}^-)	α_2 (rer_{t-1}^+)	-	Negative
Both (α_1, α_2)	-	$H_0: \alpha_2 = \alpha_1$	Positive if $\lvert\alpha_2\rvert > \lvert\alpha_1\rvert$ Negative if $\lvert\alpha_2\rvert < \lvert\alpha_1\rvert$ Symmetric if H_0 is sustained

Source: Lourenço and Vasconcelos (2019).

3.2 Source and processing of data

We extract 1227 sectoral exports of four digits of the Harmonized System (HS). However, initially, the sectors were filtered, comprising only those that exported at least half of the analyzed months (130 months). After this initial filter, the sample comprised 700 sectors from the Comex Stat platform, of the Brazilian Ministry of Economy (2020).

The classification proposed by Lall (2000) was used to analyze the technological intensity of these sectors. The author classified the sectors into five categories, namely primary products (PP), resource-based manufactured products (RB), low technology (LT), medium technology (MT) and high technology (HT). Although restrictive, the 700 selected sectors represent around 98% of Brazil's total bilateral exports to the United States in the period.

We use the Organization for Economic Co-operation and Development (OECD) total industry production series (2021) as a proxy for US income. The nominal exchange rate was also obtained from the Federal Reserve (FED 2020), while domestic and foreign prices were collected from the International Monetary Fund (IMF; 2020). Thus, the bilateral real exchange rate between Brazil and the United States was calculated as follows: $rer = EP^*/P$, where E

is the nominal exchange rate and P (P^*) is the consumer price index for the Brazilian (US) economy.

The period analyzed runs from January 1999 to June 2020; thus, the series has 258 monthly observations. The choice of 1999 as the initial period is justified because Brazil at this time had adopted the floating exchange rate regime, having abandoned the fixed exchange rate regime. It is noteworthy that all data were deflated to 2015 prices using the Consumer Price Index obtained from the IMF (2020) and seasonally adjusted by the STL Method (Robert et al. 1990).

4 RESULTS AND DISCUSSION

Initially, we evaluated the presence of unit roots of the analyzed series, the real bilateral real-dollar exchange rate, US income, and exports from Brazil to the US of the 700 sectors. The explanatory variables of the export demand model, given by eq.(4), exchange and income, proved to be stationary until the first difference. All sectorial export series also followed this pattern by the Dickey-Fuller Augmented (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests, simultaneously.

In the single-equation approach proposed by Pesaran et al. (2001), the variables can be I(0) or I(1), otherwise F statistics cannot be trusted to determine the long-term relationship between exports and their determinants. Thus, the NARDL methodology is adequate for these 700 export demand equations.

We then analyze the number of lags of variables in the NARDL model of the 700 sectors, based on the Akaike Information Criterion (AIC). The lags for each of the variables (export from a certain sector, depreciation, appreciation, and US income) varied according to the minimization of this selection criterion.[5]

We validated the models by evaluating the presence of serial autocorrelation using the Ljung–Box test. The presence of serial autocorrelation was observed in 46 of the 700 equations that we analyzed. We capture the existence of a long-term relationship with the explanatory variables, as conducted by Verheyen (2013), in 358 sectors (51% of the sample) of the 654 remaining sectorial exports. By evaluating the sectors by their technological intensity, according to the classification of Lall (2000), we noted that around 42%, 49%, 55%, 52% and 44% of the high technology (HT), medium technology sectors (MT), low technology (LT), resource-based manufactures (RB) and primary products (PP), respectively, have a long-term relationship with the model variables.

For most sectors, regardless of technological intensity, there is a long-term structural relationship between the demand for exports and its determinants. It is clear here that the classification of the sector by technological intensity matters because the weight of the sectors, which have a long-term relationship in the relative sectoral participation in total exports, decreases, of the high technology sector, followed by for primary products, medium technology for the other classifications. A summary of these results can be seen in Table 2. The results can be seen in more detail in Table 4 in Appendix A. It should be noted that this table is a summary of the 700 estimates that we made.

Of those cases in which there was cointegration, we used the Wald test and rejected the hypothesis of symmetry of the exchange rate effect in 210 sectors. In this case, there is a greater frequency of the asymmetric effect of the exchange rate on sectorial exports, regardless of

[5] We omitted the results of the stationarity, lags and cointegration analysis because of their length.

technological intensity. However, symmetry is more frequent in sectors with high technological content. If we analyze more closely, negative (positive) asymmetry was observed in 51% (49%) of the sectors where there is asymmetry or 107 (103) sectors. In other words, we inferred that in periods of appreciation, the effect of the exchange rate on exports is more intense in most cases where there is an asymmetric effect of the exchange rate on exports.

Table 2: Summary of results on cointegration and asymmetry

I. T.	Part.	Qtd.	Cointegrated			Positive			Negative		
			Qtd.	%	Part.	Qtd.	%	Part.	qtd.	%	Part.
HT	13.93%	55	23	41.82%	71.15%	3	13.04%	0.09%	8	34.78%	9.88%
MT	29.30%	173	85	49.13%	48.92%	24	28.24%	9.52%	17	20.00%	14.22%
LT	8.48%	158	87	55.06%	33.81%	30	34.48%	3.94%	24	27.59%	9.19%
RB	19.48%	136	71	52.21%	27.94%	20	28.17%	11.01%	24	33.80%	8.30%
PP	18.52%	82	36	43.90%	61.35%	9	25.00%	8.28%	16	44.44%	7.40%
OU	9.13%	96	56	58.33%	38.44%	17	30.36%	1.33%	18	32.14%	29.52%
Total	98.82%	700	358	51.14%	47.98%	103	28.77%	7.02%	107	29.89%	12.14%

Source: search results.

Note: I. T.: Sectoral Technological Intensity. High-Tech (HT), Medium Tech (MT), Low Tech (LT), Resource-Based Manufactures (RB), Primary Products (PP) and Unclassified (OU).[6]

Regarding technological intensity, we observe that about 13% of the 23 high-tech sectors with a cointegration ratio, 28% of the 85 medium technology, 34% of the 87 low technology, 28% of the 71 resource-based manufactures and 25% of the 36 on primary products had a positive asymmetric effect of the exchange rate on exports. In this case, we verified that the high technology sector has the smallest percentage of sub-sectors with this behavior. This indicates that the RER effect is more intense in periods of exchange devaluation than in periods of exchange appreciation. In turn, in 35%, 20%, 28%, 34% and 44% of the sectors of high technology, medium technology, low technology, resource-based manufactures and primary products, respectively, we observe that the effect of the rate of exchange rate on exports is more intense in periods of exchange appreciation. The negative asymmetry of the exchange rate is only not more common in the medium technology and low technology sectors. Nevertheless, sectors with negative asymmetry have a greater share in total exports compared to sectors with positive asymmetry, except for manufacturing sectors based on natural resources and primary products.

Assessing the direction of the effect of the exchange rate on exports in different sectors, it was observed that in 66 of the 107 cases where there was negative asymmetry, the effect of an exchange rate appreciation tends to benefit a certain sector. This shows that in the long run, regardless of technological intensity, exchange rate appreciations have a positive effect on these sectors. This result is in line with the results found by Amiti et al. (2014), in which currency valuations are positively associated with exports because large exporters are large importers and, therefore, an appreciation can reduce production costs. These sectors have a relative importance in the sectorial participation due to technological intensity, considering sectors with negative asymmetry, except for medium technology sectors. A summary of these results is given in Table 3. They are also further detailed in Appendix A in Table 4.

[6] We obtained the sectoral representation percentages (%) by filters. For example, 41.82% of the 55 high technology (HT) sectors (23 sectors) showed co-integration. In turn, 13.04% of these 23 sectors (3) present positive asymmetry. Thus, 52% have a symmetry relationship. In turn, these 55 sectors had 13.93% in the share of total exports. Still, the HT sectors with co-integration represent 71.15% of the participation of these sectors, or 9.91% of the total participation in exports. Furthermore, HT sectors with positive exchange rate asymmetry represent 0.09% of the share of these sectors or 0.01% of total exports.

We observe that in 87.38% of the cases in which there is a positive asymmetry of the exchange rate, in the long run, devaluations lead to an increase in exports. This occurs in about 67%, 92%, 87%, 90% 78% of the sectors that had positive asymmetry of high, low and medium technology, resource-based manufactures and primary products, respectively. In the rest, we verified that the increase in exports is associated with appreciation of the real exchange rate. Thus, in most of these cases, it seems that we can validate the hypothesis that currency devaluations will make the exported content cheaper, making it more competitive in the long run. This observation is valid in periods of exchange devaluations, both for dynamic sectors with a high technological content and for less sophisticated sectors. Thus, the discussions about "Dutch disease" that is widely debated by Bresser-Pereira (2013) do not seem to be valid here.

Table 3: Summary of results regarding the direction of the exchange rate effect when positive asymmetry, negative asymmetry, or linearity

I. T.	Positive			Negative			Simmetric	
	$\alpha_2 > 0$	%	Part.	$\alpha_1 > 0$	%	Part.	$\alpha_1 > 1; \alpha_2 > 0$	Part.
HT	2	66.67%	0.08%	2	25.00%	1.6%	3	0.09%
MT	22	91.67%	9.26%	8	47.06%	13.4%	15	2.33%
LT	26	86.67%	3.66%	6	25.00%	2.0%	10	0.26%
RB	18	90.00%	10.56%	9	37.50%	5.9%	14	1.05%
PP	7	77.78%	1.75%	10	62.50%	1.6%	8	0.15%
OU	15	88.24%	1.02%	6	33.33%	24.5%	1	0.00%
Total	90	87.38%	5.58%	41	38.32%	8.1%	51	3.88%

Source: search results.
Note: I. T.: Sectoral Technological Intensity. High-Tech (HT), Medium Tech (MT), Low Tech (LT), Resource-Based Manufactures (RB), Primary Products (PP) and Unclassified (OU).[7]

Finally, it is worth describing the cases in which a non-linear exchange rate effect was not observed. Of the 148 cases in which cointegration was observed, only 69 showed a significant long-term effect of the exchange rate on exports. Of these sectors, exports from 51 of them have a positive relationship with currency devaluations. Most cases are in the low-medium-high technology sectors (28). This shows that the discussions by Cimolli et al. (2013), Colacelli (2009), Goya (2020) and Missio and Jayme Jr. (2012) are valid, in which a currency devaluation benefits sectors with higher technological content, offsetting the low competitiveness in terms of quality and sophistication or encouraging investments in R&D. In other cases, either an asymmetric phenomenon is not observed or the decomposed components of the exchange rate are not significant.

Some patterns that we found deserve to be highlighted and emphasized. The first is that there will be losers and winners in the face of exchange rate variations, and that this phenomenon can have long-term effects. In addition, large sectors seem to benefit from currency valuations, while small sectors have more intense and positive effects against exchange rate depreciation. Finally, while most of the high-tech sub-sectors have negative asymmetry, as well as resource-based on manufacturing and primary products, most of the medium-low-tech sub-sectors are more affected in periods of currency devaluation. These details provide evidence to support the hypothesis that exports are not linearly affected by the exchange rate. Thus, these characteristics must be considered by the monetary authority when there is a need to influence exchange rate variations.

[7] The percentages refer to the sectors in which there was positive or negative asymmetry, as shown in Table. For example, we noted that in 67% (2) of the three HT sectors that had positive asymmetry currency devaluations have a positive effect on exports.

5 FINAL CONSIDERATIONS

This work has contributed to a gap in the international trade literature; namely, to evaluate the asymmetric effects of the exchange rate on exports from Brazil to the United States, from 1999–2020, considering the technological intensity of production in the sectors over the long term. deadline. A non-linear approach was applied to construct the model, breaking down the exchange rate between periods of exchange devaluation and periods of exchange appreciation.

We observe that there is a long-term relationship between the model variables in most cases. In most of those cases where this relationship exists, we noticed an asymmetric effect of the exchange rate. However, the exchange rate proved to be an important determinant of sectoral exports in the long run, with a distinction between positive asymmetric, negative asymmetric, and symmetric effects.

In most cases, regardless of the technological intensity of the sector, a certain pattern was observed: when there is positive asymmetry, devaluations have a positive effect on sectorial exports and, in the case of negative asymmetry, appreciations are associated with an increase in exports. This result is in line with the fact that a devalued exchange rate makes exports cheaper or even, and these valuations can reduce production costs. However, negative asymmetry was more frequent, the sectors that suffer from this phenomenon are usually larger.

It is noteworthy that the summary of the results does not cover all of the details of the various results that we found in this study. Thus, for future work, we propose to examine the sectorial characteristics and their relationship with the results found here in more detail because they are too extensive to be included in this study.

Finally, our results have important policy implications. Contrary to a linear effect of the exchange rate on exports, we observed an asymmetric phenomenon in several sectors. In addition, several sectors needed valued exchange rates to improve their costs given their high demand for imports because they are larger sectors and with greater technological content. However, certain sectors benefit from moments of exchange devaluation due to increased competitiveness. This highlights the continued weakness of the Brazilian export sector vis-à-vis exchange rates. In this case, policy makers should balance the interests of large and small manufacturers, and dynamic sectors of low technology content.

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APPENDIX A

Table 1: Results of export demand models that co-integrated and without autocorrelation

Code	Industry	Part.	I.T.	α_1 (rer^-_{t-1})	α_2 (rer^+_{t-1})	Wald	Ljung–Box
	Positive Assimetry						
x8470	Calculating machines, accounting ma[...]	0.01%	HT	7.05** (2.78)	-2.45 (2.03)	8.92***	15.56
x8506	Cells and batteries; primary	0.00%	HT	4.54*** (1.38)	2.15** (1.00)	4.16**	16.84
x2844	Radioactive chemical elements and r[...]	0.00%	HT	-3.94* (2.35)	-2.55 (1.71)	0.54	21.41
x8464	Machine-tools; for working stone, c[...]	0.00%	MT	11.26*** (2.92)	6.82*** (1.99)	4.61**	8.31
x8903	Yachts and other vessels; for pleas[...]	0.02%	MT	10.96*** (3.15)	4.61** (1.89)	6.64***	21.67
x8457	Machining centres, unit constructio[...]	0.04%	MT	6.44* (3.33)	1.10 (2.15)	3.93**	13.45
x8509	Electro-mechanical domestic applian[...]	0.00%	MT	5.71*** (2.05)	1.69 (1.36)	5.07**	10.16
x5516	Woven fabrics of artificial staple [...]	0.00%	MT	5.69*** (1.86)	2.48** (1.06)	5.15**	19.02
x3822	Composite diagnostic or laboratory [...]	0.01%	MT	4.97** (2.40)	1.96 (1.73)	1.55	14.55
x8420	Machines; calendering or other roll[...]	0.00%	MT	4.50* (2.55)	-2.18 (1.67)	9.23***	15.50
x2207	Ethyl alcohol, undenatured; of an a[...]	1.82%	MT	3.99** (1.81)	-1.19 (1.28)	8.62***	17.69
x8417	Furnaces and ovens; industrial or l[...]	0.02%	MT	3.15* (1.78)	-0.43 (1.28)	6.03**	13.67
x8425	Pulley tackle and hoists other than[...]	0.00%	MT	2.84** (1.29)	1.22 (0.90)	2.41	13.93
x3307	Perfumery, cosmetic or toilet prepa[...]	0.00%	MT	1.77*** (0.64)	0.14 (0.37)	7.71***	12.49
x7306	Tubes, pipes and hollow profiles (e[...]	0.10%	MT	1.56*** (0.58)	-0.20 (0.39)	12.94***	17.10
x8479	Machinery and mechanical appliances[...]	0.09%	MT	1.02*** (0.39)	0.43 (0.30)	2.21	7.18
x8422	Dish washing machines; machinery fo[...]	0.02%	MT	0.92** (0.46)	-0.45 (0.35)	8.86***	6.73
x3917	Tubes, pipes and hoses and fittings[...]	0.04%	MT	0.85** (0.37)	0.23 (0.24)	4.79**	11.28
x9001	Optical fibres and optical fibre bu[...]	0.01%	MT	-0.56** (0.24)	-0.17 (0.20)	4.85**	7.96
x5402	Synthetic filament yarn (other than[...]	0.00%	LT	8.02*** (2.08)	2.67* (1.43)	5.75**	7.35
x3922	Sanitary ware; baths, shower-baths,[...]	0.00%	LT	7.58*** (1.73)	2.31* (1.24)	11.69***	21.18
x3925	Plastics; builders' wares n.e.s. or[...]	0.00%	LT	6.97*** (2.12)	2.20 (1.39)	6.05**	9.93
x7010	Carboys, bottles, flasks, jars, pot[...]	0.00%	LT	6.66*** (2.50)	-1.42 (1.76)	10.60***	13.35
x7214	Iron or non-alloy steel; bars and r[...]	0.05%	LT	5.78** (2.24)	1.59 (1.50)	5.37**	11.43
x9608	Pens; ball-point, felt tipped, othe[...]	0.00%	LT	5.35** (2.32)	-1.14 (1.62)	6.90***	15.82
x9505	Festive, carnival or other entertai[...]	0.00%	LT	4.36** (2.05)	2.26 (1.42)	1.65	6.64
x6401	Footwear; waterproof, with outer so[...]	0.01%	LT	3.92* (1.99)	-1.12 (1.58)	6.32**	12.11
x6506	Headgear; n.e.s. in chapter 65, whe[...]	0.00%	LT	2.93* (1.68)	1.80 (1.35)	0.47	11.50
x8201	Tools, hand; spades, shovels, matto[...]	0.01%	LT	2.56*** (0.98)	-0.17 (0.69)	7.93***	19.75
x6205	Shirts; men's or boys' (not knitted[...]	0.00%	LT	2.52** (1.17)	0.69 (0.73)	3.53*	10.49
x6202	Coats; women's or girls' overcoats,[...]	0.00%	LT	2.25** (1.09)	-0.76 (0.80)	5.15**	20.25
x6102	Coats; women's or girls' overcoats,[...]	0.00%	LT	2.20** (0.85)	-0.26 (0.63)	7.61***	25.46
x7317	Nails, tacks, drawing pins, corruga[...]	0.00%	LT	1.65*** (0.43)	1.06*** (0.30)	3.88**	5.11
x8215	Cutlery; spoons, forks, ladles, ski[...]	0.01%	LT	1.01** (0.47)	0.38 (0.30)	2.10	14.90
x4202	Trunks; suit, camera, jewellery, cu[...]	0.01%	LT	0.55** (0.25)	0.07 (0.20)	2.90*	8.24
x7615	Aluminium; table, kitchen or other [...]	0.08%	LT	0.36* (0.21)	0.06 (0.15)	2.22	11.06
x3923	Plastic articles for the conveyance[...]	0.07%	LT	0.29*** (0.10)	0.10 (0.07)	6.96***	11.06
x8205	Tools, hand; (including glaziers' d[...]	0.01%	LT	-0.42* (0.25)	-0.18 (0.17)	1.18	11.81
x2827	Chlorides; chloride oxides and chlo[...]	0.01%	RB	8.56*** (3.15)	0.56 (2.14)	7.63***	16.91
x1101	Wheat or meslin flour	0.00%	RB	7.50*** (2.15)	4.08*** (1.35)	4.57**	12.88
x2713	Petroleum coke, petroleum bitumen; [...]	0.10%	RB	6.93** (3.28)	4.35 (2.66)	0.54	17.45
x2712	Petroleum jelly; paraffin wax, micr[...]	0.01%	RB	5.17* (2.63)	2.82 (1.84)	1.23	11.38
x4811	Paper, paperboard, cellulose waddin[...]	0.01%	RB	4.76*** (1.40)	1.52 (0.93)	8.47***	21.15
x2903	Halogenated derivatives of hydrocar[...]	0.03%	RB	4.27* (2.32)	-1.91 (1.56)	10.07***	18.89
x6809	Plaster or compositions based on pl[...]	0.00%	RB	4.22* (2.24)	1.22 (2.13)	1.18	18.02
x2005	Vegetable preparations n.e.s.; prep[...]	0.00%	RB	3.67*** (1.21)	1.39* (0.74)	5.87**	19.84
x3302	Odoriferous substances and mixtures[...]	0.01%	RB	1.81* (0.97)	-0.54 (0.67)	7.34***	16.08
x2208	Ethyl alcohol, undenatured; of an a[...]	0.01%	RB	1.16* (0.68)	0.33 (0.42)	2.36	3.94
x1102	Cereal flours; other than of wheat [...]	0.00%	RB	0.81** (0.32)	-0.52** (0.25)	12.83***	9.50
x2009	Fruit juices (including grape must)[...]	1.55%	RB	0.65** (0.31)	-0.29 (0.24)	8.86***	13.00
x3301	Oils; essential (concretes, absolut[...]	0.28%	RB	0.56*** (0.17)	0.00 (0.15)	11.32***	9.57
x2103	Sauces and preparations therefor; m[...]	0.00%	RB	0.45* (0.25)	0.19 (0.21)	1.29	12.77
x2106	Food preparations not elsewhere spe[...]	0.08%	RB	-0.45** (0.20)	0.08 (0.18)	5.53**	6.37
x7404	Copper; waste and scrap	0.01%	RB	-5.60** (2.73)	0.95 (1.82)	8.19***	16.75
x0206	Edible offal of bovine animals, swi[...]	0.00%	PP	4.02* (2.43)	-0.36 (1.78)	3.49*	14.30
x0506	Bones and horn-cores, unworked, def[...]	0.00%	PP	3.40** (1.33)	-0.59 (1.03)	7.86***	13.83
x1804	Cocoa; butter, fat and oil	0.23%	PP	3.11** (1.23)	0.80 (0.80)	4.51**	16.93
x1805	Cocoa; powder, not containing added[...]	0.06%	PP	0.41*** (0.15)	-0.02 (0.14)	11.86***	11.05
x7502	Nickel; unwrought	0.14%	PP	-5.34** (2.31)	-1.51 (1.58)	4.07**	23.32
x6210	Garments made up of fabrics of head[...]	0.00%	OU	10.77*** (2.23)	5.17*** (1.45)	9.76***	10.07
x2921	Amine-function compounds	0.01%	OU	5.01** (2.31)	-0.25 (1.64)	5.17**	9.52
x8311	Wires, rods, tubes, plates, electro[...]	0.00%	OU	4.96** (2.35)	2.07 (1.84)	1.46	10.26
x5602	Felt; whether or not impregnated, c[...]	0.00%	OU	4.75*** (1.81)	1.62 (1.21)	4.39**	19.36
x5910	Textiles; transmission or conveyor [...]	0.00%	OU	4.05* (2.30)	-0.40 (1.52)	4.92**	8.21
x6801	Stone; setts, curbstones and flagst[...]	0.00%	OU	3.98** (1.86)	-1.67 (1.32)	8.07***	15.78

Continuation of Table 4

Code	Industry	Part.	I.T.	α_1 (rer^{-}_{t-1})		α_2 (rer^{+}_{t-1})		Wald	Ljung–Box
x5903	Textile fabrics impregnated, coated[...]	0.00%	OU	3.75**	(1.57)	1.83	(1.19)	1.22	17.40
x5211	Woven fabrics of cotton, containing[...]	0.00%	OU	3.70**	(1.49)	-0.87	(1.06)	6.56**	16.07
x6101	Coats; men's or boys' overcoats, ca[...]	0.00%	OU	3.42*	(1.87)	0.92	(1.26)	2.65	18.69
x0811	Fruit and nuts; uncooked or cooked [...]	0.01%	OU	2.87**	(1.33)	-0.92	(0.99)	7.98***	5.94
x4901	Printed books, brochures, leaflets [...]	0.02%	OU	1.21***	(0.38)	-0.37	(0.24)	15.18***	11.44
x6112	Track suits, ski suits and swimwear[...]	0.02%	OU	0.29*	(0.16)	-0.08	(0.13)	7.43***	17.46
	Negative Assimetry								
x8471	Automatic data processing machines [...]	0.18%	HT	0.13	(0.13)	0.27**	(0.13)	2.94*	12.05
x8543	Electrical machines and apparatus; [...]	0.04%	HT	0.36	(0.30)	0.71***	(0.22)	1.91	11.34
x8473	Machinery; parts and accessories (n[...]	0.11%	HT	-0.03	(0.10)	-0.17*	(0.09)	4.76**	14.11
x2939	Alkaloids, vegetable; natural or re[...]	0.01%	HT	-0.63	(2.85)	-3.73*	(2.00)	1.60	10.83
x9030	Instruments, apparatus for measurin[...]	0.01%	HT	-0.15	(0.39)	-0.67*	(0.35)	3.03*	24.94
x3004	Medicaments; (not goods of heading [...]	0.20%	HT	0.07	(1.47)	-2.32*	(1.18)	2.28	8.85
x8503	Electric motors and generators; par[...]	0.82%	HT	0.03	(0.14)	-0.26**	(0.13)	5.52**	18.64
x9017	Drawing, marking-out, mathematical [...]	0.01%	HT	-0.48	(0.34)	-0.93***	(0.26)	2.06	8.87
x3911	Petroleum resins, coumarone-indene [...]	0.01%	MT	1.23	(0.78)	1.65**	(0.74)	0.77	19.82
x9004	Spectacles, goggles and the like; c[...]	0.00%	MT	0.15	(1.70)	3.46**	(1.41)	3.50*	12.09
x3824	Prepared binders for foundry moulds[...]	0.03%	MT	0.26	(0.17)	0.43***	(0.17)	2.33	11.66
x7207	Iron or non-alloy steel; semi-finis[...]	3.88%	MT	0.32	(0.55)	1.29***	(0.49)	3.44*	20.72
x9002	Lenses, prisms, mirrors and other o[...]	0.00%	MT	1.71	(1.64)	3.39***	(1.29)	1.55	19.21
x9028	Gas, liquid or electricity supply o[...]	0.01%	MT	0.81	(1.86)	-2.25*	(1.33)	3.86**	21.13
x8478	Machinery; for preparing or making [...]	0.00%	MT	2.03	(2.46)	-3.92**	(1.91)	4.69**	10.29
x8458	Lathes for removing metal	0.03%	MT	-2.02	(2.47)	-3.79**	(1.74)	0.83	11.82
x8441	Machines; for making up paper pulp,[...]	0.02%	MT	-0.68	(1.36)	-2.83**	(1.28)	3.08*	14.54
x8460	Machine-tools; for deburring, sharp[...]	0.00%	MT	-3.25	(2.76)	-5.18**	(2.33)	0.42	11.55
x8607	Railway or tramway locomotives or r[...]	0.15%	MT	-0.30	(0.26)	-0.58**	(0.25)	2.74*	21.18
x9019	Mechano-therapy, massage appliances[...]	0.00%	MT	-2.28	(2.23)	-4.16**	(1.77)	1.01	12.93
x8714	Vehicles; parts and accessories of [...]	0.01%	MT	0.48	(0.66)	-1.55**	(0.61)	7.04***	21.03
x7227	Steel, alloy; bars and rods, hot-ro[...]	0.00%	LT	2.10	(2.65)	4.08*	(2.15)	0.51	14.94
x7308	Structures of iron or steel and par[...]	0.04%	LT	1.90	(1.72)	2.51**	(1.18)	0.19	25.24
x3926	Articles of plastics and articles o[...]	0.06%	LT	0.12	(0.13)	0.26**	(0.12)	0.83	24.51
x7212	Iron or non-alloy steel; flat-rolle[...]	0.00%	LT	3.06	(2.22)	3.90**	(1.58)	0.23	19.28
x4820	Registers, account books, diaries a[...]	0.11%	LT	-0.12	(0.20)	-0.30*	(0.18)	0.83	14.72
x5807	Labels, badges and similar articles[...]	0.00%	LT	-0.97	(0.69)	-0.90*	(0.54)	0.01	16.66
x5007	Woven fabrics of silk or of silk wa[...]	0.00%	LT	3.33*	(1.93)	-3.85*	(2.27)	6.56**	6.98
x6106	Blouses, shirts and shirt-blouses; [...]	0.01%	LT	-0.13	(0.24)	-0.29*	(0.16)	0.75	15.72
x6203	Suits, ensembles, jackets, blazers,[...]	0.02%	LT	-0.54	(0.48)	-0.64*	(0.35)	0.06	11.40
x7616	Aluminium; articles n.e.s. in chapt[...]	0.03%	LT	-0.02	(0.11)	-0.23**	(0.10)	3.21*	12.54
x7219	Stainless steel; flat-rolled produc[...]	0.16%	LT	0.52	(0.56)	-1.03**	(0.40)	7.59***	6.30
x3406	Candles, tapers and the like	0.00%	LT	1.29	(2.09)	-4.78***	(1.83)	8.17***	5.22
x6217	Clothing accessories n.e.s.; parts [...]	0.00%	LT	0.43	(0.48)	-1.00***	(0.36)	10.19***	15.23
x7226	Alloy steel flat-rolled products, o[...]	0.00%	LT	0.11	(2.50)	-6.44***	(2.01)	6.60**	23.68
x7312	Stranded wire, ropes, cables, plait[...]	0.03%	LT	-0.10	(0.24)	-0.84***	(0.20)	8.99***	13.80
x7418	Table, kitchen or other household a[...]	0.00%	LT	1.52	(1.75)	-7.76***	(1.80)	14.47***	9.58
x5705	Carpets and other textile floor cov[...]	0.00%	LT	-1.18	(1.98)	-6.47***	(1.50)	8.71***	19.76
x4413	Densified wood, in blocks, plates, [...]	0.01%	RB	-0.02	(2.18)	2.80*	(1.66)	2.30	6.96
x4806	Vegetable parchment, greaseproof pa[...]	0.00%	RB	2.66	(2.74)	3.67*	(2.07)	0.13	11.71
x4504	Agglomerated cork (with or without [...]	0.00%	RB	1.35	(1.32)	2.51**	(1.12)	0.74	7.33
x4414	Wooden frames; for paintings, photo[...]	0.15%	RB	-0.01	(0.08)	0.20***	(0.07)	9.82***	13.81
x6903	Ceramic goods; (eg retorts, crucibl[...]	0.01%	RB	0.72	(0.68)	-0.77*	(0.47)	5.72**	23.24
x1516	Animal or vegetable fats and oils a[...]	0.01%	RB	0.69	(1.89)	-2.92**	(1.48)	4.01**	17.39
x8104	Magnesium; articles thereof, includ[...]	0.01%	RB	-1.85	(1.88)	-3.19**	(1.61)	0.44	14.43
x4013	Inner tubes, of rubber	0.00%	RB	-0.47	(1.31)	-1.97**	(0.93)	1.98	13.23
x4417	Tools, tool bodies, tool handles, b[...]	0.05%	RB	0.11	(0.09)	-0.17**	(0.08)	7.95***	9.48
x3507	Enzymes; prepared enzymes not elsew[...]	0.00%	RB	1.21	(2.58)	-4.20**	(1.92)	5.81**	12.19
x4006	Unvulcanised rubber in other forms [...]	0.00%	RB	0.07	(1.32)	-3.26***	(1.09)	8.14***	9.27
x1702	Sugars, including lactose, maltose,[...]	0.02%	RB	-2.57	(2.06)	-4.98***	(1.57)	2.07	13.82
x6804	Millstones, grindstones, grinding w[...]	0.01%	RB	-0.21	(0.15)	-0.52***	(0.15)	6.56**	8.84
x6805	Abrasive powder or grain; natural o[...]	0.06%	RB	-0.31	(0.62)	-2.18***	(0.60)	8.34***	23.49
x2934	Heterocyclic compounds; n.e.s. in c[...]	0.02%	RB	-4.24	(2.74)	-10.55***	(1.97)	7.52***	11.89
x0803	Bananas, including plantains; fresh[...]	0.00%	PP	3.78	(2.35)	2.87*	(1.73)	0.25	11.39
x7603	Aluminium; powders and flakes	0.01%	PP	3.38	(2.68)	3.17*	(1.86)	0.01	13.66
x7411	Copper tubes and pipes	0.02%	PP	1.89	(1.92)	2.35*	(1.28)	0.07	8.13
x0903	Mate	0.01%	PP	0.91	(0.60)	1.18**	(0.58)	0.54	20.43
x0101	Horses, asses, mules and hinnies; l[...]	0.01%	PP	2.05	(1.48)	2.93***	(1.05)	0.46	11.67
x0604	Foliage, branches and other parts o[...]	0.00%	PP	1.41	(1.75)	3.94***	(1.29)	2.31	17.91
x0801	Nuts, edible; coconuts, Brazil nuts[...]	0.51%	PP	-0.08	(0.07)	-0.16**	(0.07)	3.32*	17.15
x1209	Seeds, fruit and spores; of a kind [...]	0.01%	PP	-0.84	(1.51)	-3.12***	(1.10)	3.38*	18.41
x0602	Plants, live; n.e.s. in heading no.[...]	0.01%	PP	-0.16	(0.13)	-0.36***	(0.11)	1.77	10.31

Continuation of Table 4

Code	Industry	Part.	I.T.	α_1 (rer^{-}_{t-1})		α_2 (rer^{+}_{t-1})		Wald	Ljung–Box
x0601	Bulbs, tubers, tuberous roots, corm[...]	0.00%	PP	-1.86	(2.24)	-7.47***	(1.67)	7.64***	18.31
x0301	Fish; live	0.00%	PP	-0.63**	(0.24)	-1.03***	(0.22)	2.97*	4.96
x6304	Furnishing articles; excluding thos[...]	0.00%	OU	-1.43	(1.29)	2.02**	(0.93)	10.88***	10.37
x7508	Nickel; other articles thereof n.e.[...]	0.01%	OU	-0.07	(0.88)	1.58**	(0.68)	3.21*	21.37
x5608	Twine, cordage or rope; knotted net[...]	0.00%	OU	2.46	(1.62)	3.14***	(1.12)	0.27	23.39
x2710	Petroleum oils, oils from bituminou[...]	2.22%	OU	-0.05	(0.96)	1.97***	(0.68)	5.69**	9.56
x6303	Curtains (including drapes) and int[...]	0.00%	OU	3.23*	(1.81)	5.83***	(1.53)	3.64*	14.20
x7320	Springs and leaves for springs, of [...]	0.03%	OU	0.03	(0.09)	-0.14*	(0.09)	9.58***	5.65
x4908	Transfers (decalcomanias)	0.00%	OU	-0.03	(0.31)	-0.44*	(0.25)	2.04	12.33
x6212	Brassieres, girdles, corsets, brace[...]	0.01%	OU	-0.21	(0.25)	-0.40*	(0.21)	0.56	10.20
x5209	Woven fabrics of cotton, containing[...]	0.01%	OU	-0.89	(1.02)	-1.56**	(0.74)	0.69	8.82
x8309	Stoppers, caps, lids (including cro[...]	0.03%	OU	0.74	(0.84)	-1.50**	(0.70)	5.91**	11.88
x5210	Woven fabrics of cotton, containing[...]	0.00%	OU	0.99	(2.19)	-4.15**	(1.65)	5.90**	10.46
x9205	Musical instruments; wind, (eg clar[...]	0.00%	OU	-2.62	(1.93)	-4.77**	(1.86)	1.03	20.34
x9206	Musical instruments; percussion (eg[...]	0.00%	OU	-1.17	(2.18)	-4.00**	(1.55)	2.06	10.36
x4821	Paper or paperboard labels of all k[...]	0.00%	OU	-0.02	(0.42)	-0.80***	(0.28)	4.66**	20.41
x5208	Woven fabrics of cotton, containing[...]	0.01%	OU	0.18	(0.18)	-0.61***	(0.18)	14.83***	17.26
	Symmetric								
x2938	Glycosides, natural or reproduced b[...]	0.01%	HT	5.75**	(2.64)	7.32***	(2.00)	0.65	7.99
x8518	Microphones and stands therefor; lo[...]	0.02%	HT	0.55***	(0.21)	0.36*	(0.18)	1.68	5.06
x8532	Electrical capacitors; fixed, varia[...]	0.06%	HT	0.31**	(0.14)	0.36***	(0.12)	0.16	11.62
x8504	Electric transformers, static conve[...]	0.27%	HT	-0.61***	(0.23)	-0.62***	(0.22)	0.01	14.16
x8502	Electric generating sets and rotary[...]	0.10%	HT	0.86	(2.39)	1.17	(1.76)	0.02	14.85
x8545	Carbon electrodes, carbon brushes, [...]	0.03%	HT	0.25	(0.18)	0.12	(0.17)	1.27	9.43
x9033	Machines and appliances, instrument[...]	0.00%	HT	0.24	(1.45)	-0.35	(0.98)	0.24	10.28
x9013	Liquid crystal devices not constitu[...]	0.01%	HT	0.02	(1.17)	0.31	(0.83)	0.08	20.94
x9026	Instruments, apparatus for measurin[...]	0.08%	HT	0.00	(0.10)	0.07	(0.08)	0.38	7.97
x8542	Electronic integrated circuits and [...]	0.07%	HT	-0.16	(0.33)	0.00	(0.24)	0.27	18.20
x8802	Aircraft; (eg helicopters, aeroplan[...]	7.85%	HT	-0.33	(0.49)	0.19	(0.45)	2.85*	3.72
x8410	Turbines; hydraulic water wheels an[...]	0.02%	HT	-3.95	(3.05)	-1.37	(2.18)	1.09	14.72
x8514	Industrial or laboratory electric ([...]	0.00%	MT	8.61***	(2.72)	6.33***	(1.91)	1.37	13.14
x3809	Finishing agents, dye carriers to a[...]	0.00%	MT	6.90***	(2.49)	5.90***	(1.72)	0.29	12.40
x3207	Pigments, prepared; opacifiers, col[...]	0.00%	MT	6.28**	(2.60)	5.91***	(2.15)	0.02	16.80
x9102	Wrist-watches, pocket-watches, stop[...]	0.00%	MT	5.96***	(2.17)	3.71**	(1.55)	1.76	23.87
x8462	Machine-tools; (including presses) [...]	0.06%	MT	5.76*	(2.98)	3.92*	(2.03)	0.66	7.54
x3405	Polishes, creams, scouring pastes, [...]	0.00%	MT	5.09**	(2.29)	2.63*	(1.54)	1.88	11.24
x8907	Boats, floating structures, other ([...]	0.00%	MT	4.32*	(2.20)	3.05*	(1.64)	0.32	8.95
x3903	Polymers of styrene, in primary for[...]	0.05%	MT	3.71*	(2.10)	2.99*	(1.52)	0.21	13.74
x3909	Amino-resins, phenolic resins and p[...]	0.01%	MT	2.81***	(0.97)	1.23*	(0.66)	2.67	21.34
x8477	Machinery; for working rubber or pl[...]	0.02%	MT	1.46***	(0.54)	1.80***	(0.51)	1.16	18.73
x8484	Gaskets and similar joints of metal[...]	0.05%	MT	1.01***	(0.20)	1.05***	(0.20)	0.20	12.29
x8438	Machinery n.e.s. in this chapter, f[...]	0.04%	MT	0.92***	(0.24)	0.73***	(0.20)	1.35	20.84
x8429	Bulldozers, graders, levellers, scr[...]	1.71%	MT	0.26*	(0.15)	0.24**	(0.11)	0.03	4.73
x8536	Electrical apparatus for switching,[...]	0.15%	MT	0.15**	(0.08)	0.20***	(0.07)	1.26	7.25
x8448	Machinery, auxiliary; for use with [...]	0.01%	MT	-1.98**	(0.88)	-1.41**	(0.62)	0.64	8.64
x7201	Pig iron and spiegeleisen in pigs, [...]	3.05%	MT	-2.72***	(1.04)	-2.03***	(0.76)	0.55	21.88
x3805	Gum, wood or sulphate turpentine, o[...]	0.01%	MT	3.13	(2.34)	1.69	(1.69)	0.52	8.91
x8451	Machinery (not of heading no. 8450)[...]	0.00%	MT	3.09	(2.35)	-0.65	(1.58)	3.68*	17.49
x8450	Household or laundry-type washing m[...]	0.02%	MT	2.87	(1.86)	-0.45	(1.23)	4.29**	19.40
x8515	Electric (electrically heated gas) [...]	0.00%	MT	2.60	(1.70)	-0.49	(1.25)	2.76*	15.32
x3819	Hydraulic brake fluids and other pr[...]	0.00%	MT	2.49	(1.71)	1.24	(1.23)	0.90	25.74
x3810	Metal-pickling preparations; fluxes[...]	0.01%	MT	2.23	(1.99)	0.63	(1.29)	0.58	3.44
x8442	Machinery and apparatus; for type f[...]	0.00%	MT	2.09	(2.41)	-0.01	(1.94)	0.64	19.93
x3404	Waxes; artificial, prepared	0.00%	MT	1.78	(2.51)	0.39	(1.72)	0.47	15.42
x3802	Activated carbon; activated natural[...]	0.01%	MT	1.74	(2.34)	1.05	(1.53)	0.15	17.69
x3814	Organic composite solvents and thin[...]	0.00%	MT	1.55	(1.60)	1.37	(1.10)	0.02	15.75
x3904	Polymers of vinyl chloride or of ot[...]	0.01%	MT	1.46	(2.60)	-0.72	(1.89)	0.70	9.33
x8707	Bodies; (including cabs) for the mo[...]	0.00%	MT	1.32	(2.76)	-0.43	(1.97)	0.55	9.36
x8434	Milking machines and dairy machiner[...]	0.00%	MT	1.16	(2.47)	2.44	(1.78)	0.41	12.95
x8423	Weighing machines; excluding balanc[...]	0.00%	MT	0.98	(2.03)	-1.74	(1.46)	2.74*	11.42
x8513	Lamps; portable, electric, designed[...]	0.00%	MT	0.88	(1.95)	0.36	(1.40)	0.11	19.98
x9020	Breathing appliances and gas masks;[...]	0.00%	MT	0.84	(1.08)	1.24	(0.82)	0.18	16.89
x8465	Machine-tools; (including machines [...]	0.01%	MT	0.80	(0.88)	0.01	(0.58)	1.15	16.92
x3906	Acrylic polymers in primary forms	0.01%	MT	0.65	(1.08)	0.34	(0.72)	0.12	20.77
x3403	Lubricating preparations and those [...]	0.00%	MT	0.42	(1.73)	-0.13	(1.23)	0.13	10.23
x7315	Chain and parts thereof, of iron or[...]	0.02%	MT	0.35	(0.59)	-0.44	(0.58)	4.49**	17.91
x8480	Moulding boxes for metal foundry, m[...]	0.03%	MT	0.32	(0.28)	-0.04	(0.22)	2.86*	15.57
x3808	Insecticides, rodenticides, fungici[...]	0.05%	MT	0.28	(1.71)	-1.56	(1.18)	1.63	4.11
x8424	Mechanical appliances for projectin[...]	0.04%	MT	0.28	(0.18)	0.02	(0.14)	3.42*	13.09

Continuation of Table 4

Code	Industry	Part.	I.T.	α_1 (rer^{-}_{t-1})		α_2 (rer^{+}_{t-1})		Wald	Ljung–Box
x3919	Self-adhesive plates, sheets, film,[...]	0.02%	MT	0.26	(0.25)	-0.09	(0.20)	1.57	15.70
x8418	Refrigerators, freezers and other r[...]	0.09%	MT	0.18	(0.12)	-0.04	(0.10)	6.35**	7.80
x8516	Electric water, space, soil heaters[...]	0.00%	MT	0.13	(0.34)	0.02	(0.26)	0.15	14.54
x8538	Electrical apparatus; parts suitabl[...]	0.02%	MT	0.11	(0.14)	-0.02	(0.11)	1.35	14.57
x8439	Machinery; for making pulp of fibro[...]	0.04%	MT	0.05	(0.43)	0.23	(0.32)	0.20	13.24
x8544	Insulated wire, cable and other ele[...]	0.17%	MT	0.04	(0.07)	0.02	(0.07)	0.17	11.78
x8466	Machine-tools; parts suitable for u[...]	0.04%	MT	0.02	(0.16)	-0.08	(0.14)	0.33	21.12
x8482	Ball or roller bearings	0.18%	MT	-0.02	(0.07)	-0.06	(0.06)	0.50	19.11
x3603	Safety fuses; detonating fuses; per[...]	0.01%	MT	-0.02	(1.54)	0.24	(1.15)	0.03	21.62
x2905	Acyclic alcohols and their halogena[...]	0.07%	MT	-0.16	(0.22)	-0.15	(0.20)	0.00	23.82
x3815	Reaction initiators, reaction accel[...]	0.06%	MT	-0.18	(2.37)	2.77	(1.78)	1.42	14.56
x8521	Video recording or reproducing appa[...]	0.00%	MT	-0.35	(2.00)	-1.39	(1.36)	0.39	17.91
x7304	Tubes, pipes and hollow profiles, s[...]	0.35%	MT	-0.74	(0.51)	-0.50	(0.48)	0.60	6.75
x9306	Bombs, grenades, torpedoes, mines, [...]	0.09%	MT	-0.88	(1.13)	0.61	(0.84)	1.82	21.11
x3701	Photographic plates and film in the[...]	0.03%	MT	-0.99	(1.14)	-1.53	(0.93)	0.25	22.94
x7224	Alloy steel in ingots or other prim[...]	1.44%	MT	-1.22	(1.74)	1.42	(1.29)	3.28*	21.36
x7218	Stainless steel in ingots or other [...]	0.00%	MT	-2.65	(2.40)	-0.03	(1.57)	1.73	8.75
x9602	Vegetable, mineral carving material[...]	0.00%	LT	5.70***	(2.07)	3.57**	(1.39)	1.57	19.92
x7020	Glass; articles n.e.s. in chapter 7[...]	0.00%	LT	5.63***	(2.02)	4.63***	(1.38)	0.36	23.99
x4602	Basketwork, wickerwork and other ar[...]	0.00%	LT	4.07**	(1.93)	2.98**	(1.46)	0.50	11.68
x6201	Overcoats, car-coats, capes, cloaks[...]	0.00%	LT	3.93**	(1.71)	3.42***	(1.24)	0.16	15.80
x5702	Carpets and other textile floor cov[...]	0.00%	LT	3.06**	(1.48)	2.03*	(1.03)	0.78	12.27
x9601	Ivory, bone, tortoise-shell, horn, [...]	0.00%	LT	1.67**	(0.73)	1.48**	(0.74)	0.22	4.45
x9609	Pencils (not of heading no. 9608), [...]	0.14%	LT	1.51***	(0.51)	1.49***	(0.50)	0.00	6.08
x8202	Tools, hand; blades for saws of all[...]	0.02%	LT	0.38**	(0.18)	0.30**	(0.14)	0.23	6.83
x6406	Footwear; parts of footwear; remova[...]	0.01%	LT	-0.34*	(0.17)	-0.30*	(0.17)	0.13	8.81
x4104	Leather of bovine or equine animals[...]	0.17%	LT	-0.61***	(0.20)	-0.68***	(0.19)	0.74	10.59
x5703	Carpets and other textile floor cov[...]	0.00%	LT	-0.92**	(0.46)	-0.67*	(0.38)	0.27	8.42
x9606	Buttons, press-fasteners, snap-fast[...]	0.00%	LT	-3.85**	(1.92)	-5.47***	(1.72)	1.18	12.80
x7208	Iron or non-alloy steel; flat-rolle[...]	0.24%	LT	-4.35***	(1.41)	-2.68***	(0.94)	2.67	4.88
x7209	Iron or non-alloy steel; flat-rolle[...]	0.29%	LT	-4.89**	(2.08)	-6.41***	(1.90)	0.45	12.06
x7215	Iron or non-alloy steel; bars and r[...]	0.00%	LT	2.94	(2.22)	0.74	(1.56)	1.51	14.35
x7310	Tanks, casks, drums, cans, boxes an[...]	0.00%	LT	2.34	(1.77)	-1.58	(1.20)	6.68***	18.96
x7302	Railway or tramway track constructi[...]	0.00%	LT	2.29	(2.08)	-1.93	(1.41)	5.82**	14.23
x7220	Stainless steel; flat-rolled produc[...]	0.00%	LT	2.11	(2.50)	2.87	(1.77)	0.14	15.80
x7313	Barbed wire of iron or steel; twist[...]	0.01%	LT	1.95	(1.54)	1.26	(1.04)	0.29	12.33
x7223	Stainless steel wire	0.00%	LT	1.93	(2.01)	2.06	(1.62)	0.00	15.52
x7114	Articles of goldsmiths' or silversm[...]	0.01%	LT	1.92	(1.76)	-1.34	(1.18)	4.19**	14.30
x9607	Slide fasteners and parts thereof	0.00%	LT	1.92	(1.82)	-1.25	(1.42)	2.22	15.14
x5801	Fabrics; woven pile and chenille fa[...]	0.00%	LT	1.87	(1.18)	0.03	(0.74)	2.75*	18.05
x9506	Gymnastics, athletics, other sports[...]	0.00%	LT	1.30	(1.54)	-0.25	(0.98)	1.43	18.47
x4107	Leather; of animals n.e.s. in chapt[...]	0.66%	LT	1.26	(1.34)	0.78	(0.90)	0.11	15.75
x7213	Iron or non-alloy steel; bars and r[...]	0.32%	LT	1.17	(1.91)	-1.99	(1.35)	3.36*	17.85
x4203	Articles of apparel and clothing ac[...]	0.00%	LT	0.87	(0.70)	-0.51	(0.54)	3.06*	10.38
x7324	Sanitary ware and parts thereof, of[...]	0.00%	LT	0.84	(2.15)	0.02	(1.64)	0.16	18.85
x4303	Articles of apparel, clothing acces[...]	0.01%	LT	0.84	(0.59)	0.15	(0.40)	2.11	17.99
x6214	Shawls, scarves, mufflers, mantilla[...]	0.00%	LT	0.71	(1.10)	0.10	(0.71)	0.44	22.95
x6117	Clothing accessories; made up, knit[...]	0.00%	LT	0.63	(0.77)	-0.28	(0.67)	1.53	17.61
x9615	Combs, hair-slides and similar; hai[...]	0.00%	LT	0.52	(1.46)	-0.34	(1.05)	0.42	9.82
x9612	Typewriter, similar ribbons, inked,[...]	0.00%	LT	0.51	(2.37)	-0.16	(1.80)	0.08	20.76
x3924	Tableware, kitchenware, other house[...]	0.01%	LT	0.29	(0.21)	-0.15	(0.18)	3.86**	7.67
x6405	Footwear; other footwear n.e.s. in [...]	0.02%	LT	0.25	(0.23)	-0.29	(0.21)	8.57***	13.19
x5309	Woven fabrics of flax	0.01%	LT	0.20	(0.34)	-0.20	(0.23)	2.08	10.88
x7415	Nails, tacks, drawing pins, staples[...]	0.00%	LT	0.14	(0.38)	0.36	(0.28)	0.51	18.22
x7217	Wire of iron or non-alloy steel	0.03%	LT	0.10	(0.24)	-0.23	(0.23)	4.37**	10.04
x8211	Knives; with cutting blades, serrat[...]	0.03%	LT	0.07	(0.38)	0.21	(0.33)	0.12	7.26
x7314	Cloth (including endless bands), gr[...]	0.00%	LT	0.06	(1.24)	-0.42	(0.86)	0.22	15.09
x4813	Cigarette paper, whether or not cut[...]	0.04%	LT	-0.11	(0.48)	-0.02	(0.31)	0.04	17.44
x7323	Table, kitchen, other household art[...]	0.03%	LT	-0.16	(0.60)	0.29	(0.47)	0.53	11.01
x8214	Cutlery; other articles, (eg hair c[...]	0.00%	LT	-0.29	(1.26)	-0.44	(0.93)	0.01	5.81
x7225	Alloy steel flat-rolled products, o[...]	0.05%	LT	-0.44	(2.98)	-1.52	(2.02)	0.19	15.41
x8208	Knives and cutting blades, for mach[...]	0.00%	LT	-0.63	(0.59)	0.38	(0.43)	2.88*	11.39
x7016	Glass; paving blocks, slabs, bricks[...]	0.00%	LT	-0.80	(2.47)	-0.12	(1.82)	0.09	6.08
x8213	Scissors; tailors' shears and simil[...]	0.00%	LT	-0.88	(1.15)	-0.23	(0.78)	0.48	10.91
x7612	Aluminium casks, drums, cans, boxes[...]	0.01%	LT	-0.94	(0.93)	0.46	(0.70)	2.48	6.76
x9618	Tailors' dummies and other lay figu[...]	0.00%	LT	-1.01	(0.76)	-0.59	(0.50)	0.46	12.39
x9503	Toys, other; reduced-size ("scale")[...]	0.00%	LT	-1.48	(1.49)	-0.31	(1.14)	0.60	7.80
x6001	Fabrics; pile fabrics, including "l[...]	0.00%	LT	-1.74	(1.97)	1.40	(1.38)	3.34*	21.05
x4805	Uncoated paper and paperboard n.e.s[...]	0.00%	RB	10.75***	(2.43)	12.17***	(1.79)	0.54	21.91

Continuation of Table 4

Code	Industry	Part.	I.T.	α_1 (rer^-_{t-1})		α_2 (rer^+_{t-1})		Wald	Ljung–Box
x2001	Vegetables, fruit, nuts and other e[...]	0.00%	RB	8.07***	(2.62)	6.17***	(1.86)	0.90	13.69
x2835	Phosphinates (hypophosphites), phos[...]	0.00%	RB	6.77**	(2.68)	3.61**	(1.82)	2.10	12.39
x6810	Cement, concrete or artificial ston[...]	0.00%	RB	5.45**	(2.67)	3.04*	(1.75)	1.44	10.69
x3202	Tanning substances; synthetic organ[...]	0.00%	RB	4.78*	(2.54)	3.37*	(1.83)	0.48	14.00
x1104	Cereal grains otherwise worked (eg [...]	0.00%	RB	4.70***	(1.39)	4.60***	(1.13)	0.01	18.99
x2002	Tomatoes; prepared or preserved oth[...]	0.00%	RB	4.50**	(2.23)	7.78***	(1.73)	2.59	9.52
x2932	Heterocyclic compounds with oxygen [...]	0.01%	RB	3.77*	(2.17)	4.06**	(1.68)	0.03	5.29
x3816	Refractory cements, mortars, concre[...]	0.01%	RB	3.42**	(1.71)	4.43***	(1.27)	0.37	10.48
x1106	Flour and meal; of the dried legumi[...]	0.01%	RB	3.15***	(1.14)	3.23***	(0.93)	0.01	7.86
x2836	Carbonates; peroxocarbonates (perca[...]	0.00%	RB	2.06*	(1.06)	1.38*	(0.74)	0.65	18.19
x4411	Fibreboard of wood or other ligneou[...]	0.20%	RB	0.20**	(0.09)	0.16*	(0.08)	0.58	20.48
x2931	Organo-inorganic compounds; n.e.s. [...]	0.02%	RB	-7.19***	(2.75)	-8.00***	(1.94)	0.13	20.40
x3203	Colouring matter of vegetable or an[...]	0.01%	RB	2.18	(1.72)	0.01	(1.18)	1.67	10.78
x1701	Cane or beet sugar and chemically p[...]	0.61%	RB	1.88	(1.32)	0.61	(0.82)	1.43	24.23
x2912	Aldehydes, whether or not with othe[...]	0.00%	RB	1.82	(2.12)	0.93	(1.42)	0.26	23.73
x1511	Palm oil and its fractions; whether[...]	0.01%	RB	1.19	(1.20)	-0.29	(0.78)	2.16	12.08
x6814	Mica; worked, articles of, includin[...]	0.01%	RB	1.17	(1.30)	0.24	(0.95)	0.59	25.85
x2104	Soups and broths and preparations t[...]	0.00%	RB	0.94	(1.20)	0.25	(0.81)	0.49	8.71
x7102	Diamonds, whether or not worked, bu[...]	0.02%	RB	0.83	(2.52)	1.40	(1.73)	0.08	22.43
x2707	Oils and other products of the dist[...]	0.06%	RB	0.67	(3.37)	-1.71	(2.51)	0.53	12.30
x0405	Butter and other fats and oils deri[...]	0.00%	RB	0.52	(2.15)	2.26	(1.49)	1.04	21.51
x1902	Pasta; whether or not cooked or stu[...]	0.00%	RB	0.52	(0.63)	0.36	(0.43)	0.09	7.77
x8108	Titanium; articles thereof, includi[...]	0.01%	RB	0.46	(0.35)	-0.37	(0.30)	6.01**	8.84
x2821	Iron oxides and hydroxides; earth c[...]	0.04%	RB	0.44	(0.55)	0.30	(0.37)	0.09	5.20
x4009	Tubes, pipes and hoses, of vulcanis[...]	0.05%	RB	0.27	(0.23)	-0.11	(0.17)	4.12**	7.42
x2804	Hydrogen, rare gases and other non-[...]	0.52%	RB	0.21	(0.15)	-0.02	(0.12)	3.71*	7.79
x4415	Packing cases, boxes, crates, drums[...]	0.02%	RB	0.19	(0.23)	0.26	(0.18)	0.15	8.14
x4008	Plates, sheets, strip, rods and pro[...]	0.05%	RB	0.07	(0.12)	0.00	(0.10)	0.30	16.62
x1704	Sugar confectionery (including whit[...]	0.14%	RB	0.06	(0.12)	0.16	(0.10)	0.41	9.17
x3201	Tanning extracts of vegetable origi[...]	0.01%	RB	-0.01	(1.19)	-0.71	(0.84)	0.44	18.60
x7002	Glass in balls (other than microsph[...]	0.02%	RB	-0.19	(0.67)	0.12	(0.44)	0.33	7.01
x7009	Glass mirrors; whether or not frame[...]	0.01%	RB	-0.23	(0.24)	0.05	(0.20)	1.16	8.22
x2203	Beer made from malt	0.00%	RB	-0.29	(1.80)	-0.19	(1.45)	0.00	6.77
x7006	Glass of heading no. 7003, 7004 or [...]	0.00%	RB	-0.40	(1.75)	-0.04	(1.21)	0.06	14.88
x2825	Hydrazine and hydroxylamine and the[...]	0.16%	RB	-0.41	(0.94)	0.87	(0.74)	1.53	11.59
x1602	Prepared or preserved meat, meat of[...]	0.92%	RB	-0.68	(0.50)	-0.32	(0.47)	1.32	25.67
x1515	Fixed vegetable fats and oils (incl[...]	0.01%	RB	-1.03	(0.78)	0.14	(0.65)	1.46	14.33
x1603	Extracts and juices of meat, fish o[...]	0.01%	RB	-2.52	(3.06)	0.08	(2.20)	0.98	18.75
x8105	Cobalt; mattes and other intermedia[...]	0.01%	RB	-3.85	(2.71)	-1.98	(1.80)	0.73	13.34
x0713	Vegetables, dried leguminous; shell[...]	0.00%	PP	4.78**	(2.08)	2.93**	(1.48)	1.12	7.71
x0907	Cloves; (whole fruit, cloves and st[...]	0.00%	PP	4.24*	(2.50)	4.09**	(1.72)	0.01	22.83
x0401	Milk and cream; not concentrated no[...]	0.00%	PP	3.91*	(2.14)	3.75**	(1.53)	0.01	15.86
x1202	Ground-nuts; not roasted or otherwi[...]	0.00%	PP	3.49*	(2.10)	3.08*	(1.59)	0.04	6.17
x4402	Wood charcoal (including shell or n[...]	0.00%	PP	3.21**	(1.44)	1.68*	(0.92)	1.74	15.09
x0910	Ginger, saffron, tumeric (curcuma),[...]	0.02%	PP	3.11**	(1.54)	3.72***	(1.21)	0.21	10.35
x7407	Copper; bars, rods and profiles	0.05%	PP	1.52***	(0.53)	1.25**	(0.51)	0.66	10.14
x0902	Tea	0.01%	PP	-1.76**	(0.79)	-1.05*	(0.56)	1.29	4.56
x0510	Ambergris, castoreum, civet and mus[...]	0.00%	PP	4.34	(2.78)	0.12	(2.02)	2.59	4.48
x7403	Copper; refined and copper alloys, [...]	0.13%	PP	3.89	(3.19)	2.88	(2.44)	0.09	17.17
x7901	Zinc; unwrought	0.07%	PP	2.34	(3.01)	-1.15	(2.07)	2.05	16.63
x2508	Clays; (not including expanded clay[...]	0.00%	PP	2.01	(2.10)	-0.46	(1.71)	1.03	16.92
x1404	Vegetable products not elsewhere sp[...]	0.00%	PP	1.84	(2.23)	2.22	(1.55)	0.04	15.26
x0507	Ivory, tortoise-shell, whalebone an[...]	0.00%	PP	1.81	(2.02)	-0.11	(1.38)	1.28	9.60
x0714	Manioc, arrowroot, salep, Jerusalem[...]	0.01%	PP	1.17	(0.71)	0.76	(0.48)	0.48	8.74
x0207	Meat and edible offal of poultry; o[...]	0.00%	PP	-0.04	(2.88)	-1.88	(2.19)	0.38	9.44
x0807	Melons (including watermelons) and [...]	0.02%	PP	-0.09	(0.09)	-0.10	(0.08)	0.00	7.63
x0904	Pepper of the genus piper; dried or[...]	0.21%	PP	-0.38	(0.28)	0.04	(0.20)	2.82*	16.26
x0504	Guts, bladders and stomachs of anim[...]	0.01%	PP	-0.59	(0.80)	-0.08	(0.54)	0.60	9.61
x2709	Petroleum oils and oils obtained fr[...]	9.79%	PP	-0.71	(2.35)	1.14	(1.74)	0.60	9.21
x5212	Other woven fabrics of cotton, n.e.[...]	0.00%	OU	7.61***	(2.00)	7.52***	(1.46)	0.00	19.81
x4902	Newspapers, journals and periodical[...]	0.00%	OU	-0.98*	(0.52)	-1.72***	(0.52)	1.52	15.70
x6908	Ceramic flags and paving, hearth or[...]	0.29%	OU	-1.58***	(0.48)	-1.31***	(0.44)	0.38	5.82
x6306	Tarpaulins, awnings and sunblinds, [...]	0.00%	OU	-5.45**	(2.27)	-5.08***	(1.75)	0.04	20.28
x7806	Lead; articles n.e.s. in chapter 78	0.00%	OU	-5.99***	(1.99)	-3.17**	(1.34)	2.60	9.27
x6209	Garments and clothing accessories; [...]	0.00%	OU	3.54	(2.17)	0.43	(1.42)	2.94*	14.38
x2841	Salts of oxometallic or peroxometal[...]	0.00%	OU	3.34	(2.32)	-0.89	(1.66)	4.90**	12.18
x7907	Zinc; articles n.e.s. in chapter 79	0.00%	OU	2.91	(1.90)	1.87	(1.30)	0.45	12.11
x7204	Ferrous waste and scrap; remelting [...]	0.02%	OU	2.64	(2.93)	1.09	(2.18)	0.27	13.82
x8307	Tubing; flexible, with or without f[...]	0.01%	OU	1.50	(1.08)	0.43	(0.74)	1.38	18.32

Continuation of Table 4

Code	Industry	Part.	I.T.	α_1 (rer^{-}_{t-1})		α_2 (rer^{+}_{t-1})		Wald	Ljung–Box
x5909	Textile hosepiping and similar text[...]	0.00%	OU	1.44	(1.82)	0.80	(1.28)	0.20	6.74
x9701	Paintings, drawings, pastels, execu[...]	0.12%	OU	1.05	(0.80)	1.14	(0.78)	0.04	16.86
x2924	Carboxyamide-function compounds; am[...]	0.05%	OU	0.90	(1.28)	0.06	(0.87)	0.63	14.69
x3506	Prepared glues and other prepared a[...]	0.01%	OU	0.84	(0.62)	0.76	(0.57)	0.04	3.87
x6307	Textiles; made up articles n.e.s. i[...]	0.01%	OU	0.79	(0.49)	-0.09	(0.33)	4.62**	18.94
x3505	Dextrins and other modified starche[...]	0.02%	OU	0.68	(0.52)	0.42	(0.35)	0.40	4.14
x4911	Printed matter, n.e.s., including p[...]	0.01%	OU	0.65	(0.42)	-0.20	(0.26)	5.20**	9.02
x6105	Shirts; men's or boys', knitted or [...]	0.01%	OU	0.17	(0.84)	0.35	(0.60)	0.07	11.78
x2008	Fruit, nuts and other edible parts [...]	0.07%	OU	0.15	(0.11)	0.12	(0.10)	0.16	19.83
x6103	Suits, ensembles, jackets, blazers,[...]	0.00%	OU	0.12	(0.63)	-0.51	(0.42)	1.42	7.18
x2202	Waters, including mineral and aerat[...]	0.01%	OU	0.08	(0.29)	0.11	(0.19)	0.02	20.38
x9209	Musical instrument parts (eg mechan[...]	0.01%	OU	0.06	(0.40)	0.15	(0.36)	0.05	3.51
x1211	Plants and parts of plants (includi[...]	0.01%	OU	0.04	(0.34)	0.14	(0.23)	0.12	17.45
x4909	Printed or illustrated postcards; p[...]	0.00%	OU	-0.13	(1.95)	-1.81	(1.42)	0.93	15.61
x7325	Iron or steel; cast articles	0.04%	OU	-0.20	(0.14)	-0.10	(0.12)	1.01	5.09
x5607	Twine, cordage, ropes and cables, w[...]	0.17%	OU	-0.23	(0.23)	-0.31	(0.21)	0.29	19.36
x8704	Vehicles; for the transport of good[...]	0.26%	OU	-0.61	(1.65)	1.55	(1.20)	2.34	7.17
x6107	Underpants, briefs, nightshirts, py[...]	0.00%	OU	-1.61	(1.58)	-1.09	(1.15)	0.17	12.70
x5609	Articles of yarn, strip or the like[...]	0.00%	OU	-1.76	(1.97)	1.12	(1.51)	2.13	15.64

Source: research results.

Note: Sectoral Technological Intensity. High-Tech (HT), Medium Tech (MT), Low Tech (LT), Resource-Based Manufactures (RB), Primary Products (PP) and Unclassified (OU). *** sig. at 1%, ** sig. at 5% and * sig. to 10%. Standard deviations are in parentheses. Sectors in which there was no cointegration and those with serial autocorrelation were omitted.