Final Paper for ECON656s

J-CURVE IN MALAYSIA:

The Short-run and Long-run Impact of Exchange Rate on Trade Balance

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I. Introduction

After post-independence, Malaysia stood out as a rising star among developing countries. Though having undergone some major financial crises such as the Asian Financial Crisis in 1997 and the Global Financial Crisis in 2008, a 6% averaged GDP growth over the last four decades (despite there is a slightly diminishing growth trend in long-run) has shown its sustainable growing might. The subsequent rise in living standards and the amelioration of poverty have been benefiting Malaysian over years. In 2018, IMF claims that Malaysia performed better than anticipated growth and is getting closer to high-income status.[1] Later that year, Moody announced that its outlook for the Malaysian bank system is stable (A3). [2]

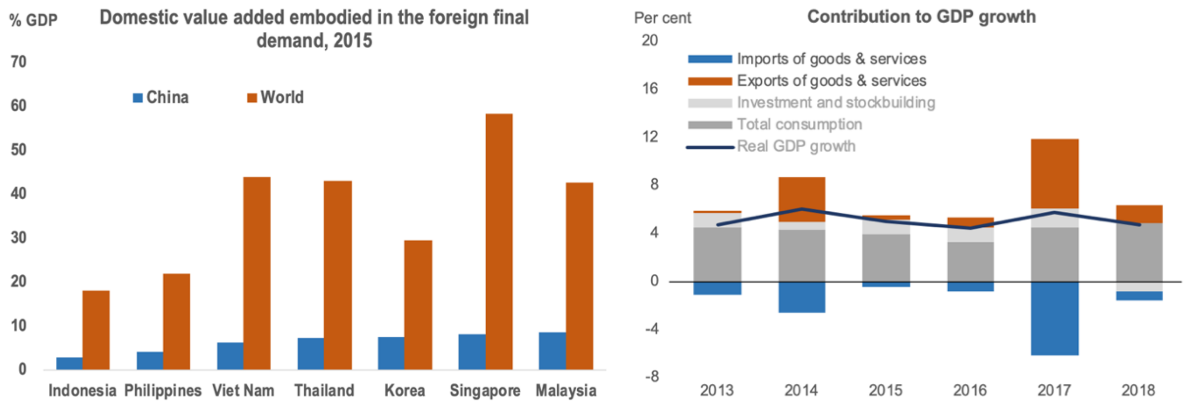
One key to Malaysia's rapid growth path lies in its external trade. It's widely acknowledged that Malaysia's strong commitment to an open trading environment enabled its economy to respond successfully to opportunities arising from increasing internationalization of production and world trade expansion. For example, it has been benefiting from trading policies like multilateral trade negotiations, ASEAN-wide economic integration and bilateral free trade agreements (FTAs). Evidence has been found in recent statistics. Figure 1 (a) shows that Malaysia is highly reliant upon trade from the perspective of large domestic value added embodied in the foreign final demand among other Asian countries. Disaggregating the trade balance into import and export, Figure 1 (b) shows that they play an important role in contributing to the GDP growth, where export imposed a positive contribution while import gave a negative one. It can be seen from these results that better trade performance is expected to help support economic

[1] IMF News: Malaysia's Economy: Getting Closer to High-Income Status, 7 March 2018.

[2] Moody's Investors Service: Outlook for Malaysian banks stable on robust macro conditions, improving capitalization, 18 Jun 2018.

growth and it is reasonable to think about achieving the goal by increasing export and cutting import, i.e. improving the trade balance.

Figure 1: Trade Statistics in Malaysia



(a) *(b)*

Data Source: OECD ECONOMIC SURVEYS: MALAYSIA 2019

One generally accepted method to improve trade balance would be devaluation through exchange rate policy. Historically, Malaysia had made several adjustments to exchange rate regimes over the last few decades. It firstly adopted a floating exchange rate system in early 1973, where the exchange rate of the MYR depended entirely on USD. Then in 1975, the value of MYR was determined based on a basket of currencies of countries that had significant trading relationships with Malaysia. During the Asian Financial Crisis in 1997, BNM (Bank of Negara Malaysia) imposed a pegged regime that the exchange rate of MYR against USD was fixed. This was intended to protect Malaysia from external shock and recurring recession. The BNM didn't change this fixed-rate regime until July 2005 when the managed float practice was replaced and has been in place until now. The transition from pegged to managed float rendered the exchange rate relatively stable.

Theoretically, the impact of domestic currency depreciation is two-fold. On the one hand, it is expected to lower the relative price and make export products attractive to foreign countries, which increases the export volume. On the other hand, the relatively high price of import products tends to restrain the demand and lead to a decrease in import. However, the direction of the impact of devaluation on the trade balance is not necessarily one-way. The Marshall-Lerner condition needs to be held along with real exchange rate depreciation. It states that devaluation will improve trade balance if the sum of import and export demand elasticity exceeds one. According to this condition, larger elasticity is more favorable for increasing trade balance. Nevertheless, in real world, elasticity is dynamic rather than invariant. In short run, demand is more inelastic, making the trade balance possibly worsen for the country that experienced a devaluation. On the contrary, in long run, the Marshall-Lerner condition is more likely to hold as some adjustments on economic variables could be made. This phenomenon is known as the J-Curve, where devaluation will firstly worsen the trade balance in short run before it ultimately improves the trade balance.

Therefore, given the rising importance of trade balance, we may wonder whether there is a J-Curve in Malaysia that may shed some insights on considering a devaluation to improve trade performance. To support the analysis, the elasticity approach will be used as a theoretical bedrock to build the model measuring the short-run and long-run impact of the exchange rate on the trade balance. For the trade balance, we consider analyzing both aggregately and bilaterally since there is evidence that some bias may be introduced through aggregation. Then based on the estimates of the model, conclusions could be made on the existence of a J-Curve both aggregately and bilaterally.

The paper will be organized as follows. Section I is an introduction. Section II gives a theoretical overview. Section III specifies the model and methodology. The data description will be in Section IV. Empirical estimation results are presented in Section V. Section VI concludes.

II. Theoretical Overview

Conventional theory suggests that there are direct or indirect effects between trade balance and macroeconomics variables like exchange rate and national income. In modeling the trade balance, we start by reviewing the standard "two-country" imperfect substitutes model proposed by Goldstein and Kahn (1985), and Rose and Yellen (1989). The model assumes that imports and exports cannot totally substitute for domestic goods.

Firstly, we posit that the demand for imported goods depends on the relative price of imports and real domestic income:

$$M = M(RP, Y) \tag{1}$$

where M is domestic demand for imports. RP denotes the relative price of imported goods to domestic goods. Y is the real domestic income.

Call e the nominal exchange rate between the domestic currency and the rest of the world currency, P_x^* the foreign currency price of foreign exports, P the domestic price level of all goods and P^* the foreign price level of all goods, we can express the RP as:

$$RP = \frac{eP_x^*}{P} = \frac{eP^*}{P} \cdot \frac{P_x^*}{P^*} = REX \cdot RP^* \tag{2}$$

where RP^* is the relative price of foreign exported goods to foreign goods. REX is the real exchange rate.

Substituting the RP in equation (2) into equation (1) gives the following:

$$M = M(REX \cdot RP^*, Y) \tag{3}$$

Similarly, the foreign demand for imports depends on foreign income and domestic relative export prices:

$$M^* = M^*\left(\frac{RP}{REX}, Y^*\right) \tag{4}$$

Given that in equilibrium, the volume of imported goods equals the goods exported by the rest of the world and vice versa:

$$X = M^*, X^* = M \tag{5}$$

where X is the exported goods by home country and X^* is exported goods by the rest of the world.

Then we write the balance of trade TB as the ratio of X and M:

$$TB = \frac{X}{M} = \frac{M^*}{M} = \frac{M^*(\frac{RP}{REX}, Y^*)}{M(REX \cdot RP^*, Y)} \tag{6}$$

Assuming RP and RP^* is constant, equation (6) could be rewritten as:

$$TB = TB(REX, Y, Y^*) \tag{7}$$

Finally, we get Equation (7) which expresses the balance of trade as a function of the real exchange rate and domestic and foreign incomes.

III. Model and Methodology

Following the "two-country" imperfect substitutes model, this paper exploits the modified trade balance model developed by Bahmani-Oskooee and Bolhasani (2008):

$$lnTB = \beta_1 + \beta_2 lnREX + \beta_3 lnGDP + \beta_4 lnGDP^* + \varepsilon$$

where TB is the trade balance and REX is the real exchange rate. GDP measures the domestic real output and GDP^* measures foreign real output.

However, this model only captures the long-term effect (β_2) where time series analysis is not taken into consideration. To account for the short-run effect, we apply the ARDL (autoregressive distributed lag) model which uses the bounds testing procedure (Pesaran, Shin & Smith, 2001) and incorporates the long-run trade balance model into an Error Correction Model (ECM). This allows us to measure the short-run effect and the long-run effect simultaneously in a single equation. More specifically, the reason for this model selection is that firstly, ARDL allows for both non-stationary and stationary time series with mixed order of integration (I(0) or I(1)) as variables. Secondly, it's relatively more efficient in the case of small and finite data sizes. Thirdly, unbiased long-run estimates associated with valid t statistics can be obtained (Nkoro & Uko, 2016). What's more, no preliminary cointegration test is needed before estimation (Shrestha & Bhatta, 2018). Given these advantages, it's clear that ARDL can provide a more efficient way of estimating the effect on our purpose.

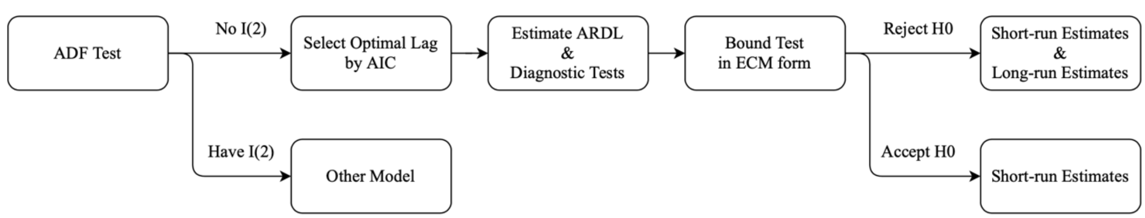
Fitting into our context, the unconstrained ECM representation of the ARDL model is given by:

$$\Delta lnTB_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta lnTB_{t-i} + \sum_{i=0}^{q_1} \gamma_i \Delta lnREX_{t-i} + \sum_{i=0}^{q_2} \delta_i \Delta lnGDP_{t-i} + \sum_{i=0}^{q_3} \delta_i \Delta lnGDP^*_{t-i} + \lambda_1 lnTB_{t-1} + \lambda_2 lnREX_{t-1} + \lambda_3 lnGDP_{t-1} + \lambda_4 lnGDP^*_{t-1} + u_t$$

where Δ denotes the first difference. p, q_1, q_2 and q_3 are the optimal lag length. The dynamics of short-run effect is captured by β, γ, δ. The second part ($\lambda_1 TB_{t-1} + \lambda_2 REER_{t-1} + \lambda_3 GDP_{t-1} + \lambda_4 GDP^*_{t-1}$) represents the long-run relationship and it can be retrieved as an error correction (EC_{t-1}) term to further explore the adjustment speed from short-run dynamics to long-run equilibrium. By looking at the sign of the coefficient of β_i and λ_2 respectively, we could know what a depreciation would impact on the trade balance in short-run and long-run. If the short-run estimates are negative while the long-run estimate is positive, a J-Curve is likely to be shown during the period being examined.

A clear process of implementing the ARDL model is presented in Figure 2. Before estimation, there will be an ADF test of all the variables to ensure that no variable of I(2) exists. After that, the optimal lags of the ARDL will be selected by the AIC information criterion. Then the ARDL model will be implemented using the selected lags. Some diagnostic tests will also be provided before moving to the next step. Then the bound test will be conducted to test the null hypothesis: $\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 = 0$ that there is not a long-run relationship. If we reject the null, which indicates that there is long-run relationship (co-integration), the model will be re-estimated in the unconstrained ECM form to get both the long-run and short-run estimates. Otherwise, we should only specify the short-run dynamics and omitted the long-run relationship, which means that we could only draw conclusion on the short-run.

Figure 2: Process of ARDL Estimation



IV. Data Description

This paper will use quarterly data from 1999 Q4 to 2019 Q3. The selection was based on data availability, avoiding structural breaks and modeling purposes. The major trading partners discussed in this paper would be the top 5 countries that have the largest trade with Malaysia: Singapore, China Mainland, USA, Japan, and Thailand. Table 1 provides some statistics of trade share in Malaysia.

Table 1: Trade Share in Malaysia

Country	Trade Share (Whole World)	Relative Trade Share (Five Countries)	Trend
Singapore	13.5%	25.0%	⇒
China	11.5%	21.8%	⇑
United States	12.5%	22.8%	⇓
Japan	11.2%	20.6%	⇓
Thailand	5.2%	9.7%	⇑
Total	53.9%	100.0%	⇓

Averageing Over 1999Q4 to 2019Q3

Based on the ARDL model specification above, the variables needed are:

- Trade Balance (TB): to use the log-form, the trade balance will be defined as export over import (X/M). The aggregate trade balance is calculated in USD using aggregate bilateral trade balance of Malaysia over its 5 major trading partners.
- Real Exchange Rate (REX): for bilateral analysis, the REX is defined as:

$$REX_i = \frac{P_i \times NEX_i}{P_M}$$

where NEX_i is the nominal bilateral exchange rate of Malaysia against the country i (defined as the number of MYR per currency of country i). P_i is the price level measured by CPI in country i, and P_M is the price level of Malaysia measured by CPI as well. The exchange rate for aggregate analysis, NEX_A, will be calculated as a trade-share weighted average of the NEX_i of the 5 trading partners. All CPI is based on 2010.

- GDP and GDP*: the domestic GDP (GDP) and foreign GDP (GDP*) is in real term which are measured with constant 2005 USD (in millions). The aggregate foreign real GDP will be calculated as a trade-share weighted average of real GDP of the 5 major partners.

The data for the bilateral Export and Import are available in the IMF DOTS (Direction of Trade Statistics) database; Nominal exchange rate and CPI are available in the IMF's IFS

(International Financial Statistics) database; Real GDP is available in World Bank's GEM (Global Economic Monitor) database and CEIC.

V. Empirical Estimation Results

Firstly, for ARDL to provide valid estimation and t statistics, we have to validate that none of the variables in the model are of I(2). ADF test is a common way to test unit root and it will be applied in this paper. All the variables in the specification are tested and the results are in Table 2. We can see that they are all stationary in level or first-difference, i.e. of I(0) or I(1). Specifically, except for trade balance with China, Japan, and Thailand, they are stationary in first-difference.

Table 2: ADF Tests Results for Non-Stationarity of Variables

	Level	First Difference	Order of Integration
Aggregate Level			
Trade Balance	−1.1391	−10.58***	I(1)
REX	−0.7829	−8.2719***	I(1)
GDP*	1.503	−6.482***	I(1)
Bilateral Level			
TB - Singapore	−0.5698	−6.8761***	I(1)
TB - China	−1.7655*	−8.8286***	I(0)
TB - US	−1.0231	−9.3008***	I(1)
TB - Japan	−2.1806**	−11.2064***	I(0)
TB - Thailand	−2.0524**	−9.5307***	I(0)
REX - Singapore	0.9007	−7.4464***	I(1)
REX - China	−1.0395	−5.8236***	I(1)
REX - US	0.2019	−6.6958***	I(1)
REX - Japan	0.5763	−7.5214***	I(1)
REX - Thailand	−1.0879	−6.2938***	I(1)
GDP - Malaysia	0.1426	−4.1506***	I(1)
GDP - Singapore	−0.9952	−3.7564***	I(1)
GDP - China	0.7012	−3.436**	I(1)
GDP - US	−0.3126	−3.0646**	I(1)
GDP - Japan	−0.9376	−5.2675***	I(1)
GDP - Thailand	−1.288	−4.2809***	I(1)

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$
All variables are in tested in log form

After the validation, we can follow the process in Figure 2 to conduct the ARDL estimation. The results of optimal lags and p value of Bound test are presented in Table 3. According to the q1 lags (which is the lag of REX), we can see that only the results of United States and Japan could help us investigate whether there is a deterioration on trade balance in short-run. The results of p-value of Bound Test indicate that except for Japan, relationships among variables do exist in long-run. Therefore, in the case of Japan, we can only give an analysis of short-run dynamics. In aggregate trade and bilateral trade with Singapore, China, the United States, and Thailand, we are safe to analyze both short-run and long-run effects.

Table 3: ARDL Optimal Lags and Bound Test of Co-integration Results

Country		Optimal Lags			p value of Bound Test		Long-run
	p	q1	q2	q3	I(0)	I(1)	Relationship
Aggregate	1	0	0	5	0.000	0.000	YES
Singapore	1	0	1	0	0.004	0.020	YES
China	1	0	0	0	0.006	0.031	YES
United States	2	3	5	2	0.000	0.003	YES
Japan	5	2	5	0	0.402	0.705	NO
Thailand	1	0	0	1	0.000	0.002	YES

All lags are selected by AIC criterion

p: Trade Balance, q1: REX, q2: GDP, q3: GDP*

To verify the stability of the estimated model, the tests of CUSUM and CUSUMSQ are also employed to the estimation in each case. The results of CUSUM and CUSUMSQ statistics are all staying within the critical bounds, indicating the stability of the model specification. The graphs are presented in the Appendix.

V.i Aggregate Trade between Malaysia and its Major Trade Partners

ARDL(1,0,0,5) is selected based on AIC for the case of aggregate trade. The regression results are shown in Table 4.

Table 4: Aggregate Trade - Selected ARDL(1,0,0,5) Estimation Results

Dependent Variables: $lnTB$		
	Coefficients	t - statistics
$lnTB_{t-1}$	0.295*	(2.61)
$lnREX$	0.0459	(0.47)
$lnGDP$	-0.0672	(-1.04)
$lnGDP^{*}$	-0.451	(-1.91)
$lnGDP^{*}_{t-1}$	0.0400	(0.14)
$lnGDP^{*}_{t-2}$	0.0317	(0.14)
$lnGDP^{*}_{t-3}$	-0.288	(-1.24)
$lnGDP^{*}_{t-4}$	0.184	(0.74)
$lnGDP^{*}_{t-5}$	0.491*	(2.14)
$constant$	0.734	(0.52)
N		75
R^2		0.697
$Adjusted\ R^2$		0.655
LL		153.8
	Diagnostic Tests	
Serial Correlation	Breusch-Godfrey LM test	$Chi^2(5)$=3.057 [0.6912]
Normality	Jarque-Bera test	$Chi^2(5)$=0.20 [0.9028]
Heteroskedasticity	White's test	$Chi^2(54)$=49.29 [0.6565]
Functional Form	Ramsey's RESET test	$F(3, 62)$=0.92 [0.4349]

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

p value in brackets

The model suggests that the real exchange rate, domestic income and foreign income account for 65.5% of trade balance performance. Since we only include 5 partners here which account for 53.9% of the trade share, we can expect the adjust R^2 to be higher when we consider the counterpart to be all of its trade partners. The results of the diagnostic tests all also presented at the bottom of Table 4. We can see that the model behaves normally and it's reasonable to continue to the bound test.

We know from the bound test in Table 3 that there is a long-run relationship, so we present the ECM form of ARDL(1,0,0,5) estimation in Table 5. The long-run estimates indicate that there is a positive relationship between REX and TB but not statistically significant. It indicates that devaluation may not be an effective method to improve TB in the long-term. Besides, the coefficient on ΔREX is positive and there is no lag on ΔREX, indicating that the relationship is only contemporaneous but not in any delayed effect in short-run conditional on

TB being initially in the long-run equilibrium. Therefore, it's likely that there is a deteriorated short-run effect of the exchange rate on trade balance but not a favorable positive effect in long-run equilibrium. The EC_{t-1} term is significantly negative at 1% level, reconfirming the existence of a long-run cointegration. This shows that the adjustment at a speed of 66% to equilibrium following short-run shocks.

Table 5: Aggregate Trade - Selected ARDL(1,0,0,5) ECM Estimation Results

Dependent Variables: $\Delta lnTB$		
	Coefficients	t - statistics
	Long-run Estimate	
$lnREX_{t-1}$	0.0650	(0.46)
$lnGDP_{t-1}$	-0.0953	(-1.07)
$lnGDP^*_{t-1}$	0.0105	(0.05)
	Short-run Estimate	
$\Delta lnREX$	0.0459	(0.47)
$\Delta lnGDP$	-0.0672	(-1.04)
$\Delta lnGDP^*$	-0.451	(-1.91)
$\Delta lnGDP^*_{t-1}$	-0.418	(-1.84)
$\Delta lnGDP^*_{t-2}$	-0.387	(-1.73)
$\Delta lnGDP^*_{t-3}$	-0.675**	(-3.11)
$\Delta lnGDP^*_{t-4}$	-0.491*	(-2.14)
constant	0.734	(0.52)
	Adjustment	
EC_{t-1}	-0.705***	(-6.26)
N		75
R^2		0.454
Adjusted R^2		0.378
LL		153.8

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In conclusion, there is not a J-curve for aggregate trade in Malaysia. The only thing that we can conclude is that the cointegration between these variables exists. It's often stated in literatures that aggregate level analysis suffers from bias, so we move on to see some results on bilateral trade.

V.ii Bilateral Trade between Malaysia and Singapore

ARDL(1,0,1,0) is selected based on AIC for the case of trade between Malaysia and Singapore.

The regression results are shown in Table 6.

Table 6: Singapore - Selected ARDL(1,0,1,0) Estimation Results

Dependent Variables: $lnTB$		
	Coefficients	t - statistics
$lnTB_{t-1}$	0.655***	(8.38)
$lnREX$	-0.161	(-1.00)
$lnGDP$	-0.102	(-0.29)
$lnGDP_{t-1}$	0.862*	(2.49)
$lnGDP^*$	-0.696***	(-3.67)
$constant$	-0.496	(-0.81)
N		79
R^2		0.807
$Adjusted\ R^2$		0.794
LL		116.6
	Diagnostic Tests	
Serial Correlation	Breusch-Godfrey LM test	$Chi^2(5)$=0.480 [0.9928]
Normality	Jarque-Bera test	$Chi^2(5)$=3.19 [0.2031]
Heteroskedasticity	White's test	$Chi^2(20)$=17.10 [0.6466]
Functional Form	Ramsey's RESET test	$F(3, 70)$=1.32 [0.2756]

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

p value in brackets

The model suggests that the real exchange rate, domestic income and foreign income account for 79.4% of trade balance performance, which is a pretty good result validating the two-country model. The diagnostic tests presenting in Table 6 also indicate that the model behaves normally and it's reasonable to conduct the bound test.

We know from the bound test in Table 3 that there is a long-run relationship in the case of Singapore, so we present the ECM form of ARDL(1,0,1,0) estimation in Table 7. Unfortunately, the long-run estimates indicate that though not statistically significant, there is a negative relationship between REX and TB which is not in line with what a J-curve suggests. Thus, it's not wise to consider devaluation as a mean for better trade balance. Also, similar to the case of aggregate trade, there is no lag on ΔREX thus no lagged deteriorated effect in the short-run. Even though the contemporaneously short-run effect (the coefficient on ΔREX) is negative, it's again not significant. The EC_{t-1} term is significantly negative at 1% level, reconfirming the existence of a long-run cointegration. This shows that the adjustment at a speed of 34.5% to equilibrium following short-run shocks.

Table 7: Singapore - Selected ARDL(1,0,1,0) ECM Estimation Results

Dependent Variables: $\Delta lnTB$			
	Coefficients	t - statistics	
	Long-run Estimate		
$lnREX_{t-1}$	-0.467	(-1.04)	
$lnGDP_{t-1}$	2.205***	(3.93)	
$lnGDP^{*}_{t-1}$	-2.020***	(-4.55)	
	Short-run Estimate		
$\Delta lnREX$	-0.161	(-1.00)	
$\Delta lnGDP$	-0.102	(-0.29)	
$\Delta lnGDP^{*}$	-0.696***	(-3.67)	
$constant$	-0.496	(-0.81)	
	Adjustment		
EC_{t-1}	-0.345***	(-4.41)	
N			79
R^2			0.250
$Adjusted\ R^2$			0.198
LL			116.6

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In conclusion, there is not a J-curve in the trade between Malaysia and Singapore. The only thing that we can conclude is that the cointegration between these variables exists.

V.iii Bilateral Trade between Malaysia and China

ARDL(1,0,0,0) is selected based on AIC for the case of trade between Malaysia and China. The regression results are shown in Table 8.

The model suggests that the real exchange rate, domestic income and foreign income account for 63.8% of trade balance performance. The diagnostic tests presenting in Table 8 also indicate that the model behaves normally and it's reasonable to conduct the bound test.

Table 8: China - Selected ARDL(1,0,0,0) Estimation Results

Dependent Variables: $lnTB$		
	Coefficients	t - statistics
$lnTB_{t-1}$	0.649***	(7.95)
$lnREX$	0.0894	(0.44)
$lnGDP$	-1.340**	(-2.88)
$lnGDP^{*}$	0.670**	(2.92)
$constant$	5.344*	(2.47)
N		79
R^2		0.657
$Adjusted\ R^2$		0.638
LL		65.24
	Diagnostic Tests	
Serial Correlation	Breusch-Godfrey LM test	$Chi^2(5)$=2.500 [0.7765]
Normality	Jarque-Bera test	$Chi^2(5)$=4.03 [0.1332]
Heteroskedasticity	White's test	$Chi^2(14)$=17.40 [0.2356]
Functional Form	Ramsey's RESET test	$F(3,70)$=1.56 [0.2056]

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

p value in brackets

We know from the bound test in Table 3 that there is a long-run relationship in the case of China, so we present the ECM form of ARDL(1,0,0,0) estimation in Table 9. Once again, similar to the result of aggregate trade, there is a positive relationship between REX and TB but not statistically significant. No lag on the short-run estimate and the coefficients are positive, which contradict the J-curve phenomenon.

Table 9: China - Selected ARDL(1,0,0,0) ECM Estimation Results

Dependent Variables: $\Delta lnTB$		
	Coefficients	t - statistics
	Long-run Estimate	
$lnREX_{t-1}$	0.255	(0.43)
$lnGDP_{t-1}$	-3.820**	(-3.13)
$lnGDP^{*}_{t-1}$	1.909**	(3.23)
	Short-run Estimate	
$\Delta lnREX$	0.0894	(0.44)
$\Delta lnGDP$	-1.340**	(-2.88)
$\Delta lnGDP^{*}$	0.670**	(2.92)
$constant$	5.344*	(2.47)
	Adjustment	
EC_{t-1}	-0.351***	(-4.29)
N		79
R^2		0.210
$Adjusted\ R^2$		0.168
LL		65.24

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

It's clear that no J-curve shows in the trade between Malaysia and China. The only conclusion we can draw is that there is a long-run relationship among the variables due to the significant negative sign on the EC_{t-1} term.

V.iv Bilateral Trade between Malaysia and United States

ARDL(2,3,5,2) is selected based on AIC for the case of trade between Malaysia and the United States. The regression results are shown in Table 10.

Table 10: United States - Selected ARDL(2,3,5,2) Estimation Results

Dependent Variables: $lnTB$		
	Coefficients	t - statistics
$lnTB_{t-1}$	0.450***	(3.68)
$lnTB_{t-2}$	-0.197	(-1.60)
$lnREX$	0.652*	(2.48)
$lnREX_{t-1}$	-0.527	(-1.43)
$lnREX_{t-2}$	0.432	(1.16)
$lnREX_{t-3}$	-0.303	(-0.81)
$lnREX_{t-4}$	0.983*	(2.66)
$lnREX_{t-5}$	-0.845**	(-3.12)
$lnGDP$	-0.796	(-1.34)
$lnGDP_{t-1}$	0.466	(0.73)
$lnGDP_{t-2}$	-0.889	(-1.40)
$lnGDP_{t-3}$	-0.919	(-1.78)
$lnGDP^*$	4.065*	(2.15)
$lnGDP^*_{t-1}$	-2.477	(-0.89)
$lnGDP^*_{t-2}$	3.513	(1.88)
$constant$	-53.95***	(-4.34)
N		75
R^2		0.856
$Adjusted\ R^2$		0.820
LL		98.51
	Diagnostic Tests	
Serial Correlation	Breusch-Godfrey LM test	$Chi^2(5)$=4.044 [0.5432]
Normality	Jarque-Bera test	$Chi^2(5)$=0.61 [0.7374]
Heteroskedasticity	White's test	$Chi^2(74)$=75.00 [0.4457]
Functional Form	Ramsey's RESET test	$F(3,56)$=0.34 [0.7955]

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
p value in brackets

The model suggests that the real exchange rate, domestic income and foreign income account for 82.0% of trade balance performance, generating a much greater convincing power for the two-country model. The diagnostic tests presenting in Table 10 also indicate that the model behaves normally and it's reasonable to conduct the bound test.

We know from the bound test in Table 3 that there is a long-run relationship in the case of the United States, so we present the ECM form of ARDL(2,3,5,2) estimation in Table 9.

Table 11: United States - Selected ARDL(2,3,5,2) ECM Estimation Results

Dependent Variables: $\Delta lnTB$			
	Coefficients	t - statistics	
	Long-run Estimate		
$lnREX_{t-1}$	0.526**	(3.17)	
$lnGDP_{t-1}$	-2.863***	(-8.46)	
$lnGDP^*_{t-1}$	6.832***	(7.79)	
	Short-run Estimate		
$\Delta lnTB_{t-1}$	0.197	(1.60)	
$\Delta lnREX$	0.652*	(2.48)	
$\Delta lnREX_{t-1}$	-0.267	(-0.97)	
$\Delta lnREX_{t-2}$	0.164	(0.59)	
$\Delta lnREX_{t-3}$	-0.139	(-0.51)	
$\Delta lnREX_{t-4}$	0.845**	(3.12)	
$\Delta lnGDP$	-0.796	(-1.34)	
$\Delta lnGDP_{t-1}$	1.808**	(2.90)	
$\Delta lnGDP_{t-2}$	0.919	(1.78)	
$\Delta lnGDP^*$	4.065*	(2.15)	
$\Delta lnGDP^*_{t-1}$	-3.513	(-1.88)	
$constant$	-53.95***	(-4.34)	
	Adjustment		
EC_{t-1}	-0.747***	(-5.31)	
N			75
R^2			0.495
$Adjusted\ R^2$			0.367
LL			98.51

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The long-run estimates are positive and statistically significant. The estimate of the coefficient on REX suggests that the trade balance ratio (X/M) will increase 52.6% on average given a 1% increase in REX at 5% significance level. Besides, for the short-run estimates, the contemporaneous effect of REX is significantly positive while the lagged effects are not unified in sign and go back and forth. Even though there are some negative signs, they are not significant. According to J-curve, the lagged effects expected to be negative in large lag while gradually be positive as lag length becomes smaller. Thus, the short-run results are not ideal as expected so we cannot conclude that there is a J-curve. Nevertheless, the EC_{t-1} term is negative and statistically significant, which reassures the existence of a long-run relationship.

In conclusion, the results show no evidence of a J-curve in the trade between Malaysia and the United States. However, we can still conclude that in the long-run, a devaluation will improve the trade balance with the United States.

V.v Bilateral Trade between Malaysia and Thailand

ARDL(1,0,0,1) is selected based on AIC for the case of trade between Malaysia and Thailand. The regression results are shown in Table 12.

Table 12: Thailand - Selected ARDL(1,0,0,1) Estimation Results

Dependent Variables: $lnTB$		
	Coefficients	t - statistics
$lnTB_{t-1}$	0.442***	(4.19)
$lnREX$	-0.0313	(-0.13)
$lnGDP$	0.152	(0.59)
$lnGDP^*$	0.801	(1.38)
$lnGDP^*_{t-1}$	-1.037	(-1.80)
$constant$	0.963	(0.52)
N		79
R^2		0.309
$Adjusted\ R^2$		0.262
LL		90.73
	Diagnostic Tests	
Serial Correlation	Breusch-Godfrey LM test	$Chi^2(5)$=4.751 [0.4470]
Normality	Jarque-Bera test	$Chi^2(5)$=0.37 [0.8306]
Heteroskedasticity	White's test	$Chi^2(20)$=23.75 [0.2536]
Functional Form	Ramsey's RESET test	$F(3, 70)$=0.85 [0.4699]

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
p value in brackets

The model suggests that the real exchange rate, domestic income, and foreign income only account for 26.2% of trade balance performance, which is not ideal in terms of a two-country model. The diagnostic tests presenting in Table 10 indicate that the model behaves normally and it's reasonable to conduct the bound test.

Table 13: Thailand - Selected ARDL(1,0,0,1) ECM Estimation Results

Dependent Variables: $\Delta lnTB$			
	Coefficients	t - statistics	
	Long-run Estimate		
$lnREX_{t-1}$	-0.0562	(-0.13)	
$lnGDP_{t-1}$	0.272	(0.59)	
$lnGDP^*_{t-1}$	-0.423	(-0.78)	
	Short-run Estimate		
$\Delta lnREX$	-0.0313	(-0.13)	
$\Delta lnGDP$	0.152	(0.59)	
$\Delta lnGDP^*$	0.801	(1.38)	
constant	0.963	(0.52)	
	Adjustment		
EC_{t-1}	-0.558***	(-5.28)	
N			79
R^2			0.292
Adjusted R^2			0.244
LL			90.73

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We know from the bound test in Table 3 that there is a long-run relationship in the case of Thailand, so we present the ECM form of ARDL(1,0,0,1) estimation in Table 11. The results are very similar to that of the case of Singapore. What's worse, all the coefficients are not significant. The long-run effect of REX is negative, and no lagged short-run estimates of REX are there, which all contradict the J-curve phenomenon. Therefore, it's not likely to be a good way to implement devaluation in favor of a better trade balance in the case of Thailand.

V.vi Bilateral Trade between Malaysia and Japan

Among all the cases, only Japan shows no evidence of a long-run relationship among all the variables. However, we could still use the ARDL model to measure the short-run effect. One way is to estimate the model in first-differences without the error correction term. Estimating the model in levels would also be an acceptable approach. The coefficients can still be interpreted as short-run coefficients (Kripfganz & Schneider, 2016). Therefore, for simplicity, we estimate the model in levels and the results are in Table 14.

Table 14: Japan - Selected ARDL(5,2,5,0) Estimation Results

Dependent Variables: $lnTB$		
	Coefficients	t - statistics
$lnTB_{t-1}$	0.589***	(4.41)
$lnTB_{t-2}$	-0.139	(-0.98)
$lnTB_{t-3}$	0.301*	(2.15)
$lnTB_{t-4}$	0.353*	(2.46)
$lnTB_{t-5}$	-0.377**	(-2.71)
$lnREX$	-0.0739	(-0.30)
$lnREX_{t-1}$	-0.549	(-1.75)
$lnREX_{t-2}$	0.464	(1.97)
$lnGDP$	0.0185	(0.02)
$lnGDP_{t-1}$	1.573	(1.50)
$lnGDP_{t-2}$	0.492	(0.60)
$lnGDP_{t-3}$	1.225	(1.54)
$lnGDP_{t-4}$	-1.152	(-1.12)
$lnGDP_{t-5}$	-1.713*	(-2.00)
$lnGDP^*$	-2.218	(-1.94)
constant	25.89	(1.92)
N		75
R^2		0.867
Adjusted R^2		0.833
LL		76.74
	Diagnostic Tests	
Serial Correlation	Breusch-Godfrey LM test	$Chi^2(5)$=10.786 [0.0558]
Normality	Jarque-Bera test	$Chi^2(5)$=40.61 [0.7374]
Heteroskedasticity	White's test	$Chi^2(74)$=1.21 [0.5469]
Functional Form	Ramsey's RESET test	$F(3,56)$=0.75 [0.5296]

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

p value in brackets

ARDL(5,2,5,0) is selected based on AIC. The model suggests that the real exchange rate, domestic income and foreign income account for 83.3% of trade balance performance, which is ideal in terms of the two-country model. The diagnostic tests presenting in Table 14 indicate that the model behaves normally. From the coefficient on the REX we can see that in the short-run, the relationship is negative but not significant. Given this, devaluation is not seemingly a good choice.

VI. Conclusion

The paper employs aggregate and disaggregate data to test the existence of J-curve in Malaysia by treating the main trading partners of Malaysia both as a whole and separately. There is a brief conclusion in Table 15.

Table 15: Results Conclusions

Case	Long-run Effect	Significant	M-L Condition	J_curve
Aggregate	+	NO	YES	NO
Singapore	-	NO	NO	NO
China	+	NO	YES	NO
United States	+	YES	YES	NO
Thailand	-	NO	NO	NO
Japan	N/A	N/A	NO	NO

The M-L condition refers to the Marshal-Lerner condition and is evaluated regardless of the significance

Given all the empirical results, we can conclude that:

- Among all the cases we investigated, there is long-run relationships between exchange rate and trade balance except for Japan. Among these, only Aggregate, China and the United States meet the Marshal-Lerner condition. However, none of the cases show the evidence of J curves. In short, the results are various rather than unified. Although for the bilateral trade with the United States, there is a significant positive relationship between the exchange rate and trade balance, in the short-run it's unsteady. As a result, we may conclude that depreciation on the domestic currency may not be an effective way to improve trade balance in Malaysia. Other factors like regulations, infrastructure, production may attach bigger importance.
- The aggregate level analysis suffers from bias and the countries that we include may not be enough to cover all the trade since they only account for about 50% of the trade. We may want to use some other index of exchange rate like REER used by IMF as an alternative specification for the aggregate level analysis.

- We may notice that the interpretation of individual short-run effects in the ECM form of the ARDL model is pretty tricky. The period-delayed effect in the short-run due to a permanent shock to the independent variable consists of multiple components, making a correct quantitative interpretation to them cumbersome. It might be more appropriate to compute impulse response functions to describe the short-run dynamics. However, the impulse response functions only could be applied after the estimation of VAR, VECM or other time series rather than the ARDL model. Given the various advantages of the ARDL model, a transformation of ECM to one of these models in order to get impulse response functions could benefit a lot for further studies.

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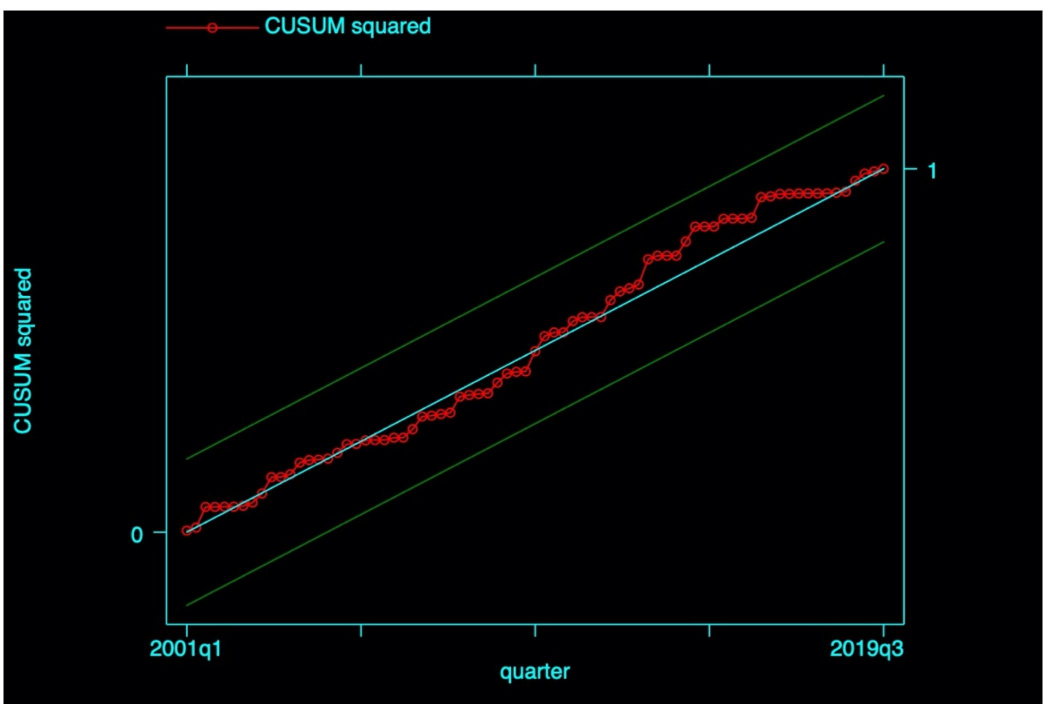
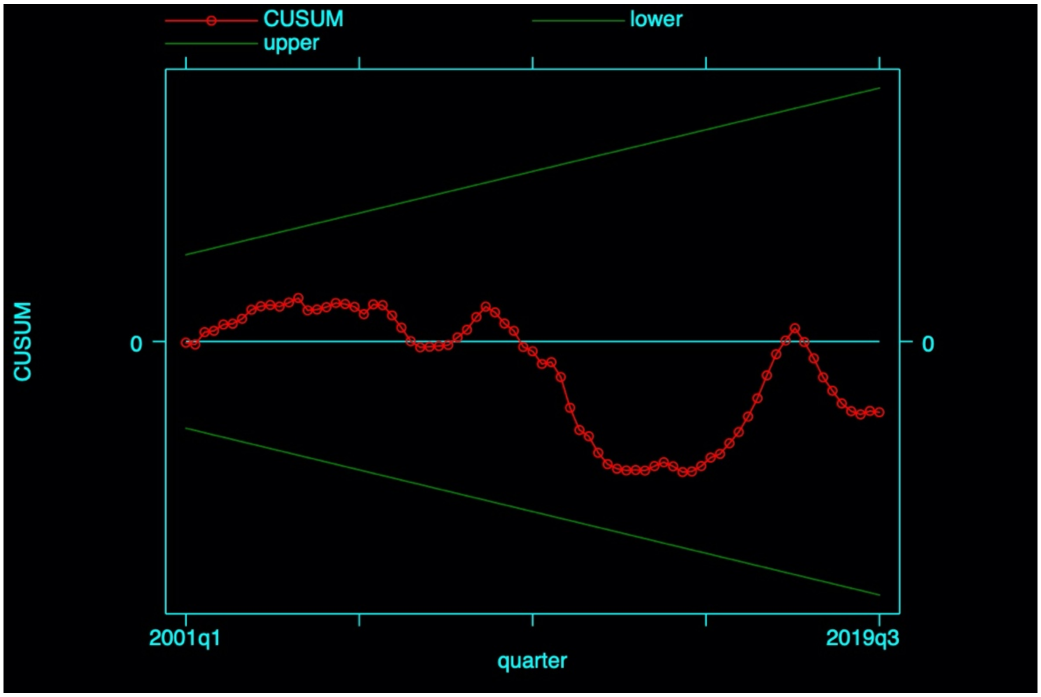
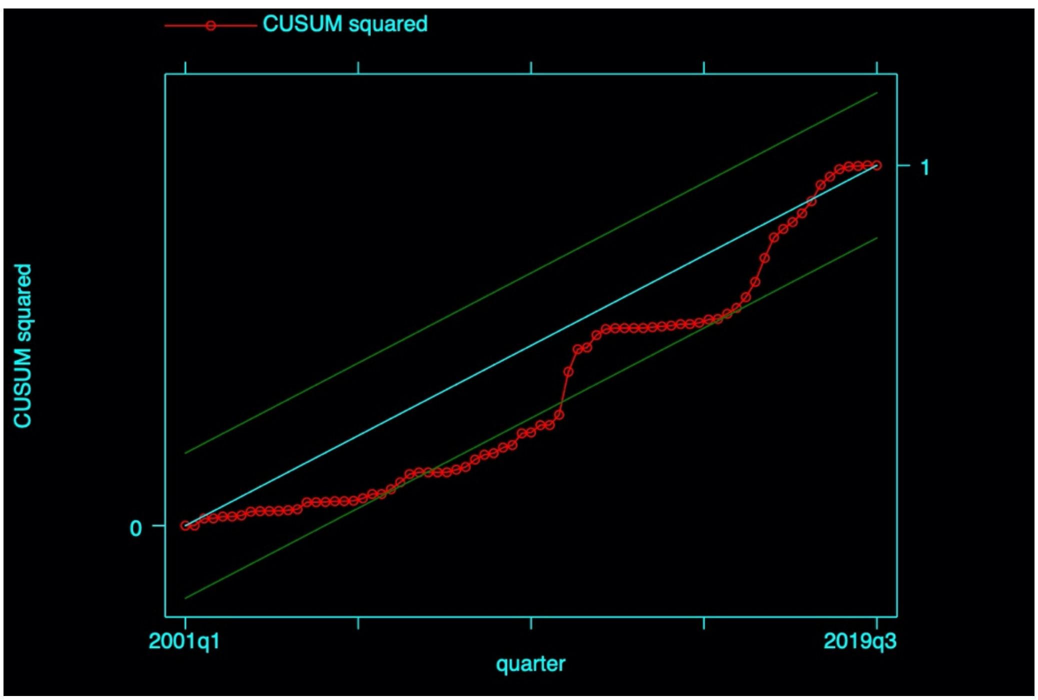
Appendix

a. CUSUM and CUSUMSQ for the case of Aggregate Trade

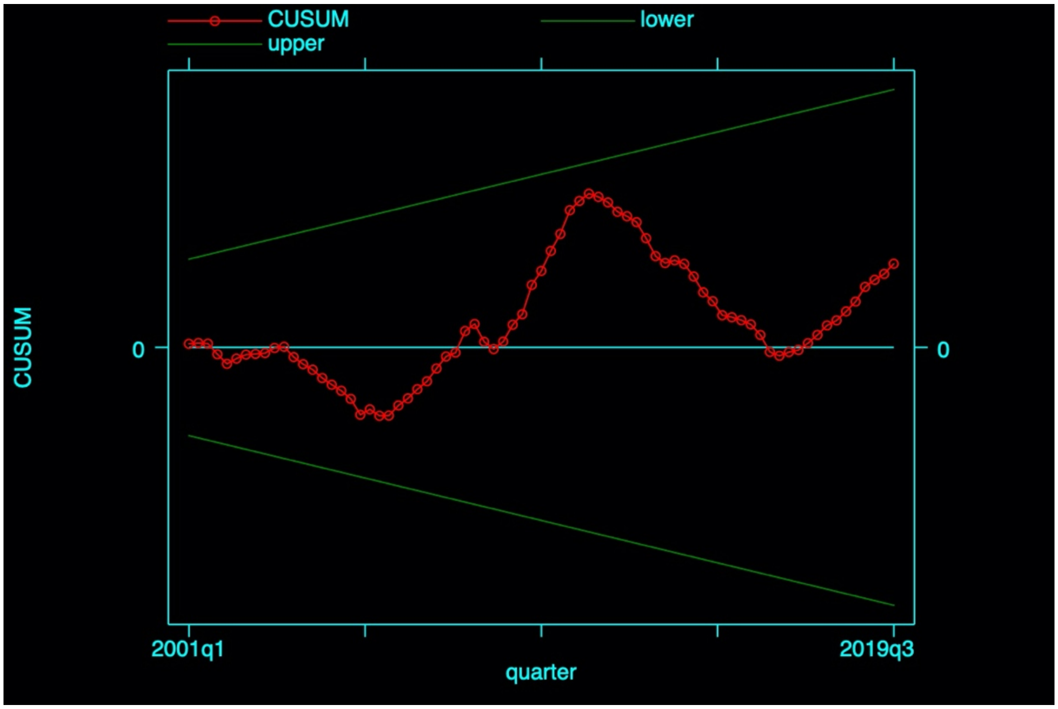


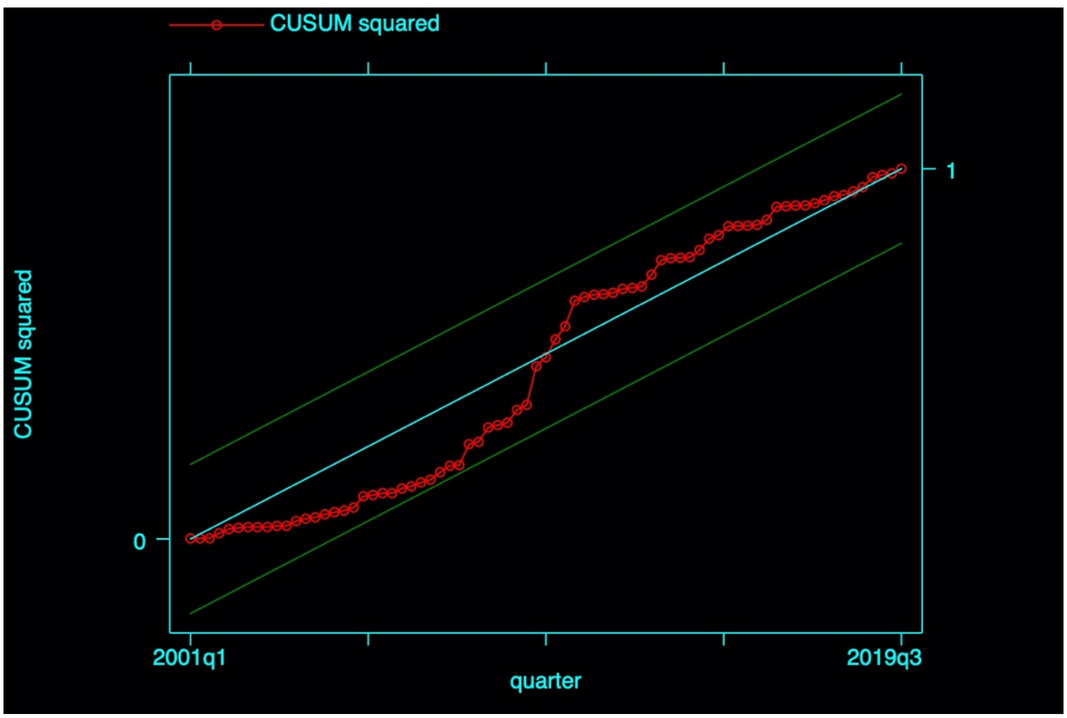
b. CUSUM and CUSUMSQ for the case of Singapore



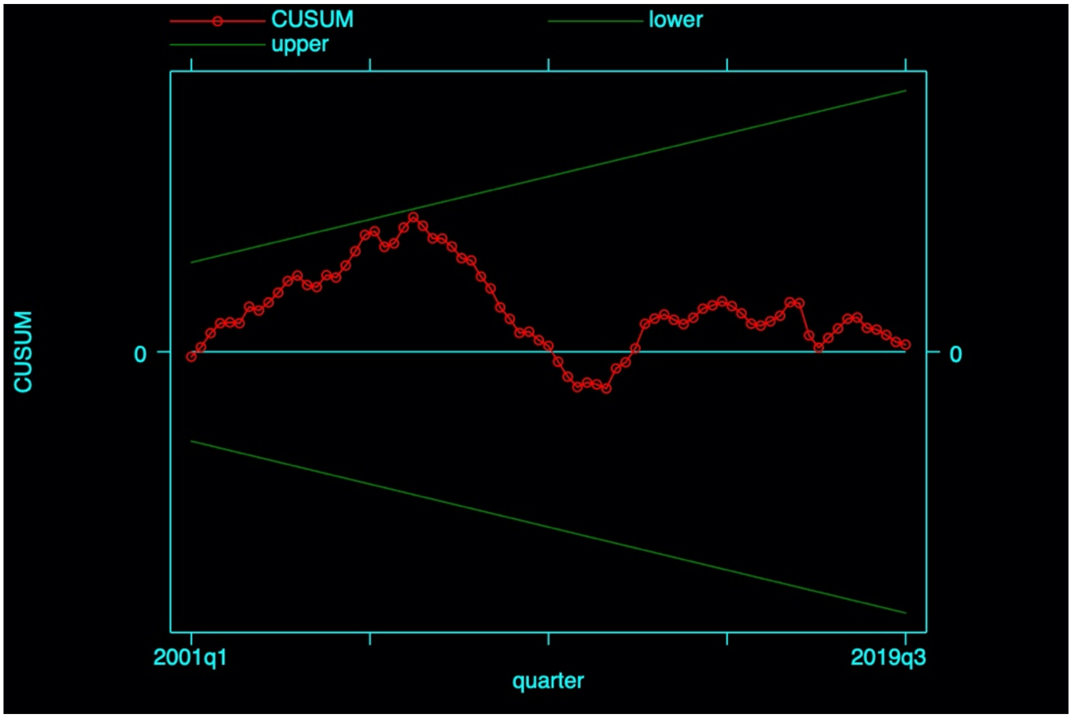


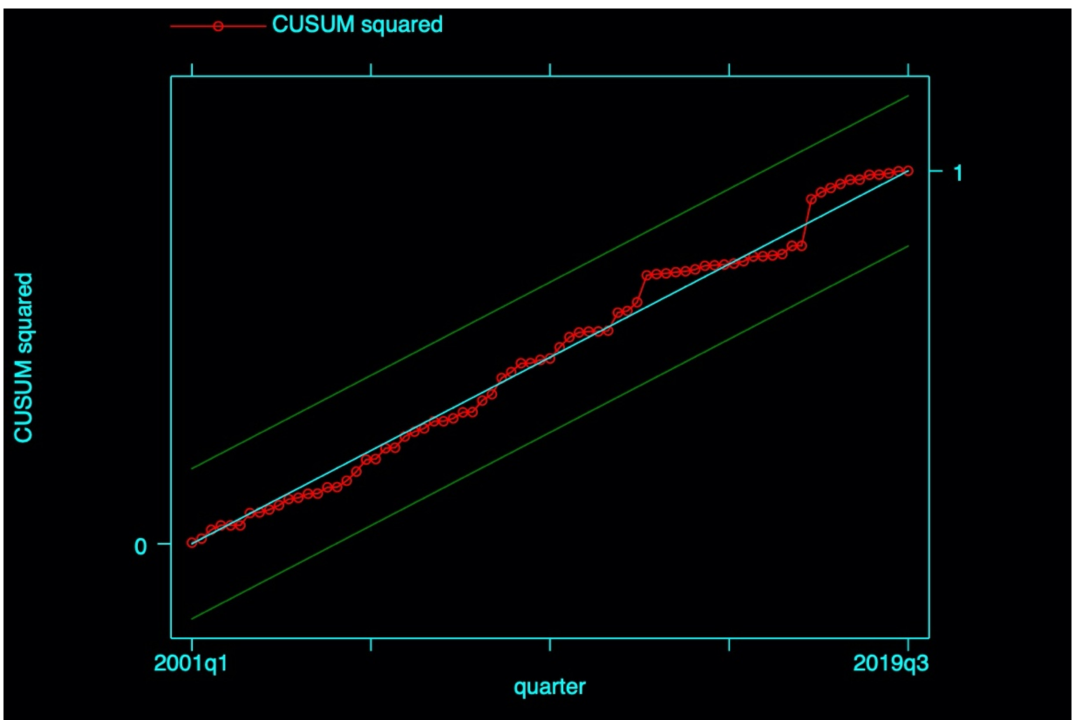
c. CUSUM and CUSUMSQ for the case of China



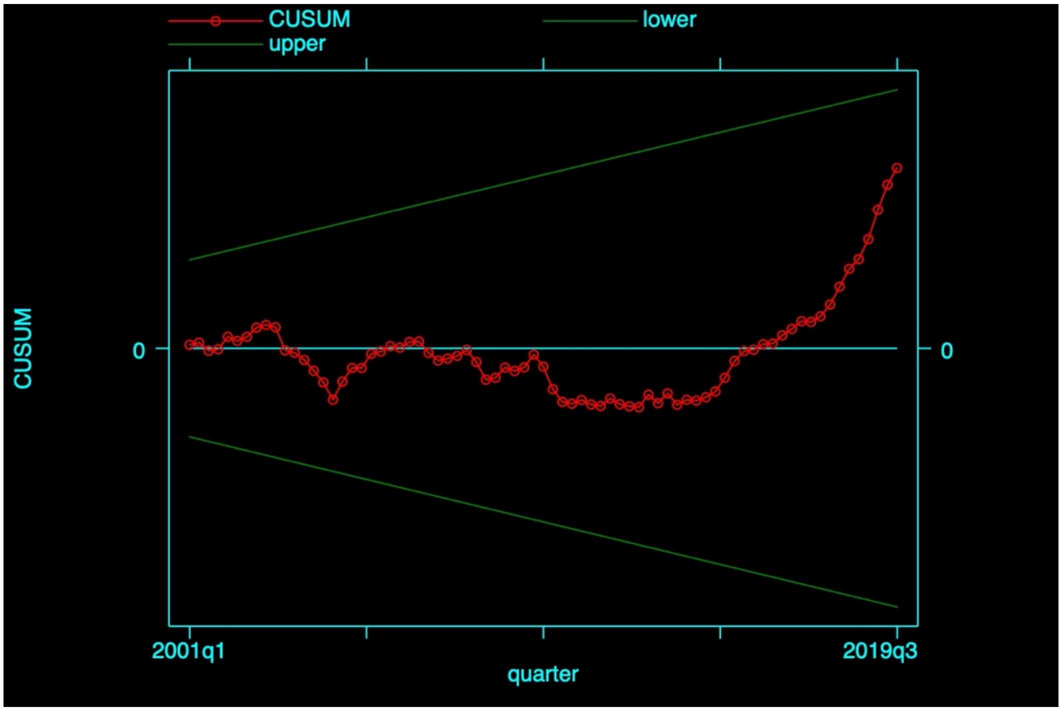


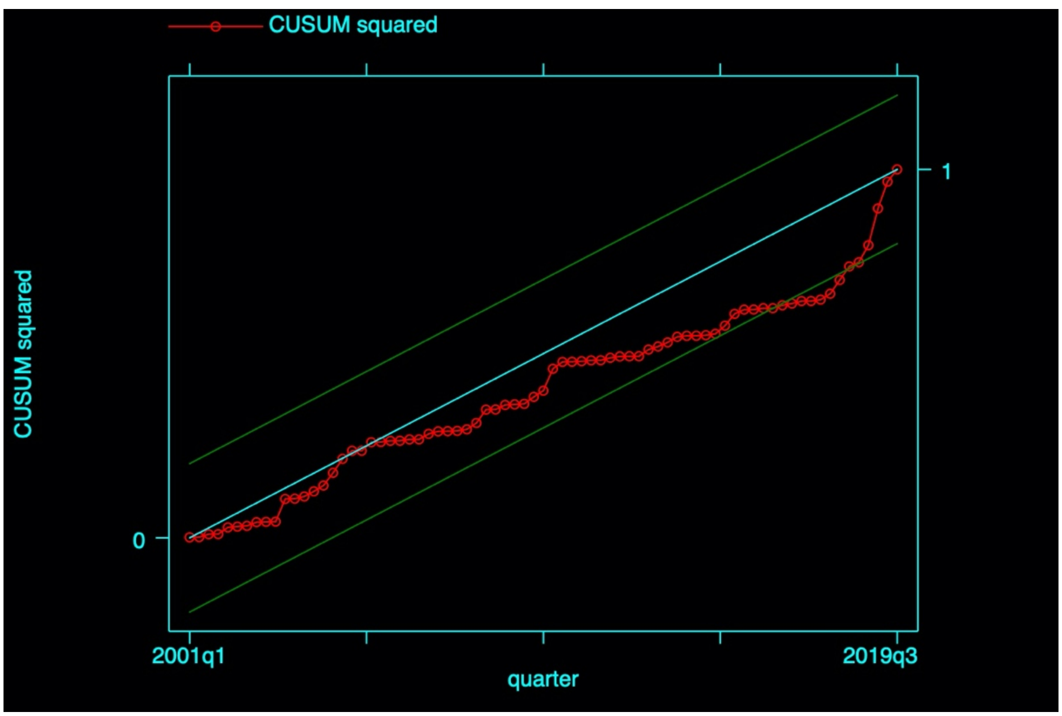
d. CUSUM and CUSUMSQ for the case of United States





e. CUSUM and CUSUMSQ for the case of Thailand





f. CUSUM and CUSUMSQ for the case of Japan