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REVIEW ARTICLE

How Exporters React to Exchange Rate Movements: An Explanation by a Threshold Model

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Abstract

The objective of this paper is to analyze the adjustments in selling prices face to movement of exchange rates. For this, we use non-linear threshold effects models. Our results confirm that the more a company is exposed to currency risk due to its exports, the higher the incentive to sell directly in the currency of the buyer is greater. Indeed, the behavior and the choice of pricing depend on direction and magnitude of changes in exchange rates. The firms may choose not to pass all changes on their selling price. This choice depends on several factors: the costs of price adjustment are not negligible, their strategic choice to win market share, and finally, by their desire to increase their profit margins face a shock changes.

Keywords: *Exchange rate, Pricing-to-Market, Threshold model.*

Introduction

Since the episode of the bubble on the dollar in the eighties, we know that exporting firms can not affect the magnitude of fluctuations in selling prices. This phenomenon is known as pricing to market has potentially significant consequences. It affects the transmission mechanism of monetary shocks on domestic and foreign economies, and increased exchange rate volatility. Many of literature have questioned the relevance of the "*Law of One Price*" which was one of the common ingredients in models of open economy macroeconomics. If we judge by the variability of real exchange rates or spreads prices between countries, the international economy is less integrated than it seems, given the intensity of trade. This explains why the impact of changes in the exchange is both incomplete and varies from one country to another. Indeed, some countries seem to enjoy the local pricing: they fix their selling price in the currency of the buyer; the export prices expressed in domestic currency are then very sensitive to fluctuations. Others, however, find it easier to impose their prices in domestic currency. Indeed, Goldberg and Knetter [14] show that the yen's rise occurred in 1994-95 (over 30%), has passed very low in price, so that Japanese exports have not been affected. The choice to leave prices unchanged in the currency of the importing country (or not fully pass the evolution of the exchange) involves a play on the margins requires both a segmentation of national markets and market power. The intensity of the phenomenon therefore depends on the nature of the products exported. Indeed, for poorly differentiated goods subject to international competition, there are naturally few possibilities of discrimination are priced in foreign currency and it applies to all producers. However, on specific goods, exporters have a greater freedom of pricing, so they may fix in their national currency, that is to say they fully reflected the fluctuations in the exchange rate. Indeed, despite strong fluctuations in the dollar pendant in recent years, the prices of U.S. imports invoiced in dollars remained relatively stable. International exporters chose price discrimination in the third degree, in order not to risk losing market share. So they did not pass the fluctuations on their selling price. Such behavior now known as pricing to market (PTM) has potentially significant consequences.

These behaviors of pricing- to-market (PTM or local currency pricing) that have multiple origins , means that companies with a market power, discriminate between markets by choosing a selling price of the destination market . Many studies have empirically verified the existence of this phenomenon. Some authors, such as Aw and Hwang [1], Betts and Devereux [3], Chari et al. [6], Kollmann [19], Obstfeld and Rogoff[24] assess the implications of PTM on the movements of exchange rates. Firms react differently to fluctuations depending on the direction and magnitude of fluctuations.Baldwin [5] and Dixit [8] have highlighted the importance of the structure of the client country market faced by exporting firms. Supporting sunk costs (sunkcosts) to the entry of new market, and fearful of losing market share against potential new entrants, they stabilize their prices in case of relative currency appreciation. In a similar vein, Froot and Klemperer [13] emphasize the strategic choice between firms win market share and increase their profit margins face an exchange rate shock. These behaviors are explained in the case of currency appreciation exporters by their desire to stabilize their market share. According to Goldberg and Knetter[14], such a strategy can be observed in case of depreciation of the domestic currency, especially when firms are constrained capacity. In addition, Delgado et al. [11] and Bec et al. [3] showed that exporting firms may choose not to pass all fluctuations on their selling prices regardless of the direction of change in exchange if these movements are short duration or low amplitude because the price adjustment costs (menu costs) are not negligible. The policy impact of exporting firms is conditional on the structure of customer market. More firms have large market shares, and their line of work is great. So they can more easily increase their selling prices in case of relative currency appreciation. Conversely, if they attempt to conquer a new market, then it is in their interest to support the exchange rate shocks on their profit margins in case of appreciation, rather than passing them on to their selling prices. The direction of change of the exchange rate and the extent of foreign exchange fluctuations are key determinants in the adoption of these behaviors.

The objective is to show that the direction and extent of the exchange rate movements are at the origin of the asymmetry of the pricing strategies of exporting firms. Our study focuses on the behavior of German exporting firms in the U.S. and Japanese markets for the sale of motor vehicles on the period 1999-2008. For this, we estimate the relationship of pricing to market with a nonlinear threshold model. The Procedures for model specification we adopt, allow us to test the linearity of the relationship. In addition, the analysis of the estimation models will give us a first intuition about the difference in dynamics by exchange rate movements. Finally, we can see by studying the generalized impulse response functions (GIRF), the response of prices to an exchange rate shock in distinguishing the direction of change of the exchange rate and the magnitude of the shock. We develop a methodology that stands out from other work on two points. Firstly, in order to test the linearity of this relationship we use the method Luukkonen et al. [20]. Then we study the behavior of exporting firms in the choice of pricing in the context of a threshold effect model type (SETAR). Finally, as Pesaran and Shin [25], we construct the generalized impulse responses answers.

The rest of the paper is organized as follows: Section 2 presents the new class of nonlinear models suggested in the literature. The methodological framework (model selection and construction of data) is discussed in section 3. The construction of generalized impulse response functions are detailed in Section 4. Then, section 5 presents the results of the behavior of firms facing an exchange rate shock. A final section concludes.

Literature Review

Introduced by Chan and Tong [7], these models are designed to estimate relationships between characterized by a dynamic that is asymmetric variables. In the context of linear models, we could not account for these asymmetries, contrary to what we can achieve through the use of models thresholds. These models are defined by the existence of several regimes, each characterized by a linear dynamics. Modeling export prices under this type of model can account for the adjustment behavior of prices depending on the plan, for example according to the phases of appreciation or depreciation of the exchange. We can then see whether the relationship between prices and the exchange rate differs from one scheme to another. In these models the regime change occurs suddenly. Thus, the transition from one regime to the other occurs continuously. It is difficult at present to know what type of model can best explain the asymmetric behavior of pricing-to-market. We hold the category of Self-Exciting Threshold Autoregressive Model (SETAR).The class of SETAR[1]model is a generalization of TAR models Chan and Tong[7]. It defines a relationship that may be non-linear over a specified period, but linear in time. In fact,

[1]The SETAR model, first introduced by Dick et al. [10] and Terasvirta and Anderson [29]. Their statistical properties were then examined byGranger and Terasvirta [15], Terasvirta and Lin [30]. Moreover, the class of SETAR models has been the subject of several recent empirical studies on financial markets (Bec et al. [4], Dufrénot and Mignon [9], Escribano et al. [12], Jawadi and Koubaa [17] ,Kapetanios et al. [18], Mignon and Dufrenot [23], Sarrantis[26] , Sarrantis [27] , Taylor and Peel[31] and Taylor et al. [32]).The results of these studies showed the ability ofSETAR models to capture the non-linearity, to reveal the irregularities and breaks in the movement, and provide an ideal framework for the study of asymmetric cyclical fluctuations.

the parameters of linear relationships associated with different sub-periods and thus define schemes that come into action according to the earlier embodiment of the process with respect to a threshold T say [28].Intuitively, the process follows a SETAR regime AR (p) when $y_{t-d} > c$, and becomes a regime AR (p) different in the next period if $y_{t-d+1} \leq c$. as the two systems have different dynamic structures, the conditional probability of the past to fall into a diet is not necessarily the same as the other falls, hence modeling the appearance of the cycle.A process SETAR (2, p = 1, d = 1) is a process that $Y_t$is assumed stationary, which is characterized by a different dynamic regime. This process follows a pattern threshold in both schemes, at least, which is then defined as follows by Equation (1):

$$Y_t = \begin{cases} \varphi_0^{(1)} - \frac{1}{2}\varphi^{(1)'}X_t + \varepsilon_t^{(1)} & if \;\; Z_t \leq s \\ \varphi_0^{(2)} - \frac{1}{2}\varphi^{(2)'}X_t + \varepsilon_t^{(2)} & if \;\; Z_t > s \end{cases} \quad (1)$$

Where, $\varepsilon_t^{(i)}$, i= 1, 2 two white noises, $\phi_j = (\phi_j^{(1)},....\phi_m^{(j)})$ j = $\{1,2\}$, denote the AR parameters in the first and second regime, $X_t = \{Y_{t-1},.....Y_{t-p};V,......V_k\}$ are explanatory variables, Zt is the transition variable that the variable is noted that "triggers" the transition from one system to another, that is to say the transition from a dynamic to another. This variable is assumed to be a variable X_t, that is to say either a delayed endogenous or exogenous. The value of this variable, which ensures the change of regime, is called the "threshold", notes that s.

When observations of the transition variable are below the threshold, the dynamics of the endogenous variable *Y*, is characterized by the parameters $\phi_j^{(1)}$, $j = 0, ….m +1$. Conversely, when the observations of the transition variable have a value greater than the threshold, the dynamics of *Y* is explained by the coefficients $\phi_j^{(2)}$, $j = 0, ….m +1$. Determining the transition variable and the threshold is fundamental. The choice of the transition variable can be guided by economic theory, but a theoretical solution can be obtained. The model with two regimes can be extended to the case of more than two regimes. The first step in the estimation of threshold models is to identify the variable and the value of the variable that provides the change of regime. We will seek to identify the transition variable and the threshold. However, it is first necessary to verify that the model is characterized by a non-linear dynamics. For this we use the test of Luukkonen et al. [20].

Methodology

The test of Luukkonen et al.[20] will determine if the time series is characterized by a non-linear dynamics of a part, and determine which variable ensures the passage of the other dynamic, second. After identifying these variables, we can then proceed to estimate the SETAR model to compare estimates studied in this framework with those in the context of a linear model series. We can then observe whether the model threshold provides information on the studied relationship.

Hypothesis Testing of Linear Model

Luukkonen et al. [20] defines (1) a methodology to test the assumption of linearity of the series, and then determine the transition variable and the threshold. Indeed, assume that a linear series is equivalent to considering it is characterized by a single dynamic. To test the linearity of this series, we test the null hypothesis of linearity against the alternative hypothesis of the existence of a threshold model. It then tests is given by the Equation (2):

$$\begin{cases} H_0 : Y_t = \varphi_0 + \varphi_i X_t \\ H_1 : Y_t = \begin{cases} \varphi_0^{(1)} - \frac{1}{2}\varphi_i^{(1)} X_t + \varepsilon_t^{(1)} & if \;\; Z_t \leq s \\ \varphi_0^{(2)} - \frac{1}{2}\varphi_i^{(2)} X_t + \varepsilon_t^{(2)} & if \;\; Z_t > s \end{cases} \end{cases} \quad (2)$$

That is to test: $\phi_i^{(1)} = \phi_i^{(2)} = 0$ (i = 0, …m +1)

Luukkonen et al. [20] proposed a test to determine if the time series is characterized by a non-linear dynamics of a part, and determines which variable ensures the passage of a dynamic one, the other part. After identifying these variables, we can then proceed to estimate the SETAR model to compare estimates studied in this framework series. We can then observe whether the model thresholds provide information on the studied relationship.

Hypothesis Testing of Nonlinear Model

However, under the assumption of linearity, time defining the transition variable and the threshold are not identifiable. They can take any value without affecting the likelihood function. Therefore, standard tests are no longer applicable. To overcome this problem, Luukkonen and Terasvirta [21], proposes a solution to this problem by approximating the nonlinear function by its Taylor series expansion. This asymptotic linear model they develop two tests depending on the degree of the Taylor approximation they choose. The approach is to approach the threshold models by non-linear models of course, but not with conflict specification parameters. Specifically, these models are given by Equation (3) which takes the form:

$$\Delta Y_t = \begin{cases} \varphi_0^{(1)} + \sum_{i=1}^{p} \varphi_i^{(1)} \Delta Y_{t-i} + \sum_{j=1}^{q} \varphi_j^{(1)} \Delta X_{t-j} + \varepsilon_t^{(1)} \\ \varphi_0^{(2)} + \sum_{i=1}^{p} \varphi_i^{(2)} \Delta Y_{t-i} + \sum_{j=1}^{q} \varphi_j^{(2)} \Delta X_{t-j} + \varepsilon_t^{(2)} \end{cases} \quad (3)$$

The dynamics of *Y* does not change. What changes here is the order in which data enters the regression. For the first r observations, that is to say for the first regime, Y follows a linear process. Therefore, the regression residuals are white noises and are orthogonal to the repressors. In contrast, the values for the variable above the transition threshold, the residuals are no longer orthogonal to function but independent variables. In other words, to determine whether the model is linear simply regress the residuals on the independent variables. The estimated coefficients will be significantly different in the second case that is to say in cases where the model would not be linear. Therefore, the test in a test of linearity of the invalidity of these coefficients. The test statistic is then independent of unidentifiable parameter s and follows a standard Fisher. It depends on the parameter *m* which is assumed fixed during the test and the transition variable. This ordered regression is then estimated recursively, which can calculate the statistical $Q_{(m)}$ based on linearity test recursive residues given by Equation (4):

$$Q(m) = \frac{\left(\sum \hat{e}_t^2 - \sum \hat{a}_t^2\right) / (m+1)}{\sum \hat{a}_t^2 / (n-b-2m-1)} \quad (4)$$

Where *b* is the number of observations used to initialize the recursive residuals $\hat{e}_t$ and estimates □$_t$ standardized and $\hat{a}_t$ are the residuals of the regression of (1, $X_{(i)}$).It is therefore necessary to perform this test for all endogenous and exogenous variables delayed. We then retain such transition variable which maximizes the statistic is to say that for which is the highest Fisher, in the case where one would reject the null hypothesis of linearity. After checking the non-linearity of the model and defines the transition variable it comes to determining the value of the transition variable that allows passage from one regime to another.

Empirical Results

Data Description

The model is estimated with monthly data for the period 1999M1-2008M12 for the sale of motor vehicles destination in Japan and the United States. The two variables are therefore the real exchange rate (quoted on uncertainty) and unit values of German auto billed in the currency of the customer. These data are derived from monetary and financial series of the Bank of France on the one hand and the base "Economic Outlook"[2] OECD other. The real exchange rate was constructed as the ratio of the price of the nominal exchange rate to the price index for consumption in the foreign country. All variables are used in logarithmic form. The series is subject to seasonal adjustment.

Statistics

The Table 1 shows the different statistical properties of the series of real[3] exchange rates and unit values on the period from 01/01/1999 to 31/12/2008. In order to test the assumption of normality of the distribution of these series, the skewness and kurtosis were added. In order to test the assumption of normality of the distribution of these series, the skewness and kurtosis were added. The results should in principle be closer assumptions commonly issued in financial theory, that the exchange rate must be independent and identically distributed random variables. Moreover, distribution is not normal but leptokurtic and asymmetric.

The assumption of independent variables is rejected because the Q statistic calculated L jung-Box with 20 delays indicates autocorrelation of the series at the first delay (Q = 0.4008 for the series of real exchange rate and Q = -0.4448 for that unit values). To check this, it is necessary to focus on the functions of auto-correlation of residuals. Indeed, if a series is strict white noise, then the series are also deducted from the square of the absolute value thereof. However, we note a clear dependence of these variables, resulted in sustained significant autocorrelations for both series. This leads us to reject the hypothesis of no autocorrelation courses and highlights the presence of heteroscedasticity, also confirmed by the ARCH test.

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[2] The use of these data has the advantage of comparability and availability of sufficient point (100 points) to make accurate estimates.

[3] The real exchange rate was constructed as the ratio of the price of the nominal exchange rate to the price index for consumption in the foreign country.

Table 1: Descriptive statistics

	Real exchange rate	Unit value
mean	2.59728e-04	0.00234
std. dev	4.35993e-03	0.05640
Jarque-Bera Test	1327.3404	1331825
p-Value(Chi^2)		
skewness	0.0000	0.0000
kurtosis	0.5827	17.3074
	6.7964	399.280
ARCH-LM TEST with 2 lags		
test statistic	701.8692	348.9605
p-Value(Chi^2)	0.0000	0.0000
F statistic	538.0818	210.9603
p-Value(F)	0.0000	0.0000
L&B:Q(20)	481.0090	456.9403
p-val	0.0000	0.0000

Analysis of skewness and kurtosis leads to the usual findings in studies of exchange rates. They are different from 0 and 3, which means that the distribution is not normal but asymmetrical with fat tails leptokurtic characterizing a distribution. The analysis of the series of performance and the rate of change of volume also shows the presence of an ARCH effect. We also note that these series have breaks in their upward trends.

The Model

Our study is to estimate a threshold model (SETAR). This type of model will allow us to analyze whether these behaviors of prices strategies at different according to changes in the exchange rate. The choice to restrict our analysis to the German exporting firms stems from a willingness to take into account a country which has a size in terms of exports sufficiently large vehicles. In addition, we choose a market with strong monopolistic competition in which German firms are relatively well established. The dynamic model that we seek to study is written as follows by the equation (5):

$$\Delta p_t = \begin{cases} \beta_0^{(1)} + \sum_{i=1}^{p} \beta_i^{(1)} \Delta p_{t-i} + \sum_{j=1}^{q} \beta_j^{(1)} \Delta e_{t-j} + \varepsilon_t^{(1)} \quad if \quad Z_t \leq s \\ \beta_0^{(2)} + \sum_{i=1}^{p} \beta_i^{(2)} \Delta p_{t-i} + \sum_{j=1}^{q} \beta_j^{(2)} \Delta e_{t-j} + \varepsilon_t^{(2)} \quad if \quad Z_t > s \end{cases} \qquad (5)$$

Where p is the logarithm of the price of German cars and e the logarithm of the real exchange rate. Z is the transition variable, and s is the value of this variable ensures that the transition from one regime to another, ie a dynamic to another. Zt is delayed either endogenous Δp_{t-i} or exogenous delayed Δe_{t-j}. The first step in the specification of these models is to verify that the model is characterized by a non-linear dynamics. We will therefore apply the methodologies Luukkonenet al.[20] to test the linearity of the model.

Linearity Tests

Note that in our study, the transition variable used is importance. This is why the tests will be conducted for all variables possible transition in this case the endogenous and exogenous variables delayed. Recall that we seek to analyze adjustments in selling prices respond to exchange rate movements. According to various theoretical studies, it is the evolution of the exchange rate which affects the behavior of pricing to market exporters. It is therefore important that these tests reject the hypothesis of linearity of the model when the transition variable is the exchange rate. The null hypothesis is given by the following Equation (6):

$$\begin{cases} H_0 : \phi_i^{(1)} = \phi_i^{(2)} \\ H_1 : \phi_i^{(1)} \neq \phi_i^{(2)} \text{ for i = 1...p and} \end{cases} \quad \begin{cases} H_0 : \phi_j^{(1)} = \phi_j^{(2)} \\ H_1 : \phi_j^{(1)} \neq \phi_j^{(2)} \text{ for } j = 1, ...q \end{cases} \qquad (6)$$

We retain the growth rate of the exchange of two delayed period as a transition variable. This is the variable for which the linearity is more strongly rejected. Indeed, we can note that the linearity assumption is also rejected when the rate of price growth is delayed by a variable period of transition, according Luukkonenet al. [20]. We recall that we retain as transition variable the variable that maximizes the statistic is to say that for which linearity is most strongly rejected. The results of tests for linearity United States and Japan are shown in Tables 2 and 3.

Table 2: Results of linearity tests (United States)

Zt	Δp_{t-1}	Δe_{t-1}	Δe_{t-2}	Δe_{t-3}
F(4,79)	10.48	9.14	11.22	10.54
(p-value)	(0.343)	(0.139)	(0.847)	(0.647)

In the case of the United States, the results of linearity tests applied to the data (Fisher tests) leads to reject linearity (at the 10% level) when the transition variable is the exchange rate delayed by two periods. However, even if the statistics are maximized for the same transition variable, they cannot reject the hypothesis of linearity at the threshold of 20 or 28% depending on the test statistic used. Even if the tests do not seem to enter a different dynamic depending on exchange rate regime, it does not mean that the SETAR model does not give us information relevant to study the phenomenon of pricing to market for the United USA.

Table 3: Results of linearity tests (Japan)

Zt	Δp_{t-1}	Δe_{t-1}	Δe_{t-2}
F(3,81)	2.81	1.39	1.71
(p-value)	(0.16)	(0.21)	(0.19)

In the case of Japan, the results of linearity tests applied to the data (Fisher tests), leading to reject the linearity of the model at the 10%. Is the growth rate of exchange of a delayed period was chosen as a transition variable. At this stage of our study, we note that linearity tests conclude to reject the hypothesis of linearity of the model, against the alternative of a nonlinear SETAR model types. Moreover, the transition variable is retained in both cases is the delayed exchange rate. We can therefore conclude that the evolution of the exchange rate has prompted officials to change their strategy. German exporting firms will adopt a behavior impact of currency fluctuations on sales prices, the United States and Japan, according to the evolution of the exchange rate. Therefore, the pricing strategy of firms differs according to the evolution of the exchange rate. It is now to determine the threshold for which the value of the exchange rate changes the behavior of firms. We will therefore seek to determine the threshold value, s.

Detection of the Threshold

To the threshold value, we use the methodology of Granger and Terasvirta[15]that minimizes the residual variance of the threshold model. The test results are reported in Table 4 and the following Figures 1-2:

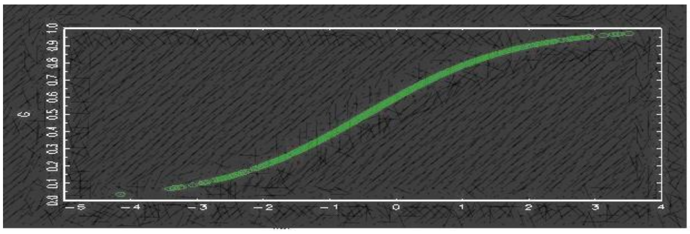

Fig. 1: Transition function *vs* transition variable: Case of the United States

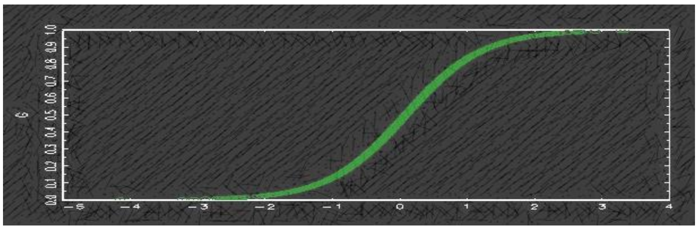

Fig. 2: Transition function *Vs* transition variable: Case of the Japan

Table 4: Detection threshold: transition variable

United States	Japan
-0.01961	-0.00462

The result of this test shows that the value of the exchange rate that causes this change in behavior on the part of German firms differs significantly from one country to another. Indeed, the United States exchange rate should decrease by less than 2% before that firms do not change their strategy, then it is sufficient that a 0.4% decline in Japan. It is now to estimate these relationships in the context of a threshold model to see if this specification brings an interest in the study of these behaviors.

Relationship between Prices and Exchange Rates

In this section we present estimates of the relationship between prices and exchange rates under a threshold model. We take here the Methodology Melka and Perraudin [22],both in form and in the comparison between linear models and threshold model. The overall results of this phenomenon of pricing to market are presented in Tables 5-6.

Table 5: Estimated SETAR model (case of United States)

	SETAR model	
	If Δp_{t-1} $\leq$ -0.01961	**if Δp_{t-1}** >-0.01961
Constant	-0.01 (-1.51)	0.02 (1.95)
ΔP_{t-1}	-0.462 (-3.35)	0.16 (1.00)
ΔP_{t-2}	-0.94 (-2.91)	0.38 (0.93)
Δe_{t-1}	-1.01 (-1.21)	-0.93 (-1.32)
AIC	**-7.01**	
Residual variance*1000	1.73	

Table 6: Estimated SETAR model (case of Japan)

	SETAR model	
	Si Δp_{t-1} $\leq$ -0.00462	**Si Δp_{t-1}** >-0.00462
Constant	0.20 (4.48)	0.367 (0.006)
ΔP_{t-1}	-0.62 (-3.45)	-0.33 (-2.97)
ΔP_{t-2}	2.57 (2.88)	-0.90 (-2.23)
Δe_{t-1}	1.01 (2.10)	-0.09 (-0.31)
AIC	**-5.90**	
Residual variance*1000	**3.02**	

Before interpreting our results of simulation model, it is therefore necessary to estimate our data in the context of a linear model. The results are deferred in the following Tables 7-8.

Given the results of two of our model estimates that are deferred in the tables above. We note that it has improved the quality adjustment when estimating the impact of relationships in the model thresholds, especially in the case of the United States. Indeed, the AIC criteria threshold models are lower than those of linear models. Moreover, we observe that the ratio of residual variances SETAR models to linear models is 0.95 in the case of the United States, 0.85 for Japan. This ratio can be seen as an indication, the more this ratio is less than 1 to more business tend to practice pricing according to the market .

Table 7: Estimate of linear Model (case of United States)

	linear model
Constant	-0.01 (-1.51)
ΔP_{t-1}	-0.462 (-3.35)
ΔP_{t-2}	-0.94 (-2.91)
Δe_{t-1}	-0.45 (-1.21)
AIC	**-7.01**
Residual variance*1000	1.82

Table 8: Estimate of linear Model (case of Japan)

	linear model
Constant	0.0025 (0.40)
ΔP_{t-1}	-0.35 (-2.874)
ΔP_{t-2}	-1.06 (-3.23)
Δe_{t-1}	0.12 (-0.34)
AIC	**-5.52**
Residual variance*1000	3.54

What interests us in the first place is to observe the existence of asymmetry in the behavior of German firms, and not to determine the model that best explains the growth rate of prices for motor vehicles.

Our model results presented in Tables 5-6 show that there are asymmetries. We said that the transition from one system to another entails particularly significant changes in the behavior of German firms impact. This confirms our initial intuition to know the degree of impact of exchange rate changes varies considerably as a dynamic one pass to another. The coefficients of the exchange rate change sign and magnitude when in the second regime. The first scheme is defined for values of less than or equal to exchange -0.01961. Therefore, when the exchange rate is below this threshold, the German firms face an appreciation of their currency against the foreign currency.

We observe that the degree of impact is positive (1.01), so they increase their prices. Conversely, when the exchange rate increases, firms change their strategy repercussion. Against the depreciation of their currency, German firms strongly and sharply lower sales prices charged in the currency of the buyer.

In the case of the United States the threshold regime change is negative. The first regime is characterized by a strong appreciation of the German currency, while the second scheme is defined for values of less than -0.02 exchange, ie for an appreciation of less than 2% of the euro against the dollar. When the euro appreciates by more than 2% German firms do not greatly increase their selling prices. Instead they adopt the opposite strategy, their prices fall (the pass-through coefficient is -1.01). They choose to raise their prices in the case of an assessment under 2%.

In the case of Japan, the positive threshold and is very close to 0. The first scheme is defined for values of less than or equal to exchange -0.00462. Therefore, when the exchange rate is below this threshold, the German firms face an appreciation of their currencies against the yen. We observe that the degree of impact is positive (1.44), so they increase their prices.

Given the results of our estimation in the model framework thresholds we can confirm that the German exporting firms have an asymmetric behavior. So it is legitimate to look at the response rate of price growth to a shock in the exchange rate. Knowing that the transition variable is not endogenous but exogenous delayed. To do this uses the same methodology as [25]. For the construction of impulse response functions.

Behavior of Exports to an Exchange Rate Shock

The Generalized Impulse Response Functions (GIRF)

In this section we rely on the method of Sarrantis[25] to achieve these response functions. These authors present a generalized to the class of non-linear and linear models applicable models methodology. According to them, the response of a variable to a shock depends on present and past values of the series as the response functions must be constructed conditional on this set of information.

According to them (Sarrantis [25]),the impact is uncertain because the transition variable is endogenous delayed. In this case, the choice of the initial condition, the size and the sign of the determinant is shock. In addition, the choice of an initial condition that does not belong to a steady state is very important because otherwise the process converges towards its long-term value without changing the regime. And therefore the choice of a threshold model would no longer have any use. The impulse response functions are calculated from the coefficient matrices Ai of order (m×m), obtained from the representation of the moving average (MA) associated with the VAR model are given by the following Equation (7):

$$\mathbf{Zt} = \sum_{j=0}^{\infty} A_j U_{t-j} + \sum_{J=0}^{\infty} B_J W_{t-j} \quad (7)$$

Where A_{ij} matrices are obtained from the recursive relationships.

$$\mathbf{Aj} = \phi_1 A_{j-1} + \phi_2 A_{j-2} + \dots\dots + \phi_P A_{j-P} \; (j= 1 ,2,\dots..)$$

$$\text{With: } \begin{cases} A0 = I_m \text{ and } Aj = 0 \; (j<0) \\ Bj = Aj \text{ for } (j = 1,2,\dots..) \end{cases}$$

From this VAR representation, we are interested in the analysis of dynamic adjustment in the short term with the calculation of the generalized impulse response functions (GIRF), the concept has been proposed for dynamic systems nonlinear byKapetanios[18] and extended to linear multivariate models byPesaran and Shin[25].A difference of traditional impulse response functions (Cholesky decomposition), the GIRF avoid the problem of the dependence of the order of variables in the VAR model. Therefore, instead of analyzing the response variable to a shock in all elements of "u_t" is obtained directly in response to a shock element determined. The causal order of the variables is more important.Generalized response variable $\mathbf{Z_t}$following a shock magnitude δj in the j-th variable (Equation 7) equal to the standard deviation ($\delta_j = \sqrt{\sigma_{jj}}$) can be formulated according to the following expression is given by the Equation (8):

$$\text{GIRF}\left(Y_{it}, Y_{jt}, h\right) = \frac{e_i' C_h \sum e_j}{\sqrt{\sigma_{jj}}} \quad \textbf{with } h = 0,\dots\dots n$$

Where: ep (p = i, j) is the p-th column of an identity matrix of size m(I_m) and σ_{ij}^2 is the variance of the j-th disturbance.

In study, we wish to know the response of the growth rate of prices to a shock in the exchange rate. We assume that the transition variable is an exogenous variable; the construction of response functions must be adapted. AsPesaran and Shin [25], we first construct a series "Initial" stochastic Δ_p defined by the Equation (9):

$$\Delta p_t = \begin{cases} \varphi_0^{(1)} - \frac{1}{2}\sum_{j=1}^{p} \varphi_i^{(1)} \Delta p_{t-1} - \frac{1}{2}\sum_{j=1}^{q} \varphi_j^{(1)} \Delta e_{t-j} + \varepsilon_t^{(1)} \;\; if \;\; Z_t \le s \\ \varphi_0^{(2)} - \frac{1}{2}\sum_{j=1}^{p} \varphi_i^{(2)} \Delta p_{t-1} - \frac{1}{2}\sum_{j=1}^{q} \varphi_j^{(2)} \Delta e_{t-j} + \varepsilon_t^{(2)} \;\; if \;\; Z_t > s \end{cases} \quad (9)$$

Where ε_t test a stochastic shock. $\Delta e_t = \overline{m}$ exchange rate which is delayed we fix their average value. Then, we construct a "shocked" series notes that $\Delta\tilde{p}_t$ In effect, we assume a temporary shock σ affecting the exchange rate. In order to determine the presence of a behavior by exporting firms according to the exchange rate movement. We assume for example that the variation of the exchange rate is positive. And donations this case we are interested in a positive exchange rate shock of +20% (positive major shock) we define $\sigma =$ +1.2 Then we will specify in each graph, what kind of impact it question. We define a positive impact by increasing the exchange rate (a depreciation of the German currency), and a negative shock in a decrease in the exchange rate (an appreciation of the German currency)

Behavior of Exporting Firms Faces a Movement of Change

We remind you that our goal is to verify the behavior of German exporting firms face a movement exchange. Specifically we check if there are asymmetries in price responses. We distinguish the effect of appreciation and depreciation, high amplitude or not. For all graphs we present the "corrected" values in order to compare them. These response functions therefore possible to observe the presence or absence of asymmetry in behavior, without having to worry about the size of the shock. We define a positive currency impact of a decrease of x% of the value of the currency of the exporter in relation to the currency of the client, and a negative currency impact of an increase of x% of the value of the currency exporter faces the client money.

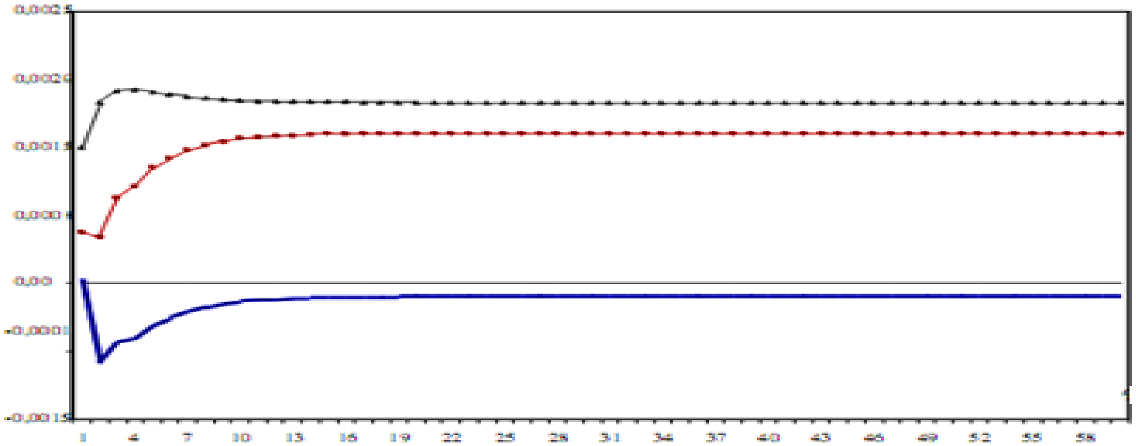

Fig. 3: Response[4] of prices to positive and negative exchange rate shock of high amplitude

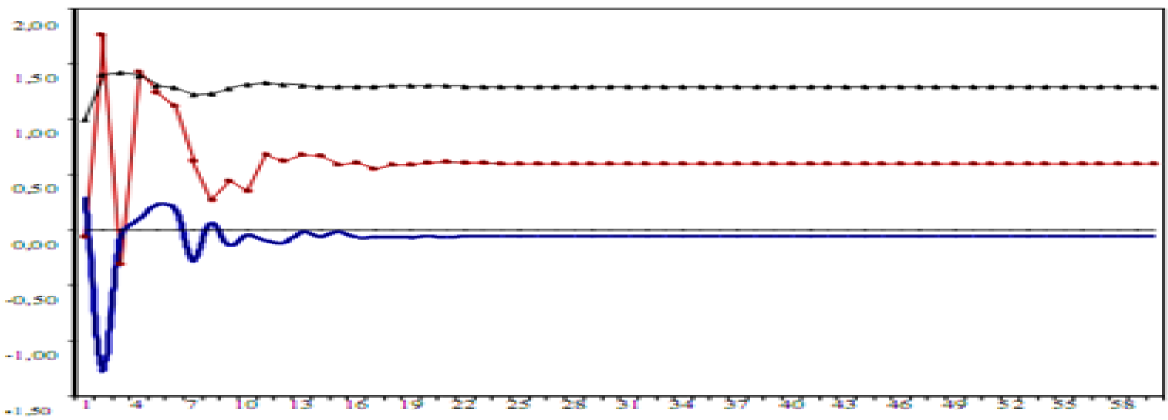

Fig. 4: Response[5] of prices to positive and negative exchange rate shock of low amplitude

[4] **The red line** Positive exchange rate shock (+10%); **Blue line,** Negative exchange rate shock (+10%);**Black line**, Positive exchange rate shock (+20%);

[5] **The red line** Positive exchange rate shock (+10%); **Blue line,** Negative exchange rate shock (+10%);**Black line**, Positive exchange rate shock (+20%);

According to Figures 3 and 4, the German exporting firms have an asymmetric behavior. Also, the degree of impact of currency fluctuations on their selling price differs depending on the direction of change of the exchange and depending on the size (small or large) of the movement of change. We explain this strategy by their fear of the risk of losing market share (Froot and Klemperer [13]), while they supported the entry of these markets significant costs (Baldwin[5] and Dixit [8]). Indeed, these behaviors result in the willingness of firms to limit the increase in selling prices of their products in case of relative currency appreciation.

These results also allow us to conclude on the importance of adjustment costs (menu costs) in the impact behavior of firms. According to Delgadoet al.[11] and Betts and Devereux [3], the direction of change of the exchange rate does not affect the degree of impact of currency fluctuations on sales prices. These authors show that the extent of variation determines the choice of firms to pass or not to pass on exchange rate movements on their selling price. Therefore, the existence of adjustment costs will probably explains in part the behavior of pricing-to-market as firms adopt an asymmetric behavior depending on the direction of change of the exchange.

The analysis of response functions price German firms face variations of high and low amplitude of change and to determine what type of strategy they adopt. We can conclude here, they prefer to increase their profit margins rather than increasing their market share. Nevertheless, it is important to note that the behavior of German firm's impact is symmetric in the case of an assessment of +10% or +20%.

They do not pass the 20% appreciation of their currencies than they do when 10% appreciation. Faced with strong variations of their currencies (in the case of an assessment), they fear losing market share, and cannot take the risk of increasing their profit margins by increasing their prices proportionately more cases appreciation of +20%.

These results for the asymmetries in the behavior of firms depending on the extent of exchange rate shock are therefore opposed to theoretical conclusions Delgadoet al. [11] and Betts and Devereux [3], but are in agreement with those ofBaldwin [2] and Dixit [8] and Melka and Perraudin [22]. So the menu costs have little influence on the behavior of German firm's impact. They seek above all to maintain their competitive position in the customer market. Also, they affect less fluctuation in case of appreciation in the event of impairment. However, they do not adopt strategy boosted in order to gain market share. Arbitration occurs between the ability to conquer market share and increase the certainty of their profit margins.

Conclusion

The estimation of behavior adopted by the German exporting firms in the automotive market with a thresholds model, shows that German firms have an asymmetric behavior. Thus, we can therefore conclude that German firms choose to increase their profit margins rather than market share. Indeed, in the face of changes in their currency, the exporting firms must arbitrate between the conquest of market shares or increasing their profit margins. The degree of impact of exchange rate movements on the price of German exporting firms is dictated by their desire not to lose market share. They therefore affect relatively more strongly than the testimonials depreciation of their currency against the currency of the customer.

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