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An Investigation into the 1999 Collapse of the Brazilian Real

Omar F. Saqib[*]

Abstract

This study argues that the political considerations were an important factor behind the crisis of the Brazilian real in January 1999. The divided coalition government and a president facing impending elections eschewed the correction of external misalignments and the fiscal austerity at a time when the markets were already excited by the 1997-98 East Asian and 1998 Russian financial crises. The hypothesis is established after confirming the vulnerability of Brazilian economy to currency crisis through Masson's model of multiple equilibrium and then it is tested by running a maximum likelihood logit regression.

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1 Introduction[1]

The famous pegged exchange rate stabilisation program, 'plano real', launched in early 1994 achieved its objective of low inflation without provoking any recession. The success accompanied consumption boom and a notable decrease in poverty and income inequality. The program, however, culminated in the January 1999 currency crisis. In this context, therefore, two developments in the post 'plano real' period were noteworthy: growing fiscal and external imbalances and the events of two financial crises during 1997-98.

Among external imbalances, real exchange rate appreciation and current account deficit were the most alarming. From 1.2 billion dollars in 1994, the current account deficit stood at 34.6 billion dollars in 1998. Many institutions and individuals iterated warnings regarding real exchange rate appreciation.[2] Consequently, imports increased from 20 billion dollars in 1992 to 57 billion dollars in 1998, an increase of nearly 65 percent, whereas, exports increased by only 31 percent. Furthermore, total external debt rose from 22.57 percent in 1995 to 31.15 percent of GDP in 1998. High public spending commitments, especially privileges given to the civil servants, including pensioners, and retirement benefits under generous social security system, resulted in huge fiscal imbalances. It is not surprising then to find a monumental public sector debt of 41.9 percent of GDP in 1998. The debt increased at an average rate of 5 percent each year during 1995-97. However, there was an increase of nearly 17.6 percent in 1998 alone. It is also evident from the debt figures of the federal government and the central bank: the debt share of these institutions increased from 18.8 percent in 1997 to 25 percent of GDP in 1998.

In the second part of 1997, successive devaluations in a number of East Asian countries prompted speculative attacks on many emerging economies currencies, including South American economies. In an orthodox manner and in accordance with the International Monetary Fund's strategy, Brazil was the first among these economies to counter the threat. It did so, by tightening of monetary and fiscal policies, by increasing interest rates, and by promising a reduction in the public sector deficit of 2 percent of GDP. Nevertheless, the Brazilian authorities were unable to satisfy the markets as the turbulence returned in August 1998 when the Russian ruble experienced crisis. With renewed pledges of reduction in fiscal imbalances, high interest rates, and due to an agreed loan of 41.5 billion dollars from the International Monetary Fund, Brazil ended 1998 with an uneasy calm. This, however, lasted until the first week of the year 1999. Following the announcement of a moratorium on debt payments by the governor of Minas

[1] All figures from Banco Central do Brasil (1999) and (2000) and *International Financial Statistics* database.
[2] See, among others, Dornbusch (1999) and Economist (1999).

Gerais, a full-fledged attack on the real began that eventually resulted in the free floating of the currency on 18 January 1999.

Hence, this brief chronology indicates that the real collapse was preceded by two most significant and popular indicators of any currency crisis.[3] The first indicator relates to the deterioration in fiscal and external balances, in line with the predictions of the traditional literature on currency crises especially the first- and second-generation theories.[4] The second indicator relates to the events of two similar episodes: East Asian financial melt down during 1997-98 and the fall of the Russian ruble in August 1998. The question, therefore, arises as to why the Brazilian authorities failed to prevent the crisis despite these glaring indicators and numerous warnings?[5]

After confirming Brazil's vulnerability to currency crisis through Masson's model (Section 2), the paper argues that the answer lies in political factors. Two concepts, 'war of attrition' and 'elections and devaluations', are first identified and then translated into a theoretical framework (Section 3). To test the hypothesis, the study uses the maximum likelihood logit estimate method that shows that the political factors among conventional factors have a strong hint of explanation to this crisis (Section 4). The findings of this study add to the less-explored political uncertainties associated with the currency crises. The main hypothesis is briefly competed with the hypotheses of poor economic fundamentals and pure contagion effects as an alternative explanation to the January 1999 crisis of the Brazilian real (Section 5).

2 Brazil's Vulnerability to Currency Crisis

Pure contagion effects, as modelled by Masson (1998) and (1999), refers to the vulnerability of an economy to contagion for only certain ranges of the fundamentals where changes in expectations are self-fulfilling and markets are subject to multiple equilibrium. The model is based on Jeanne (1997). Jeane derives the necessary conditions on Obstfeld's (1986) and (1996) hypothesis of grey area of country fundamentals and shows that fundamentals determine the grey area where multiple equilibrium of a currency crisis is possible. The study focuses on the 1992-93 crisis of the French franc and describes government temptation to devalue in order to decrease the unemployment rate. In the context of emerging economies like

[3] See, among others, Kaminsky, et al. (1998) for the leading indicators of currency crises.
[4] See, for seminal literature, Krugman (1979), Flood and Garber (1984), Obstfeld (1986), and Obstfeld (1996).
[5] See, among others, several issues of *The Economist* in 1998 voicing concern over the possibility of the collapse of the Brazilian real.

Brazil, however, fundamental like external debt is more significant than unemployment rate. In particular, the model places prime emphasis on a country's indebtedness, which as shown, weakens its fundamentals. The model fairly comprehensively explains the vulnerability of emerging economies to currency crises.[6]

As evident from Table 1, in the year preceding the 1997-98 East Asian financial crisis, Brazil's fundamentals were in much favourable position. This could be attributed to high level of international reserves and low level of external debt. However, with the increase in external debt and reduction in international reserves, the fundamentals were first within the multiple equilibrium region (1997) and then in highly adverse position (1998). The fact that the economy was in multiple equilibrium region in 1997 can be translated into a lower probability of crisis and the economy to be inside crisis region in 1998 into high probability of crisis.

3 What Went Wrong? The Hypothesis

The question arises as to why the Brazilian authorities failed to prevent the crisis despite obvious fragility, as outlined in the preceding sections. The reason lies in two concepts of political economy. The first reason stems from the concept of 'war of attrition' as modelled by Alesina and Drazen (1991). A typical example to explain this phenomenon is an unsustainable budget deficit due to lack of political agreement. The delay in fiscal stabilisation may last until it becomes extremely costly. In the context of currency crises, this concept is quite suggestive since it describes the situation of multiple equilibrium. Given that there is deterioration in (lets say) fiscal balances, the likelihood of a speculative attack increases or decreases with or without budget deficit along with the actions of key political figures. In spite of numerous warnings especially after the East Asian and Russian crises, the Brazilian government represented by a coalition of five political parties failed to convince the markets of its commitment.

The second reason stems from the concept of 'devaluation and timing of elections.' The argument is that devaluations to correct the exchange rate misalignments are usually delayed before elections. This is due to the significant political costs that an incumbent might have to incur by using this policy tool, especially before elections.[7] Stein and Streb (1999) by taking into account 242 episodes of presidential and parliamentary elections, note that in months 2, 3, and

[6] See, Appendix I for the methodology and application in this case of the Masson's model.
[7] Stein and Streb (1999) and Ploeg (1989).

4 after elections the average rate of nominal depreciation is 2 percentage points higher than it is for other months and the average rate of depreciation is more than doubled.

A popular misalignment is the overvalued real exchange rate that tends to arise after an exchange rate based stabilisation program. To correct this, devaluation is necessary. However, an incumbent is reluctant in fear of being voted out of office since an overvalued currency means cheap consumer goods and high real urban wages. The Brazilian Presidential elections in October 1998 preceded the January 1999 crisis of the real.

Theoretical Framework

This discussion leads to the hypothesis that the political factors among the conventional ones suggest a strong hint of explanation to the real crash. Thus, the study formulates a relationship in which unexpected currency depreciation depends on a vector of economic fundamentals (traditional indicators of currency crises) and consistency of the authorities:

$$e_t - \bar{e}_t = \omega.(\mathrm{B}_{it} - \overline{\mathrm{B}}_i) - \gamma \mathrm{Z}_t \qquad i = 1,...,n \qquad (1)$$

Where, e_t the nominal exchange rate, $\bar{e}_t$ the equilibrium exchange rate, B_{it} the economic fundamentals, $\overline{\mathrm{B}}_i$ the threshold values for economic fundamentals, and Z_t the consistency of the authorities in following exchange rate maintenance policies. The vector of economic fundamentals consists of traditional indicators of currency crisis, such as fiscal imbalances, current account deficit, growth rate, real exchange rate misalignment, and etceteras. Deviations from their respective threshold values render the situation favourable for a speculative attack. For example, a growth rate below its threshold value makes the circumstances favourable for a speculative attack, while a current account deficit below its threshold value accounts for the opposite.

Here, assumed for simplicity, higher the deviations of economic fundamentals from their threshold values higher the likelihood of unexpected exchange rate depreciation:

$$\partial(e_t - \bar{e}_t) / \partial(\mathrm{B}_{it} - \overline{\mathrm{B}}_i) = \omega > 0 \qquad i = 1,...,n \qquad (2)$$

Consistency means the ability of the authorities to follow policies, consistent with the exchange rate regime. Thus, higher the consistency less likely is the unexpected exchange rate depreciation:

$$\partial(e_t - \bar{e}_t) / \partial Z_t = -\gamma < 0 \qquad (3)$$

Given a shock, markets discern whether the authorities are consistent or not by observing Z_t. The consistency depends on the degree of difficulty or ease with which the authorities are able to follow required policies. A government may be particularly good at dealing with an international lender-of-last-resort, but particularly bad at resisting the temptation of following expansionary monetary policy in the hope of winning the forthcoming elections. In other words, consistency crucially depends on non-economic, mainly, political factors. Speculators, thus, focus on government by observing, for example, timing of elections or its ability to resolve its internal issues. Hence, the equilibrium of *crisis* or *no-crisis* depends upon the ability of the authorities to signal its consistency.

4 Findings

In order to test the hypothesis presented in the preceding Section, the study uses a maximum likelihood logit regression method. In this method the dependent variable is dichotomous assuming the value of 1 when the peg is in effect, 0 otherwise. The explanatory variables can be divided into three categories. The first to capture the effects of the fiscal stance of the government: net expenditures (NE) of the government and the ratio of M2 to international reserves (IR). The second accounts for the external variables: net exports (NE) and real exchange rate (RER). The final category, consisting of dummy variables, captures the effects of political considerations: dummy variables to account for the elections (DUMELEC) and the notion of 'war of attrition' (NPP).[8]

Table 2 reports the results of the maximum likelihood logit regression. It consists of two specifications of the estimates. The first does not include the political variables, whereas the latter accounts for them. As expected, the estimated coefficients have the a priori expected signs and are statistically significant at the 5 percent level, except for the NE in the first specification.

[8] See, Appendix II for the estimation methodology and the data used in the study.

Furthermore, Table 2 shows that based on two grounds the inclusion of political variables helps to predict the duration of the peg better. First, the *Pseudo* R^2 improves from 36 percent in the first specification to 39 percent in the second one. Second, a decrease in the *Theil Inequality Coefficient* from 30 percent in specification I to 13 percent in specification II indicates a considerable improvement in with-in sample predictability of the fit.

For every additional unit in NE, IR, RER, and NX, the conventional indicators of currency crises, the predicted log odds increase by 0.003 and 2.726 in the first two and decline by 0.204 and 0.003 in the latter two. In other words, increases in NE (Net Expenditure) and IR (M2/International Reserves), which signify the deterioration of the fiscal stance of the government, increase the probability of the abandonment of the peg by 0.003 and 2.726 respectively. While a rise in RER (Real Exchange Rate) and NE (Net Exports), which signify the external competitiveness of the economy, reduces the probability of the abandonment of the peg by 0.204 and 0.003 respectively.

This empirical exercise results in quite compelling role of political factors that undermined the real peg: the predicted log odds for the political variables are much higher. Other things being equal and DUMELC to be 1 (that is, when elections), the log odds increase by 7.83. Other things being equal and NPP to be 5 (that is, the highest number of political parties forming government), the log odds increase by 34.03. However, taking NPP to be 1 (that is, one political party in the government), which signifies less or no conflict, the probability of the abandonment of the peg reduces to 6.806.

6 Concluding Remarks

This study has argued that the political considerations were an important factor behind the crisis of the Brazilian real in January 1999. In particular, the divided coalition government and a president facing impending elections eschewed the correction of external misalignments and the fiscal austerity at a time when the markets were already excited by the 1997-98 East Asian and 1998 Russian financial crises.

This hypothesis, nevertheless, can be questioned on two interconnected grounds. In the literature on currency crises there is a dearth of empirical studies that account for the linkages between political variables and currency crises. In single-country literature there is no investigation of the aforementioned linkage; see, for example, Blanco and Garber (1986),

Cumby and Van Wijnbergen (1989), Goldberg (1994), Pazarbasioglu and Ötker (1997), and Ötker and Pazarbasioglu (1997). In multi-country literature only two notable studies, Klein and Marion (1997) and Eichengreen, et al. (1996), account for this relationship; others include, Frankel and Rose (1996) and Kaminsky, et al. (1998).

In general, these studies focus on economic fundamentals as the prime determinants of crises. Therefore, how compelling are the present findings given that *poor economic fundamentals* have usually tend to predict the outcome? Secondly, the crisis was preceded by East Asian and Russia crises. Therefore, how much of a light could *pure contagion effects* throw on this episode?

As evident from Table 1, the fundamentals of the Brazilian economy were known to be weak both in 1997 (inside multiple equilibrium region) and in 1998 (inside crisis region). Thus, from the point of view of poor economic fundamentals and from the point of view of pure contagion effects, why did the markets not react in 1997 and in 1998? Why did they wait until January 1999? Indeed, one explanation comes from the political uncertainties, as signified by the consistency of the authorities called into question in Section 3.

The fact that political variables turn out to be significant, relative to the conventional ones, highlights the importance of non-economic factors in determining a currency crisis. This may not imply that non-economic factors have the final say. A healthy economy with sound macroeconomic fundamentals may remain immune from speculative attacks. It is the unhealthy economy with weak macroeconomic fundamentals that invites the attention of investors in the first place. The investors then assess the commitment of the authorities by contemplating non-economic (political in this case) factors. Thus, the consistency is the key to understand the political uncertainties associated with the exchange rate crises, as signified in the Brazilian case.

Appendix I: Masson's Model

The probability of crisis (π) depends on the size of external debt (D) and the extent of devaluation (δ) along with the value of economic fundamentals (b) relevant for currency crises. Formally, letting $\alpha = \delta D$, $\phi_t = E_t b_{t+1}$, and assuming the innovation in b_t, $\varepsilon_t = b_t - \phi_{t-1}$, to have a cumulative distribution function (c.d.f.) F, then:

$$\pi_t = F\left[\alpha\pi_t - \phi_t\right] \qquad \text{(I.1)}$$

Thus, a decrease in the composite fundamental (ϕ_t) and a higher external debt leads to higher probability of crisis. The model gives two conditions for multiple equilibrium to occur. The first condition requires that in Equation (I.1) the slope of right hand side to be steeper than that of the left hand side:

$$z = \frac{\alpha}{\sigma\sqrt{2\prod}} > 1 \qquad \text{(I.2)}$$

$\prod$ is the conventional constant (3.141) and the condition shows the size of external debt and the extent of devaluation, relative to the standard deviation (σ) of shocks to the composite fundamental. The second condition requires ϕ_t to be within minimum and maximum values:

$$\alpha F(-w) + \sigma w < \phi_t < \alpha F(w) - \sigma w \qquad \text{(I.3)}$$

Where, $w = \sqrt{2(\ln z)}$. In particular, Inequality (I.3) gives the tangency points of the c.d.f of the normal distribution, where, $\phi_t^{\max}$ is the good equilibrium above that is the no-crisis region, $\phi_t^{\min}$ is the bad equilibrium below which is the crisis region, and in between the range ($\phi_t^{\min}$, $\phi_t^{\max}$) is the multiple equilibrium where crisis may or may not happen.

In implementing the aforementioned conditions, an autoregressive process of order one for the current account deficit (C_t) as a percent of GDP over 1980 to 1999 is estimated. The standard error of this regression, that is 1.72%, is taken as the estimate of σ and δ is assumed to be 25.00%, though real depreciated by more than this assumption in the first quarter of 1999.[9] After

[9] Recall that $z = \delta D / \sigma\sqrt{2\prod}$ and $w = \sqrt{2(\ln z)}$, therefore, a higher value of δ would produce biased results.

determining the criterion and the range for multiple equilibrium, the composite fundamental (ϕ_t) is calculated using the following assumption:

$$\phi_t = E(C_t) + R_t - \overline{R} - r_t^* D_t \qquad \text{(I.4)}$$

Where, $E(C_t)$ the fitted value from the regression for the current account deficit, R_t the level of international reserves, $\overline{R}$ the threshold value of international reserves (assumed to be zero), r_t^* the foreign interest rate (U.S. one year rate on Treasury Bill), and D_t the external debt.

Appendix II: Estimation Methodology and Data

The estimation methodology is based on the maximum likelihood logit estimates wherein the dependent variable is dichotomous assuming the value of one if the peg is in effect, zero otherwise. In particular, to identify the forces that undermine an exchange rate peg, consider a linear probability model that comprises dichotomous Y_i as a linear function of the explanatory variable(s) X_i:[10]

$$\mathrm{Y}_i = \beta_1 + \beta_2 \mathrm{X}_i + \mu_i \qquad \text{(II.1)}$$

Assuming $\mathrm{E}(\mu_i) = 0$, P_i as the probability of the abandonment of the peg, and $(1 - \mathrm{P}_i)$ as the probability of not abandoning the peg, the relationship in (II.1) in cumulative logistic distribution function can be expressed as:

$$\frac{\mathrm{P}_i}{1 - \mathrm{P}_i} = e^{(\beta_i + \beta_2 \mathrm{X}_i)} \qquad \text{(II.2)}$$

Where $\mathrm{P}_i / (1 - \mathrm{P}_i)$ is simply the odds ratio in favour of abandoning the peg. By taking the natural log of (II.2), the standard logit model is given as:

$$L_i = \ln\left(\frac{\mathrm{P}_i}{1 - \mathrm{P}_i}\right) = \ln e^{(\beta_1 + \beta_2 \mathrm{X}_i)} \qquad \text{(II.3)}$$
$$L_i = \mathrm{Z}_i = \beta_i + \beta_2 \mathrm{X}_i$$

For estimation purposes, write (II.3) as follows:

$$L_i = \ln\left(\frac{\mathrm{P}_i}{1-\mathrm{P}_i}\right) = \beta_1 + \beta_2 \mathrm{X}_i + \mu_i \qquad \text{(II.4)}$$

But the L.H.S. of Equation (II.4) gives meaningless expression by taking P_i as 1 and 0. In this situation the standard OLS method cannot be used to run the regression. Nonetheless, the maximum likelihood method can be used to estimate the parameters. Whereas, the maximum-likelihood method involves the maximisation of the logarithm of L by substituting for the probability functions. The logarithm of L can now be written as follows:

$$\log L = \log \mathrm{P}_i + \log(1-\mathrm{P}_i) \qquad \text{(II.5)}$$

To obtain the estimators $\hat{\beta}_1$ and $\hat{\beta}_2$, we differentiate log L with respect to β_1 and β_2 set the result equal to zero and solve:

$$\frac{\partial(\log L)}{\partial \beta_1} = \frac{\partial \mathrm{P}_i / \partial \beta_1}{\mathrm{P}_i} - \frac{\partial \mathrm{P}_i / \partial \beta_1}{1-\mathrm{P}_i} = 0 \qquad \text{(II.6)}$$

$$\frac{\partial(\log L)}{\partial \beta_2} = \frac{\partial \mathrm{P}_i / \partial \beta_2}{\mathrm{P}_i} - \frac{\partial \mathrm{P}_i / \partial \beta_2}{1-\mathrm{P}_i} = 0 \qquad \text{(II.7)}$$

The empirical part of the currency crises literature, using non-structural estimation approach, has focused on probit regressions. While both logit and probit models are of qualitative choice, the difference between them is merely of mathematical convenience.[11] The statistical inference of the results of logit model is similar to that of a standard OLS estimation.[12] See, for example, Klein and Marion (1997) for an application of logit model in determining the duration of exchange rate pegs in a multi-country analysis.

Data Used in the Study

A total of six explanatory variables are used in this investigation. The first four variables represent the internal and external imbalances and the last two, one dummy and one index, to

[10] The derivation of the model draws from Pindyck and Rubenfeld (1998) and Gujarati (1995).
[11] Gujarati (1995).
[12] See, Pindyck and Rubenfeld (1998) and Gujarati (1995) for further properties of these models.

capture the effects of political factors. The choice of the first four variables stems from two facts: first that they are the conventional indicators of currency crises and secondly due to the availability of the data. All the observations are monthly, January 1990 to July 1999, from *International Financial Statistics* database. The dependent variable takes the value of one from July 1994 to December 1998, zero otherwise. The explanatory variables are as follows.

NE: Net Expenditure

This variable, defined as the expenditure minus revenue of the federal government, attempts to capture the fiscal imbalances that preceded the crash. It is expected that higher expenditure net of revenues would have positive affect on the likelihood of crisis.

IR: M2/International Reserves

Defined as M2 to foreign exchange reserves, IR captures the effects of the loss of foreign exchange reserves prior to the crisis in a scaled form. A positive association between the likelihood of crisis and M2/international reserves is expected.

NX: Net Exports

This variable is calculated by subtracting imports from exports and tries to capture the external vulnerability of the economy. A higher value of net exports would reduce the likelihood of devaluation thus a negative relationship between net exports and probability of ending the peg is expected.

RER: Real Exchange Rate

The present study uses the textbook definition of real exchange rate thus it is expected that a higher value of real exchange rate is associated with a lesser likelihood of the crisis. In particular, Real exchange rate = nominal exchange rate (price of foreign country's tradable/price of domestic country's non-tradable). Where, foreign country's tradable is the wholesale price index of United States and domestic country's non-tradable is the consumer price index of Brazil.

DUMELC:

This is a dummy variable, responsible to capture the effects of elections on the likelihood of a crisis. This variable assumes the value of one in the six months preceding the elections, including the election month. In accordance with the theoretical assumption, a higher value of DUMELC would reflect a higher likelihood of crisis. The fact that the DUMELC is given the value of 1 for six observations is based on two grounds. First, in a sample of 115 observations, two

observations with 1 may not account for the effects. Second, election campaigns start much earlier than the actual month.

NPP:

This variable refers to the number of political parties forming a government. The index would take the value of zero for dictatorial systems, one for single-party government, two for two-party coalition government, three for three-party coalition government, and so on. It is expected that the higher the number of political parties the higher the conflict and the higher the likelihood of crisis. The index assumes the value of 4 from January 1990 to December 1991, the value of 3 from January 1992 to December 1994, the value of 5 from January 1995 to December 1998, and the value of 4 from January 1999 to July 1999. In a multi-country investigation of the link between political weakness and inflation, Edwards and Tabellini (1991) use the same index as one of the proxies to political weakness.

Table 1. Brazil's Vulnerability to Currency Crisis

(units in %GDP, except r_t^*)

Year	D_t	R_t	C_t	r_t^*	z_t	$\phi_t^{\min}$	$\phi_t^{\max}$	ϕ_t
1996	23.20	7.52	-2.99	5.02	1.33	2.59	3.15	4.55[1/]
1997	25.00	6.34	-3.80	5.07	1.45	2.69	3.89	2.96[2/]
1998	31.15	5.49	-4.36	4.82	1.74	2.91	4.58	1.36[3/]

Source: Banco Central do Brasil (2000) and *International Financial Statistics* database.

[1/] Inside no-crisis region
[2/] Inside multiple equilibrium region
[3/] Inside crisis region

Table 2. Maximum Likelihood Estimates of the Logit Regression

	(I)			(II)		
	Coefficient	t-statistics	Probability	Coefficient	t-statistics	Probability
Constant	-1.627	-2.381	0.0190	-29.573	-2.661	0.0090
NE	9.310	0.354	0.7242	0.003	1.834	0.0695
IR	1.084	3.262	0.0015	2.735	2.830	0.0056
RER	-0.056	-2.950	0.0039	-0.204	-2.525	0.0131
NX	-0.001	-3.010	0.0032	-0.003	-2.653	0.0092
DUMELC				7.832	3.209	0.0018
NPP				6.806	2.428	0.0168
Pseudo R^2		0.36			0.39	
# of Obs.		113			113	
# of Obs. with 1		54			54	
Theil Inequality Coefficient		0.30			0.13	

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