TIME-VARYING EXCHANGE RATE PASS-THROUGH IN EASTERN EUROPE

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Abstract: Using quarterly data for the 1998–2021 period, and with the application of Kalman filter estimates it is shown that the incomplete exchange rate pass-through (ERPT) is somewhat stronger for countries with a floating exchange rate regime, especially for producer prices. Since the middle of 2000s, the ERPT to consumer and producer prices for 11 Central and Eastern European (CEE) countries, as well as for the Baltic States, seems to be relatively stable in most of the countries. With the exception of the Czech Republic, Romania, and Estonia, there is a tendency for strengthening of the ERPT to producer prices in the wake of the world financial crisis of 2008–2009.

Keywords: inflation, exchange rate pass-through (ERPT), Eastern Europe, Kalman filtering

JEL classification: C22, E31

INTRODUCTION

The causality running from exchange rate movements to domestic prices, known as exchange rate pass-through (ERPT), is a key channel for the international transmission of inflation and economic cycles [Aron, Macdonald and Muellbauer 2014]. Initially, the ERPT referred to reaction of import prices to a 1 percent change in the exchange rate but later the definition has been extended to the effect of exchange rate movements on consumer or producer prices. As recently, one of the well-established facts is a decrease in the magnitude of the ERPT to consumer prices over the last decades, for example Lopez-Villavicencio and Mignon [2017], especially in the developing economies since 2010 [Jašová, Moessner and Takáts 2019]. Among the CEE countries, a recent decline of the ERPT is found mainly for

the countries with more flexible exchange rate regimes [Baxa, Šestořád 2019; Mirdala 2014]. It is common to attribute a lower ERPT to numerous factors ranging from low inflation in a more credible monetary policy environment to structural shifts [Aron, Macdonald and Muellbauer 2014]. On the other hand, a recent surge in inflation cannot but attract attention to the likely effects of significant exchange rate depreciations observed in several CEE countries. For example, since January 2020 the Polish zloty and Hungarian forint have depreciated to the basket of foreign currencies by 10 and 19 percent, respectively. For the countries with a fixed exchange rate, inflationary pressure can result from a significant weakening of the euro by 9 percent since the beginning of 2021.

The objective of our paper is to provide empirical evidence on the short-term ERPT to both consumer and producer prices for 14 Eastern European countries, with a focus on likely differences between countries with flexible and fixed exchange rates. As of the end of 2022, the issue should be highly relevant to policymakers since the recent surge in inflation can be explained by depreciation pressure. The contribution of this paper to the ERPT literature is two-fold. First, time-varying pattern of the ERPT for several Eastern European countries is analysed. Second, potential differences between pre-crisis and post-crisis ERPT since 2010 are highlighted.

The remainder of the paper proceeds as follows. Section 2 provides a brief review of the theoretical issues regarding time-varying properties of the ERPT. In Section 3, data and statistical methodology are presented. Section 4 contains the econometric results and Section 5 summarizes main conclusions.

LITERATURE SURVEY

A recent trend of a decrease in the magnitude of the ERPT can be explained in numerous ways. Among those explanations which can be relevant for the CEE countries, quality adjustments, structural changes in trading basket and geographical composition of trading partners [Aron, Macdonald and Muellbauer 2014], trade integration [Gust et al. 2010], use of high-quality inputs [Bernini and Tomasi 2015], as well as improved monetary policy performance [García-Schmidt, Garcia-Cicco 2020; Takhtamanova 2010], are worth attention. For the sample of 14 emerging countries over the 1994Q1–2015Q3 period, it is found that ERPT to consumer prices is reduced by adoption of an inflation target [López-Villavicencio, Mignon 2017]. It suggests that the CEE countries with inflation targeting regime may experience a lower ERPT. Using time series for a longer time span of 1996– 2015, Ben Cheikh and Ben Zaied [2020] obtain for 10 new EU Member States that for inflation levels above a threshold of 4.5 percent the degree of pass-through is higher and reaches a full ERPT. Consequently, the shift towards a stable and low-inflation regime contributes to a significant decline in the ERPT. Vonnák [2010] established that low inflation may decrease the ERPT in the Czech Republic, Hungary and Poland and

thus help to ignore exchange rate shocks. Estimated ERPT impulse response functions are fairly similar for the CEE countries studied. On the other hand, no reduction in the ERPT to the aggregate import prices is found for seven countries of Southeast Europe by Kurtović et al. [2018].

While it is common in the literature to find a lower ERPT in countries with more flexible exchange rate regimes in the presence of credible inflation targets that strengthens the shock-absorbing capabilities of the economy [Ha, Stocker and Yilmazkuday 2020], a lower exchange rate volatility under a fixed exchange rate regime can be the most likely factor behind the higher ERPT, as it is found for the CEE countries by Jimborean [2013].

Several studies utilize models with time-varying parameters, which can provide more precise information in comparison to time-invariant models estimated on sub-samples. Using the dataset of 88 countries with the time-varying ERPT measure, Ozkan and Erden [2015] show that the relation between exchange rate and inflation has been low and declining since mid-1980s, being positively influenced by inflation while negatively affected by exchange rate volatility, the degree of openness and output gap. Earlier estimates of time-varying parameters for six major industrial countries (the United States, Japan, Germany, the United Kingdom, France and Italy) reported a decline in the ERPT to consumer prices due to the low and stable inflation environment as well as the rise in import penetration [Sekine 2006].

A downward tendency for the ERPT for the Czech Republic can be explained by a flattened Phillips curve, or rising quality of exports and participation in global value chains, or favourable inflation expectations [Baxa and Šestořád 2019]. Also, it is mentioned that at the zero lower bound (ZLB) there is a possibility of the ERPT being higher than in normal times. Such an assumption corresponds with a proposal presented by Svensson [2000] that the zero lower bound can be overcome by a temporary exchange rate peg causing real depreciation of the domestic currency and by the temporary adoption of price-level targeting. Consequently, higher costs of imported goods should stimulate output and contribute to both lower real interest rates and higher inflation expectations.

The rolling window regression results reveal that the experience of several industrial countries in the post-crisis environment since 2009 is quite heterogeneous [Cunningham et al. 2017]. Another study reports that average ERPT to consumer inflation for 17 emerging market economies has declined in the years following the global financial crisis of 2008 [Patra et al. 2020].

There is a noticeable post-crisis decline in the ERPT for Hungary presented by Hajnal et al. [2015], but Mirdala [2014] does not confirm it in his study. Among other CEE countries, an increase in the ERPT in comparison to the pre-crisis level is found for Bulgaria, Czech Republic, Poland, and Romania, with a decrease in the ERPT for Estonia and Slovenia and no changes between pre- and post-crisis ERPT for Latvia, Lithuania, and Slovakia. The post-crisis increase in the ERPT is experienced by countries with a floating exchange rate regime.

Most of the abovementioned ERPT studies for the CEE countries implement VAR models [Baxa and Šestořád 2019; Hajnal 2016, Mirdala 2014, Vonnák 2010]. Among other estimation approaches with the parameters being constant over time, the dynamic GMM panel-data estimators [Jimborean 2013; López-Villavicencio, Mignon 2017] and the ARDL model [Kurtović et al. 2018] are utilized. In order to account for instability in the relationship between exchange rate and inflation, a nonlinear panel smooth transition regression is implemented by Ben Cheikh and Ben Zaied [2020] and the rolling window regression is used by Hajnal [2016].

DATA AND STATISTICAL METHODOLOGY

Our empirical model is estimated for 14 Eastern European economies, using variables of the consumer and producer prices (index, 2010=100), CPI_t and PPI_t, respectively, the nominal effective exchange rate (index, 2010=100), $NEER_t$, variability of consumer and producer price inflation, $CPIVAR_t$ and $PPIVAR_t$, respectively, the consumer prices in Germany (index, 2010=100), $CPIGER_t$, and the world price for crude oil (index, 2015=100), $BRENT_t$. The exchange rate depreciation means that $NEER_t$ goes up, while the nominal exchange rate appreciation means that $NEER_t$ goes down. All consumer and producer price indexes were seasonally adjusted with the X-12 method. All data come from the Eurostat and IMF International Financial Statistics online databases. The estimation samples for the individual economies are from 2000Q1 to 2021Q4, except for Albania, 2002Q1 to 2009Q4, and Serbia, 2010Q1 to 2021Q4, due to availability of time series for the producer prices. The Czech Republic, Hungary, Poland, Romania, Albania, Croatia and Serbia can be classified as countries with substantial exchange rate flexibility, while Bulgaria, North Macedonia, Slovakia, Slovenia and the Baltic States maintain different kind of fixed exchange rate arrangements. Similar to other studies [Cunningham et al. 2017; López-Villavicencio, Mignon 2017], the relationship between the NEER and inflation is augmented by accounting for external conditions.

The Phillips-Perron (PP) unit root test is applied to check the orders of integration of the three times series, with autoregressive lags being chosen according to the Akaike information criterion. The PP tests show that majority of the variables included in the analysis are I(1), except for CPI for Slovakia and Slovenia and NEER for Bulgaria and Lithuania which are stationary in levels (Table 1).

Sims [1982] advocated the time-varying coefficients model as a useful way of dealing with changes in government policy and economic institutions. In contrast to the STAR-type time specification that assumes a particular path and a smooth transition between the regimes which could be too restrictive for the case of ERPT, the use of the Kalman filter for the maximum likelihood estimation of time-varying coefficients provides with flexibility [Darvas 2013]. The Markov switching specification, as another alternative, assumes a limited number of states and thus seems less attractive for the case CEE economies, which used to evolve gradually and may not return to an earlier regime.

For the purpose of this study, the algorithm of the Kalman filter is represented by the following state space model:

$$\Delta p_t = a_0 PVAR_t + \mathbf{\Phi}_{t-1}\Delta p_{t-1} + \mathbf{\Gamma}_{t-1}\Delta x_{t-1} + \mathbf{M}_{t-1}\varepsilon_{t-1}, \tag{1}$$

$$z_t = \mathbf{H}_t p_t + \mathbf{\Omega}_t x_t + \upsilon_t, \tag{2}$$

where p_t is a vector of consumer or producer prices at the time t (in logarithms, as indicated by lowercase letters), the matrix $\mathbf{\Phi}_{t-1}$ represents the state transition between the time periods t−1 and t, x_t is a vector of observed variables that are predetermined $(x_t \in [neer_t, cpiger_t, brent_t])$, $\mathbf{\Gamma}_{t-1}$ is the matrix of coefficients for observed variables, $PVAR_t$ is volatility of consumer (or producer) price inflation, ε_t is a white noise error vector, and Δ is the operator of first differences.

Table 1. Results of the Phillips–Perron unit root test

Country	CPI		PPI		NEER	
	Level	First Diff	Level	First Diff	Level	First Diff
Czech Rep	−2.03	−4.54***	−1.98	−4.79***	−1.89	−6.80***
Hungary	−2.33	−5.41***	−1.51	−5.36***	−1.92	−14.80***
Poland	−2.61	−3.66**	−2.05	−4.54***	−0.16	−7.72***
Romania	2.93	−3.81***	2.90	−3.25***	1.67	−5.54***
Albania	−2.58	−16.46***	−2.59	−6.54***	−1.64	−8.97***
Croatia	−1.44	−6.36***	−1.83	−3.13**	−2.10	−8.85***
Serbia	2.15	−3.42***	−2.13	−3.02**	0.86	−8.58***
Bulgaria	−1.74	−5.57***	−1.87	−4.16***	−2.41*	−7.64***
North Macedonia	−2.53	−6.14***	−1.85	−5.34***	−2.72	−7.94***
Slovakia	−3.18*	−4.52***	1.77	−2.88***	−0.87	−7.73***
Slovenia	−4.17***	−5.45***	−1.43	−1.77*	0.78	−7.71***
Estonia	−0.88	−3.46**	−1.44	−1.76*	−2.35	−9.98***
Latvia	−1.18	−3.28**	−0.40	−3.01**	−1.48	−8.75***
Lithuania	−1.67	−4.55***	−2.33	−7.75***	−4.42***	−9.49***

* a model with intercept and trend is used in most of the cases, with seasonally adjusted series for CPI and PPI used; a model with no intercept and trend is used for CPI (Estonia, Romania, Serbia), PPP (Croatia, Latvia, Slovakia, Slovenia), NEER (Poland, Romania, Serbia, Slovenia); ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Source: own calculations

It is assumed that inflation is inertial, being affected by its volatility, exchange rate, commodity and foreign price shocks. Similar to Cunningham et al. [2017], the ERPT is estimated with control for oil demand shock. For the CEE countries, it is quite natural to proxy external prices with the consumer price index in Germany as the largest European economy.

Time-varying coefficients for the lagged value of p_t are modelled as driftless random walk which can capture various time paths of the parameters. On the other hand, time-varying coefficients for predetermined variables are modelled as recursive ones which implies relative stability of the relationships. The EViews 10 statistical package was used for estimations.

EMPIRICAL RESULTS

The TVP estimates of the ERPT to consumer price inflation are presented in Figures 1 and 2. Among countries with a floating exchange rate regime (Fig. 1), Poland experienced a steep drop in the ERPT to CPI at the beginning of the 2000s (similar developments but on a much smaller scale are present in Albania and Serbia). A post-crisis strengthening of the ERPT is very sharp in Hungary, Serbia and Croatia. For other countries, the value of the ERPT has not changed significantly since 2010 but statistical significance of the estimated time-varying parameters has become somewhat higher. It suggests that in a post-crisis environment of low inflation and extremely low interest rates the ERPT to CPI is more stable.

Figure 1. Estimates of the ERPT to CPI for the countries with a flexible exchange rate regime
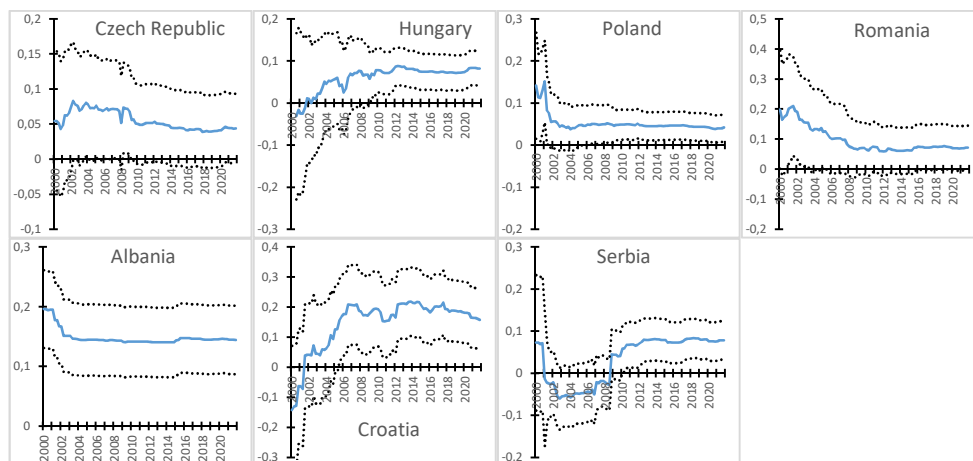

* here and hereafter point estimates are presented within the band of ± 2 standard deviations.
Source: own preparation

For countries with a fixed exchange regime (Fig. 2), the ERPT seems to be stronger, with no sign of an increase in its value or statistical significance for a post-crisis period of 2010–2021 (except Bulgaria and Latvia). A downward trend in the ERPT since the beginning of 2000s is observed in Estonia, Slovakia and Slovenia.

Except Albania, the Czech Republic, and Croatia, the ERPT to producer prices is stronger in comparison to the ERPT to consumer prices for countries with a floating exchange rate regime (Fig. 3). We notice a higher post-crisis ERPT to PPI

in Croatia, Hungary, and Poland, while it is the opposite in the Czech Republic. Among countries with a fixed exchange rate, the same outcome of stronger ERPT to PPI is observed for Bulgaria and the Baltic States (Fig. 4). Slovakia and Lithuania have experienced a sustained significant increase in the ERPT to PPI since 2010, while it was temporary in Latvia.

Figure 2. Estimates of the ERPT to CPI for the countries with a fixed exchange rate regime
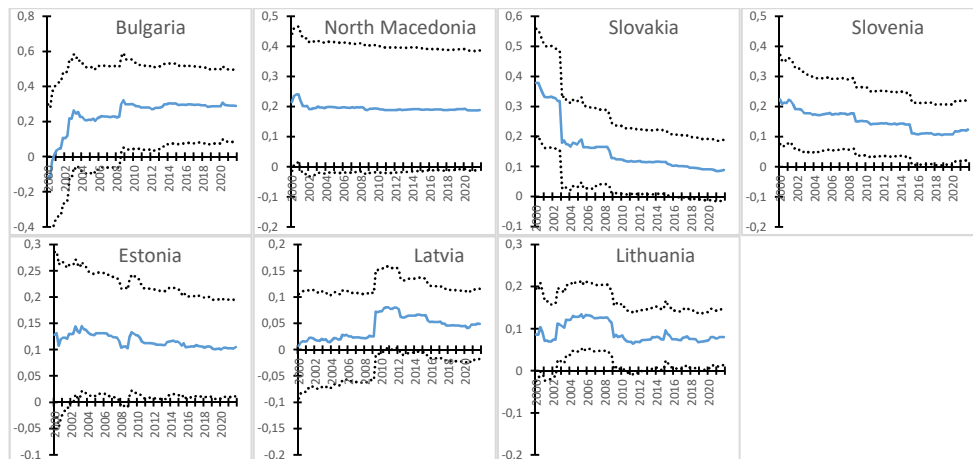
Source: own preparation

Figure 3. Estimates of the ERPT to PPI for the countries with a flexible exchange rate regime
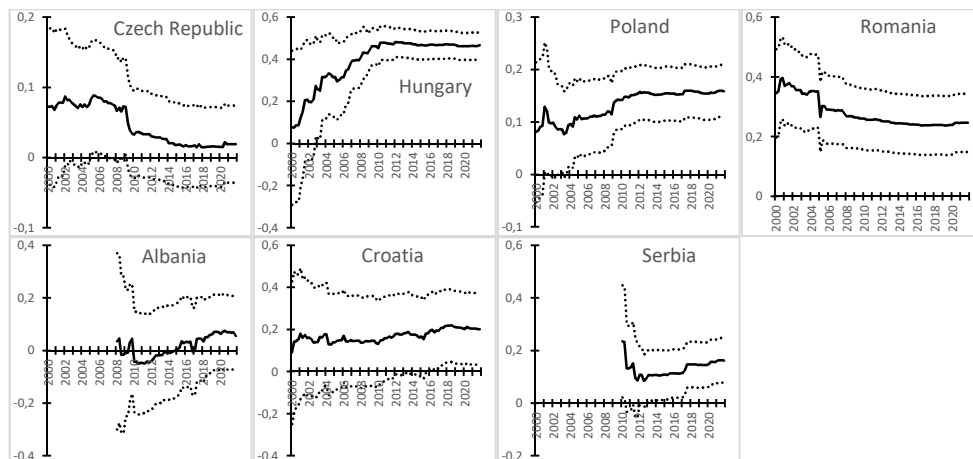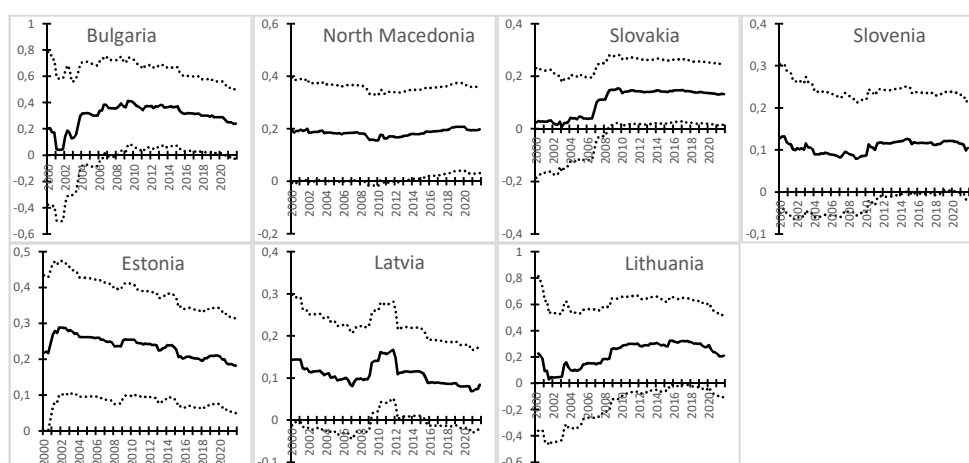

Source: own preparation

For convenience, the results are aggregated for several groups of countries in Table 2. On average, the ERPT to PPI is much higher in comparison to ERPT to CPI for the Float-4 (the Czech Republic, Hungary, Poland, Romania) and the Baltic countries for both pre- and post-crisis periods. A higher post-crisis ERPT to CPI is

observed for the Float-3 countries (Albania, Croatia, Serbia), with an opposite outcome for the Fixed-4 countries (Bulgaria, Slovakia, Slovenia, North Macedonia); however, it is not the case for the ERPT to PPI for the latter. In the post-crisis period, all groups of countries demonstrate a decrease in the standard deviation of estimated time-varying parameters for the ERPT to both consumer and producer prices.

Figure 4. Estimates of the ERPT to PPI for the countries with a fixed exchange rate regime

Source: own preparation

Table 2. Comparison of the ERPT to consumer and producer prices

Countries	CPI		PPI	
	2004Q1–2008Q2	2010Q1–2021Q4	2004Q1–2008Q2	2010Q1–2021Q4
Float-4	0.070 (0.041)	0.059 (0.026)	0.210 (0.053)	0.225 (0.034)
Float-3	0.088 (0.044)	0.136 (0.036)	—	0.111 (0.075)
Fixed-4	0.190 (0.094)	0.177 (0.078)	0.169 (0.107)	0.192 (0.088)
Baltic-3	0.092 (0.046)	0.081 (0.040)	0.165 (0.119)	0.206 (0.099)

* average standard deviation is in parentheses.
Source: own calculations

Our results mean that a widely recognized tendency for a decrease in the magnitude of the ERPT, as found in international studies [Lopez-Villavicencio and Mignon 2017, Patra, Khundrakpam and John 2020], is present in the CEE countries but it is not extraordinarily strong. Except for Croatia, Serbia and Latvia, there is no support for a significant increase in the magnitude of ERPT to CPI in a post-crisis period since 2010, as it is found for the developing economies [Jašová, Moessner and Takáts 2019]. In relation to a study by Jimborean [2013], it is confirmed that a lower exchange rate volatility can be a factor behind the higher ERPT, but it is only a case for the magnitude of ERPT to CPI, not ERPT to PPI.

Among other results, inflationary effects of the world oil prices for CPI is strong for Slovakia and North Macedonia, while in Hungary, Slovenia and Estonia it is observed since 2020. As expected, sensitivity of the PPI to the world oil prices is much more widespread. Besides Slovakia and North Macedonia, it is observed since the beginning of 2000s in Croatia, Bulgaria and the Baltic States, while in other countries this kind of relationship it is a more recent phenomenon (since the middle of last decade). Except for Romania, Albania, Serbia, North Macedonia and Bulgaria, domestic consumer prices are influenced by the German CPI. For the producer prices, only Bulgaria and Estonia lack statistically significant relation to foreign prices. Variability of CPI contributes to inflationary dynamics in almost all countries, except Albania and Poland. On the other hand, variability of PPI is a significant factor behind producer prices only in Serbia and Slovenia.

SUMMARY

Our study demonstrates that on average the incomplete ERPT is stronger for countries with a fixed exchange rate regime, being in accordance with the results of earlier studies. Since the middle of 2000s, the ERPT seems to be fairly stable in most of the countries. A post-crisis strengthening of the estimated ERPT to consumer prices is very sharp in Hungary and Serbia which practise inflation targeting, as well as in Bulgaria and Latvia, both countries supporting a fixed exchange rate of their currencies. With the exception of the Czech Republic, Romania, and Estonia, there is a tendency for strengthening of the ERPT to producer prices in the wake of the world financial crisis of 2008–2009. As a positive link between exchange rate and the consumer and producer prices is observed in majority of countries (except the Czech Republic), it argues in favour of using the exchange rate appreciation as an anti-inflationary tool. Obviously, strengthening of the euro in respect to other world currencies should be helpful for the countries which decided to peg their currencies to the European common currency. Besides nominal exchange rate changes, for most of the countries both consumer and producer prices are influenced by the consumer price dynamics in Germany and by the world oil prices, though the latter is a more recent phenomenon. Variability of CPI is a significant inflationary factor in almost all countries, except Albania and Poland, while variability of PPI is a significant factor behind producer prices only in Serbia and Slovenia.

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