



IMPACT OF CURRENCY REDENOMINATION ON INFLATION CASE STUDY TURKEY

Libor Židek^{1†} --- Michal Chribik²

^{1,2}Faculty of Economics and Administration, Masaryk University, Brno, Czech Republic

ABSTRACT

Countries that suffer from high inflation must consequently deal with an unpractical, high price level. This problem lasts even if the country is already on the disinflation path. The solution can be found in redenomination when the face value of all prices is reduced. This raises an interesting question whether redenomination as such could help the disinflation process. Cutting zeros could help convince market subjects that the central bank means its disinflation efforts seriously. In the specific, the goal of this paper is to find out if Turkish redenomination in 2005 contributed to the disinflation process. We used the Chow test and Vector–Autoregressive model to detect if redenomination created a fracture in inflation development. We indeed discovered a fracture, but it is difficult to determine the exact occurrence of the break. We can conclude that the process of redenomination as such probably had a direct impact on inflation in the country.

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Contribution/ Originality

This study is one of very few studies which have investigated the impact of denomination on price level. The goal of this paper is to find out if Turkish redenomination contributed to the disinflation. We can conclude that the process probably had a direct impact on inflation in the country.

1. IMPACT OF CURRENCY REDENOMINATION ON INFLATION – CASE STUDY TURKEY

Turkey suffered from persistently high inflation during the last three decades of the 20th century. Growth of price level was curbed to single digits only after year 2000. The

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consequence of the long period of high inflation was an enormously high price level. It brought economic costs and discomfort to market subjects. The central authorities decided to respond by redenomination of the Lira (cutting of six zeros) at the beginning of 2005. This step can be considered as an integral part of the strategy to approach standard conditions of a market economy and price levels of developed countries. The main goal of redenomination was to ease dealing with prices and costs in the economy but there was a psychological aspect as well. Lower prices were expected to help convince market subjects that the central bank was serious about keeping inflation at low level. As a consequence, redenomination could help in declining the inflation expectations in the economy and thus help the disinflation process. The goal of this paper is to find out if redenomination had an impact on the process of disinflation in Turkey. We apply econometric methods (in specific the Chow test and Vector–Autoregressive model (henceforth: VAR)) to reveal if there was a break point in the inflation development. This fracture could mean that redenomination caused a specific (additional) reaction of the Turkish economy. The structure of the paper is following. We first of all comprise the process of redenomination into the overall economic development in Turkey. Then, we concentrate on theory and practice of the redenomination process. We introduce data and the model in the following chapter. And the last chapter introduces our results.

1.1. Economic Consequences of Redenomination

The Turkish economy suffered from fundamental weaknesses and imbalances, with repeating economic crisis and lasting, relatively high inflation since the beginning of the 1970s. Average inflation in the 1980s overcame 50 % and it reached nearly 80 % per a year in the 1990s. Meanwhile, the Turkish Lira depreciated – in 1966 1 USD cost 9 TRL, in 1980 90 TRL, 1988 1 300 TRL; 1995 45 000 TRL, and in 2001 1 650 000 TRL. A currency and banking crisis took place in 1994. The economy was supposed to be stabilized by a reform program at the end of the decade. The crucial feature of the program was the crawling peg exchange rate system. But the country was struck by another currency and banking crisis in late 2000 and early 2001. It resulted in abandoning the crawling peg. The Lira started to operate in a floating system in February 2001 – the currency immediately plummeted by nearly two thirds against both the Dollar and Euro. In reaction, a new program (supported by the IMF) was approved. In the core of the program were structural reforms that were expected to heal lasting problems of the Turkish economy. The reforms covered public sector reform, improvement of the banking system, and liberalising of the private sector markets (OECD, 2002). The program was followed by strong economic growth in the middle of the first decade. GDP per person increased and living standard improved. Inflation was declining and in 2004 prices grew by only 9 % – single digit growth was achieved for the first time since 1970. But, even if the struggle to get inflation under control was successful, the price level was enormously high – prices were expressed in billion, trillion and even quadrillion liras. The smallest banknote's value was 50 000 liras and the highest 20 million liras. The higher of these banknotes allowed purchasing of 4 tickets for the cinema (Ioana, 2005). Generally, dealing with the currency

was complicated and uncomfortable for all market subjects. Redenomination became a natural solution and one of the key factors of improving the market conditions in the country.

1.2. Redenomination in Theory

Redenomination means that the face value of banknotes (and coins) in circulation is changed – in practice declined. By redenomination all prices in the economy are reduced by the same value. No market subject is directly affected (harmed or advantaged) by the process. The process is usually accompanied by issuing of new banknotes or stamping of the old banknotes in circulation. Redenomination is usually applied after hyperinflation or when the economy is seriously affected by dollarization and the central bank wants to regain seriousness. High price level causes many inconveniences in the economy – there are, for example, problems with expressing nominal values of goods and services, with accounting, statistical evidence, dealing with software, payment systems of banks and alike. Redenomination can be seen as a step that finalizes efforts of the central authorities to stabilize growth of prices in the economy.

We agree with [Ioana \(2005\)](#) that in theory redenomination should not have any direct impact on inflation because it does not change any fundamental indicators that directly affect inflation. The only (and small) exception could be in rounding of prices. New prices could be slightly rounded up. In reality, prices are usually depicted in both versions (old and new) and redenomination thus should not lead to rounding up of prices. But there could be an indirect effect of redenomination of the currency in the form of declining inflationary expectations ([Mosley, 2005](#)). The market subjects should be convinced (by the act of redenomination) that the authorities mean their struggle against inflation seriously and that decline in nominal values of the currency is a step in the disinflation process. The subjects should be convinced that inflation was a negative aspect of the old currency that would not reappear with the new currency. In this case, inflation could decline due to different behaving of market subjects that expect lower inflation. From this point of view, redenomination could be seen as another tool in the disinflation strategy that indirectly helps in declining of expectations and thus stabilizing of prices level. We should mention that there are general costs associated with applying of redenomination as well. The minimal costs are on printing banknotes and minting new coins, on advertising campaigns and changes in software. Redenomination logistics is complicated because the responsible authority must provide overall coordination of the process that has an impact on everybody in the entire economy.

1.3. Redenomination in Practice – The Case of Turkey

Redenomination, as a process that helped decline nominal value of a currency, was applied in approximately 50 countries ([Ioana, 2005](#)). It was usually used as one of the stabilization steps. For example, in Poland and Bulgaria redenomination took place after convincing success of their stabilization programs. In Turkey, redenomination was firstly considered in 1998 but inflation was still running high at that time. The parliament in the end passed a law that enabled removing six zeros from the currency and creating of a new currency (New Turkish Lira) in December 2003. Redenomination took place on the 1st of January, 2005. The exchange rate was set as 1 New

Turkish Lira (YTL) for 1 million of (old) Turkish Lira. At the same moment, two new banknotes were issued. The old currency remained in circulation till the end of 2005. There was a transitional period till the end of 2008. On the 1st January, 2009 the “New” was removed from the official name of the currency and the name returned to Turkish Lira. The consequences of redenomination were obvious – credibility of the currency increased, accounting statements were simplified and generally dealing with the currency was easier for all market subjects. The nominal value of the new currency became comparable with other currencies 1 EUR = 1.6361 YTL, 1 USD = 1.3448 YTL. And following the redenomination, inflation in Turkey stays in single digits or close to this value. The successful redenomination process was followed by implementing of the explicit inflation targeting in 2006. From this point of view redenomination was successful. The question is if redenomination by itself contributed to the disinflationary process in the country as well.

1.4. Data and Model

During the processing of the data set we used the open-source econometric program *Gnu Regression, Econometric and Time-series Library 1.9.12 (GRET)* available at www.gretl.sourceforge.net. Data entering the models are adjusted for quarterly time series. For clarity, we present variables used together with characteristics and sources in the following Table 1. In this section we apply two econometric methods.

Table-1. Summary of data

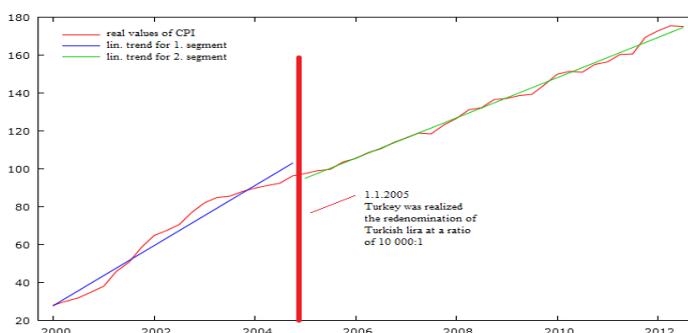
	Units	Period	Source
CPI	Index 2005 = 100	2000Q1:2012Q3	OECD iLibrary
GDP real	Index 2005 = 100	2000Q1:2012Q3	EUROSTAT
M3 broad money	millions YTR	2000Q1:2012Q3	EUROSTAT
Immediate interest rate	%	2000Q1:2012Q3	OECD iLibrary

Source: Own interpretation of the sources

The first approach models the evolution of the price level through time trend, when dependent variable CPI is estimated as a function of time. Using the OLS estimation, we selected the most appropriate biquadratic time trend:

$$CPI = \beta_0 + \beta_1*t + \beta_2*t^2 + \beta_3*t^3 + \beta_4*t^4$$

Then we used the Chow structural break test to test whether redenomination at that time, and thereafter caused a structural break or not. The resulting p-value of the Chow test for a break in the first quarter of 2005 (in this model) is zero to four decimal places. This means rejecting the null hypothesis, which says that the trend in the CPI is the same for both segments.



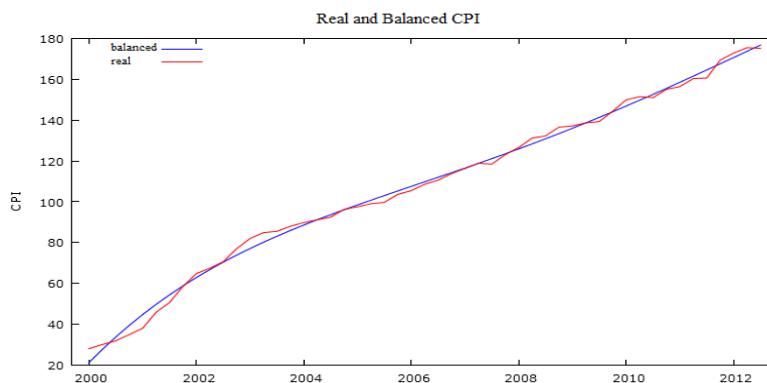


Figure-1. Supposed structural break (up) and balanced time series of the consumer price index using biquadratic trend (down).

Source: OECD iLibrary, own adaptation of output from the Gretl program

To verify the suitability of the break as of January 1, 2005 we used the QLR test, which is looking for the most likely break point in a model with time trend. When we used the model with the biquadratic trend as in the case of the break test, the obtained results revealed that the most likely period for a break was the 4th quarter of 2004. This result concurs with the time of redenomination in Turkey. On the other hand, we have to note different results in the case when the QLR test was used in a model with simple time trend. For this model, the break was set in 3rd quarter of 2003. Based on the Chow test, we are not able to say unequivocally that redenomination is the direct cause of the break, however, the obtained test results imply that the redenomination could be influential in the development of the price level. Therefore, we present a more formal approach in the form of a VAR model. This approach certainly provides a much stronger argument for the possible impact of redenomination on inflation. The processed VAR model captures price level in Turkey, which is expressed by the consumer price index (CPI). Representation of the model variables in RMPY specification (Koop, 2008) is as follows:

R – Percentage change of immediate interest rate (in the model designation: t_int_rate)

M – Growth rate of monetary aggregate M3 (t_M3)

P - Percentage change of CPI (t_CPI)

Y – Growth rate of real GDP (t_GDP_r)

Our VAR model is based on transformed (sign $t_$) quarterly data obtained from Eurostat (n.d) and OECD iLibrary (n.d). They cover the period from the first quarter of 2000 to the third quarter of 2012. The model, of course, includes the dummy variable *denom*, which represents the difference between the periods before and after the introduction of redenomination in Turkey (January 1, 2005). This dummy variable *denom* takes the value of zero up to Q4/2004 and that of unity in the remaining periods. The use of VAR model is conditioned by stationarity of time series. To check the assumption of residual stationarity, except the graphical display, we use the GRETL available Augmented Dickey-Fuller test (ADF test). Test results indicate non-stationarity in the cases of three variables, as you can see in Table 2.

Table-2. ADF test

ADF test:	CPI	int_rate	M3	HDP_r
with constant	0,4363	4,474e-033	1	0,9545
with constant and trend	0,5572	2,393e-022	0,9587	0,5572

Source: own adaptation of output from the Gretl program

Therefore, we decided to transform the time series by logarithms and then differentiated them to achieve stationarity. This was done despite the fact that the original time series of interest rates was stationary, because this transformation modifies this and other time series into a suitable form. Not only can we achieve stationarity, but we get the interpretation of the variables as on-quarter percentage changes. Transformed variables multiplied by 100 then means that we are working with the percentage change in each variable (value 1 implies a 1 percentage change (Koop, 2008)). Such modified time series were again tested for the presence of unit root. The ADF test results are shown in Table 3. To determine the optimal number of delays (lags), we use the VAR lag selection procedure. A result with the lowest value of information criteria (AIC, BIC, HQC) is probably the best. We performed standard diagnostic tests of the model.

Table-3. ADF test for transformed variables

ADF test:	t_CPI	t_int_rate	t_M3	t_HDP_r
with constant	0,3835	1,368e-010	0,0001146	1,094e-005
With constant and trend (with quadratic trend)	0,3008 (0,001633)	1,401e-009	6,147e-005	9,683e-005

Source: own adaptation of output from the Gretl program

Test of normality rejects its null hypothesis. It may be due to a lower number of observations (51) in time series. Nevertheless we decide to continue with VAR(1) model. We focus on the first equation in the model, which responds to changes in price level (Table 4). First equation VAR₁(1) with dependent variable t_CPI:

$$t_CPI_t = c + \varphi_1 * t_CPI_{t-1} + \varphi_2 * t_int_rate_{t-1} + \varphi_3 * t_M3_{t-1} + \varphi_4 * t_HDP_r_{t-1} + \psi * denom + \varepsilon_t$$

Table-4. Results for VAR₁(1)

Equation 1: t_CPI	coefficient	standard error	t-ratio	p-value
const	1,71053	1,08541	1,5759	0,12237
t_CPI_1	0,312431	0,116336	2,6856	0,01025 **
t_int_rate_1	0,0120299	0,00932802	1,2897	0,20406
t_M3_1	0,360202	0,0763621	4,7170	0,00003 ***
t_HDP_r	-0,0982627	0,139713	-0,7033	0,48565
denom	-1,87296	0,864305	-2,1670	0,03582 **
Mean dependent variable	-4,393723	S.D. dependent variable		36,09883
Sum squared residuals	60142,99	S.E. of regression		37,39885
R-squared	0,038482	Adjusted R-squared		-0,073323
F(9, 38)	0,344189	P-value (F)		0,883144
rho	-0,023762	Durbin-Watson		2,045918

Source: own adaptation of output from the Gretl, own calculations

1.5. Results

As we can see in Table 4, variables t_CPI_{t-1} , t_M3_{t-1} and $denom$ are statistically significant at a 5% level. According to the results of the model, price level is influenced by its development in the previous period. One percent change in the CPI in the previous year, causes 0.312 increase in the growth of price level in the current period. It is not a surprising result. Another statistically significant variable at a 5% level is growth rate of money supply. This is consistent with the monetarist view. The negative coefficient for the variable $denom$ means that the introduction of redenomination could cause a decline in growth of price level (year on year 1.87%). On this basis, we assume that redenomination helps reduce inflationary expectations and leads to stabilization of the price level. The other independent variables in VAR₁(1) are insignificant.

1.6. Conclusions

Our goal was to find out if redenomination contributed to decline in inflation in the Turkish economy. The process of redenomination has several consequences. Besides obvious improvements in the dealing with the currency, improvement of the accounting systems and similar progress, there was a psychological aspect as well. Redenomination helped the central authorities to convince the market subjects that they were seriously determined to keep inflation under control. We used econometric techniques to prove that the redenomination process in Turkey had an impact on disinflationary development. We discovered a fracture in the inflationary development in the country, but it is difficult to determine the exact occurrence of the break. It is, understandably, impossible to strictly distinguish denomination from other government policies. We can only conclude that the process of redenomination as such had probably a direct impact on inflation in Turkey.

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