

CORE INFLATION AND KALMAN FILTER*

UDC 004.852+338.57

TIGRAN KARAMYAN

Yerevan State University, Faculty of Economics and Management,
Master's Degree Program,
Yerevan, Republic of Armenia
tigran-met@mail.ru

DAVIT KARAMYAN

Yerevan State University, Information Technologies Educational and
Research Center of YSU, Master's Degree Program,
Yerevan, Republic of Armenia
davitkar98@gmail.com

One of the fundamental provisions of the modern economic theory is that long-term price stability in the economy is an important prerequisite for sustained economic growth as it creates healthy expectations among the household and business representatives about the price trends, which enables them to plan the future course of their future operations. In RA as well as in a number of other countries the main objective of the Central Bank is to ensure price stability, so they tend to use the rate of core inflation instead of actual inflation in their analyses and models in order to develop and implement effective monetary policy.

Here we represent an estimation of core inflation in RA from 2006 to 2019 with Kalman filter. The main objective of this article is to represent an estimation of core inflation with Kalman filter with the appropriate efficiency criteria and to compare the results with the officially published core inflation which is calculated by "Seasonal exclude and external shocks adjustment" (SEESA) and simple "Seasonal exclude" (SE) methods. The proposed method was evaluated with the appropriate efficiency criteria and the obtained results were compared with the officially published core inflation indicators. The Kalman filtered indicator of core inflation is closely correlated with monetary aggregates and interest rates and is at most matched to the actual inflation trends.

This paper is aimed to show that Kalman filtering can be a good alternative to the SE and SEESA methods developed by CBA.

Keywords: CBA, price stability, core inflation, State – Space models, Kalman filter, SE, SEESA.

Introduction: Ensuring price stability in the economy is the most important prerequisite for sustained long-term economic growth. However, many monetary and non – monetary supply and demand factors have their impact on short – term and mid – term inflation. Therefore, it is important to choose an accurate indicator that identifies the level of actual inflation, which gives a clear idea of price trends in economy. In turn, for sustained economic growth a certain "normal" rise in price levels are required, that is called core inflation.

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In RA inflation is measured by Consumer Price Index⁵⁴⁷ (CPI), which estimates changes in the overall price level of households' market basket, but the use of CPI to characterize inflation is inappropriate in some cases, as CPI trends are affected by significant volatility caused by seasonality of production and consumption of certain goods and services or other various temporary and arduously predictable supply and demand shocks. Also note that CPI, as a weighted average indicator, can be a summary estimate of the overall price level change if the distribution of CPI is normal, whereas studies have shown⁵⁴⁸ that CPI from 1996 to 2006 follows positive skewed log normal distribution.

For efficient monetary policy core inflation is mainly used instead of CPI that reflects long-term price trends and is a stable component of inflation, which is characterized by low volatility in time. It is relatively free from the influence of exogenous shocks that are typical of our economy at this stage of development and at this level of dollarization.

In this paper an implementation of Kalman filter is shown to estimate core inflation in RA. Another use of this filter in developing efficient monetary policy is the estimation of GDP gap. The model was built with Python⁵⁴⁹ programming language and the 2006-2019 real sector indicators were used as a database. This period was chosen because since 2006 the Central Bank of Armenia (CBA) has switched to a inflation targeting strategy. Among a ton of inflation calculating indicators CBA targets the 12-month⁵⁵⁰ inflation indicator, as of end-period. In addition, the distribution of CPI from 2006 to 2019 is close to normal, as there is barely positive skewness and high kurtosis as opposed to the 1996-2006 CPI.

The proposed alternative method of core inflation calculation will allow to efficiently estimate the real price changes in the economy, although, in some cases, the Kalman filtering may be not so accurate in compare with the methods⁵⁵¹ currently used by CBA. But one of the advantages of Kalman's approach is that it can estimate the real price changes of all products and services included in consumer basket without excluding the ones with high volatility.

Literature review: There are three main methods of calculating core inflation: *excluding methods*, *econometric methods* and *statistical methods*. An effective method is considered the one that is strongly correlated with monetary aggregates (cash in circulation, money base, money supply) and its trends are close to the official inflation trends. The idea of *excluding methods* in calculation of core inflation is to exclude price indices of some goods and services or to eliminate the impact of certain macroeconomic indicators and state regulation mechanisms on prices. According to common excluding methods goods and services with relatively high volatility are excluded from the market basket. However, the application of this method is difficult because it is practically impossible to clearly distinguish the impact of all such factors on prices. Currently in Armenia the core inflation is estimated according to the methodologies described below:

⁵⁴⁷ The basic formula used to calculate price indices is the Laspeyres index – $I_L = \frac{\sum P_i^{t_n} Q_i^{t_0}}{\sum P_i^{t_0} Q_i^{t_0}} \times 100$,

where $P_i^{t_n}$ and $P_i^{t_0}$ represents the prevailing price of i in period t_n and, $Q_i^{t_0}$ represents the quantity of i sold in period t_0 .

⁵⁴⁸ Աֆյան Դ., ԶԶ ԿԲ, Տնտեսական վիճակագրության զարգացման բաժին. «Բնականոն գնաճի հաշվարկման մեթոդաբանությունը Հայաստանի Հանրապետությունում. Արտաքսման և ճշգրտման եղանակ», , Հայաստանի Հանրապետության կենտրոնական բանկի բանբեր, Երևան, 2008թ., 41-63:

⁵⁴⁹ All codes are available at Github.com with the following link <https://github.com/TK666/Kalman-Filter-and-Core-Inflation>.

⁵⁵⁰ Each month the CBA targets the 12-month inflation indicator against the same reference month of the previous year in order to maintain the 12-month inflation within the confidence band of 4 percent $\pm$ 1.5 percent.

⁵⁵¹ “Seasonal Exclude & external shocks adjustment” and “Simple Seasonal Exclude”.

- Simple Seasonal Exclude – goods (“Fruits”, “Vegetables” and “Eggs”) positions in consumer basket, which production have seasonal nature and services, which tariffs are controlled by the government (housing, communication, transportation services in consumer basket) are excluded from the core inflation calculation.

- Seasonal Exclude & external shocks adjustment – according to this approach the consumer basket is divided into three groups. The first group consists of seasonal goods and services controlled by the government (that are described above). Imported⁵⁵² goods are included in the second group. The remaining goods are included in third group. To calculate the core inflation second and third groups are used.

In the case of *econometric methods*, core inflation is considered to be the part of the actual inflation which does not affect the real volumes of production in the long run. There are a great amount of articles that represent calculation of core inflation with econometric method. Quah and Vahey represented a work where the calculation was carried out with the help of two – dimensional vector autoregression (also VAR/SVAR) model with the indices of real GDP growth and inflation as variables.

Statistical methods for calculating core inflation are mainly used to reduce the volatility of the CPI. Common statistical methods that were used by CBA are median, weighted average, trimmed means, Hodrick – Prescott filter and etc.

- Calculation of core inflation with median suggests usual estimation of individual price indices median for each month.

- The essence of weighted average methods is to rescale the official weights of goods and services included in market basket. Here, unlike excluding methods, all goods and services participate in the estimation of the core inflation index, but the impact of certain goods and services with high volatility on core inflation is diminished by given weights.

- In a number of countries, it is assumed to calculate core inflation by trimmed means⁵⁵³. A trimmed mean is a method of averaging that removes a small designated percentage of the largest and smallest values before calculating the mean. After removing the specified outlier observations, the trimmed mean is found using a standard arithmetic averaging formula. According to this method, price indices of goods and services that included in market basket are put in ascending or descending order and then the indices of some goods and services are trimmed from each end of ordered set of goods and services. Note, that cumulative weights of trimmed goods and services from each end of ordered set are equal.

Today the core inflation in RA is calculated with the “Seasonal exclude and external shocks adjustment” method (developed by CBA), which corresponds to almost all efficiency criteria and has a clear economic interpretation. The advantage of this method over simple Seasonal exclude method is that in case of first the market basket includes adjusted indices of imported goods and services. In this way the influence of possible external shocks connected with the imported goods (services) and their prices (tariffs) is eliminated, whereas their trends are included in the calculation of core inflation.

The indicator of core inflation should meet certain efficiency criteria. The appropriate criteria are given below:

- First, the calculated and officially published indicator of core inflation should be closely correlated with monetary aggregates and interest rates.

- Second, the core inflation trend should be at most matched to the actual inflation trend.

⁵⁵² Here we consider a good imported if the import volumes of those goods exceed the domestic production by more than 50% and the weight of that good in consumer basket is at least 0.2%. Tukey’s method for extreme outliers is used for this group and the outliers are replaced by the average of the previous 5 years.

⁵⁵³ From June, 2004 to March, 2008 CBA calculated and officially published the core inflation rate with the method of 15% trimmed means.

• Third, the calculated indicator should be understandable and acceptable to the people and it should have some clear economic insight.

• Fourth, the calculated indicator should be comparable, applicable and should correspond to the maturity principle.

The main objective of this article is to represent an estimation of core inflation with Kalman filter with the appropriate efficiency criteria and compare the results with the officially published core inflation which is calculated by “Seasonal exclude and external shocks adjustment” and simple “Seasonal exclude” methods.

State – Space Models: Before switching to Kalman filter, let’s get some intuition about State – space models. A State – space model is a system of linear equations given as a set of input, outputs and state variables related by first – order differential equations. State variables’ values evolve through time in a way that depends on the values they have at any given time and also depends on the externally imposed values of input variables. Output variables’ values depend on the values of the state variables⁵⁵⁴.

Consider a dynamic process described by an n^{th} order difference equation of the form

$$y_{i+1} = a_{0,i}y_i + \dots + a_{n-1,i}y_{i-n+1} + u_i, i \geq 0,$$

where u_i is a zero – mean white noise process with autocorrelation $E(u_i, u_j) = R_u = Q_i \delta_{ij}$, and initial values $\{y_0, y_{-1}, \dots, y_{-n+1}\}$ are zero – mean random variables with a known $n \times n$ covariance matrix $P_0 = E(y_{-j}, y_{-k}), j, k \in \{0, n-1\}$. Note that there is no correlation between initial values and u_i white noise process (or they are statistically independent)

$$E(u_i, y_i) = 0 \text{ for } [-n+1 \leq j \leq 0 \text{ and } i \geq 0] \text{ or } i \geq j \geq 0.$$

Taking into consideration some other conditions⁵⁵⁵ n^{th} order difference equation given above can be rewritten as

$$\dot{x}_{i+1} \equiv \begin{bmatrix} y_{i+1} \\ y_i \\ y_{i-1} \\ \vdots \\ y_{i-n+2} \end{bmatrix} = \underbrace{\begin{bmatrix} a_0 & a_1 & \dots & a_{n-2} & a_{n-1} \\ 1 & 0 & \dots & 0 & 0 \\ 0 & 1 & \dots & 0 & 0 \\ \vdots & \vdots & \dots & \vdots & \vdots \\ 0 & 0 & \dots & 1 & 0 \end{bmatrix}}_A \begin{bmatrix} y_i \\ y_{i-1} \\ y_{i-2} \\ \vdots \\ y_{i-n+1} \end{bmatrix} + \underbrace{\begin{bmatrix} 1 \\ 0 \\ \vdots \\ 1 \end{bmatrix}}_G u_i, \quad (1.1)$$

From equation (1.1)

$$\dot{x}_{i+1} = A\dot{x}_i + Gu_i, \quad (1.2)$$

$$\dot{y}_i = H_i \dot{x}_i, \text{ where } H_i = [1, 0, \dots, 0]. \quad (1.3)$$

Equation (1.2) represents that a new state $\dot{x}_{i+1}$ is a linear combination of the previous state $\dot{x}_i$ and some process noise u_i . Equation (1.3) shows the way of derivation of $\dot{y}_i$ observations from the internal state $\dot{x}_i$. These equations serve as the basis for Kalman filter represented below.

Kalman filter: Kalman filter⁵⁵⁶ is a set of mathematical equations that uses a series of measurements observed over time, containing statistical noise or other irregular fluctuation, and produces estimates of unknown variables that is optimal in the sense that it minimizes the estimated error covariance – when some presumed conditions are met.

The main problem that Kalman filter trying to solve is to estimate the state $x \in \mathbb{R}^n$ process that is governed by the linear stochastic difference equation

$$x_k = Ax_{k-1} + Bu_k + w_{k-1},$$

with a measurement $z_k \in \mathbb{R}^m$ where

⁵⁵⁴ **Kailath, T.,** Sayed, A., H., & Hassibi, B. (2000). Linear Estimation. Upper Saddle River, NJ USA: Prentice Hall.

⁵⁵⁵ **G. Welch** and G. Bishop. 1995. “An Introduction to the Kalman Filter,” University of North Carolina, Department of Computer Science, TR 95-041.

⁵⁵⁶ **M. Laaraiedh.,** (2012). “Implementation of Kalman Filter with Python Language”, IETR Labs, University of Rennes 1, arXiv:1204.0375.

$$z_k = Hx_k + v_k,$$

$A_{(n \times n)}$ – The state at the previous time step $k - 1$ to the state at the current step k (without driving function or process noise),

$B_{(n \times l)}$ – optional control input $u \in \mathbb{R}^l$ to the state x ,

$H_{(m \times n)}$ ⁵⁵⁷ – The state to the measurement z_k ,

w_{k-1} and v_k – random variables that represent the process and measurement noise. These variables are assumed to be independent of each other, white and with normal probability distribution: $p(w) \sim N(0, Q)$, $p(v) \sim N(0, R)$, where Q and R are process and measurement noise covariances that might change with each time step or measurement.

The Kalman filter estimates the process state at some time and then obtains feedback in the form of noisy measurement. So the Kalman filter process has two steps: time update equations and measurement equations (Fig 1). The time update equations are responsible for projecting forward (in time) the current state and error covariance estimates to obtain the a priori estimates for the next time step. The measurement update equations are responsible for the feedback – i.e. for incorporating a new measurement into the a priori estimate to obtain an improved a posteriori estimate.

TIME UPDATE (“PREDICT”)

(1) Project the state ahead

$$\hat{x}_k^- = A\hat{x}_{k-1} + Bu_k$$

(2) Project the error covariance ahead

$$P_k^- = AP_{k-1}A^T + Q$$

Where:

○ $\hat{x}_k^-$ and $\hat{P}_k^-$ are the predicted mean and covariance of the state, respectively, on the time step k before seeing the measurement.

○ $\hat{x}_0$ and P_0 are initial estimates

⁵⁵⁷ In practice A and H matrices might change with each time step, but here they are assumed to be constant.

MEASUREMENT UPDATE (“CORRECT”)

(1) Compute the Kalman gain

$$K_k = P_k^- H^T \left(\overbrace{H P_k^- H^T + R}^{S_k} \right)^{-1}$$

(2) Update estimate with measurement z_k

$$\hat{x}_k = \hat{x}_k^- + K_k \overbrace{(z_k - H \hat{x}_k^-)}^{V_k}$$

(3) Update the error covariance

$$P_k = (I - K_k H) P_k^-$$

Where:

- $\hat{x}_k$ and P_k are the estimated mean and covariance of the state, respectively, on time step k after seeing the measurement.
- K_k is the filter gain, which tells how much the predictions should be corrected on time step k .
- V_k is the innovation or the measurement residual on time step k .
- S_k is the measurement prediction covariance on the time step k .
- z_k is the mean of the measurement on time step k .

Fig 1. The Kalman filter process: time update equations and measurement equations.

Data description: There are cases when CPI isn't as good indicator as it might be for developing the right monetary policy. For example, the CPI indicators from 1996 to 2006 follows positive skewed log normal distribution as it can be seen in the Fig 2.

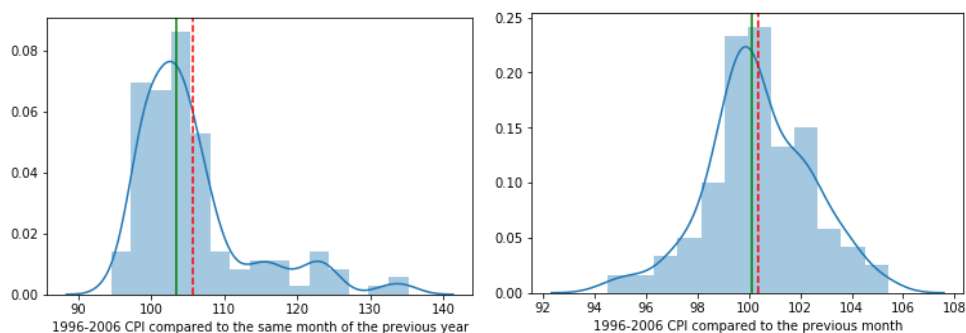


Fig 2. CPI from 1996 to 2006: the skewed log normality of the CPI distribution.

Since 2006 the CBA has switched to a inflation targeting strategy and since then the “abnormality” of the CPI distribution almost vanished (Fig 3).

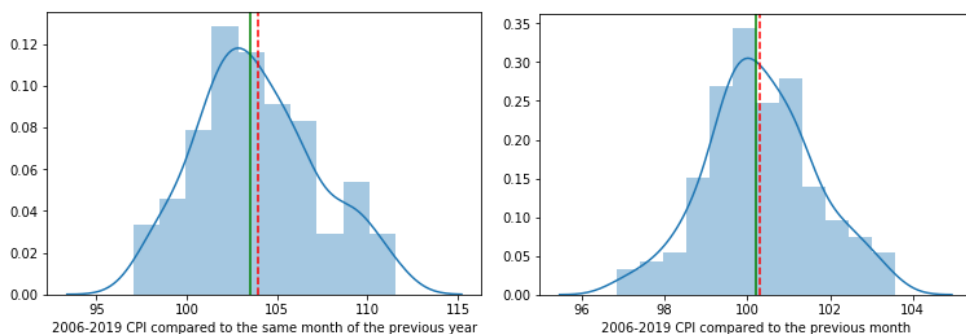


Fig 3. CPI from 2006 to 2019: barely positive skewness and high kurtosis.

Here we will draw our attention to 3 main indicators: CPI and Core inflation indicators calculated by the “Seasonal Exclude & external shocks adjustment”(SEESA) and “Simple Seasonal Exclude”(SSE) methods. The dataset consists of 167 observations and 7 parameters.

Date 01/2006- 10/2019	SEESA compared to the same month of the previous year	SEESA compared to the previous month	SE compared to the same month of the previous year	SE compared to the previous month	CPI compared to the same month of the previous year	CPI compared to the previous month
2006/1	98.594810	100.291715	98.743545	100.288545	97.026080	102.479797
2006/2	99.083378	100.057609	99.101892	99.904263	97.918800	100.248507
2006/3	99.604120	100.366690	99.447619	100.198904	98.939609	100.090708
2006/4	101.191824	100.746102	100.872023	100.556315	100.122466	100.284364
2006/5	102.216325	100.337057	101.712238	100.210270	102.426835	102.403234

Table 1. Dataset sample: the source of dataset https://www.cba.am/Storage/AM/downloads/stat_data_arm/Inflation.xls.

The last two parameters were used to estimate the core inflation with Kalman filter, while the first four (except “Date 01/2006-10/2019”) helped us to conclude about the efficiency of our methodology. Our results were compared to the ones CBA monthly calculated and officially published. Also, as an optional data monetary aggregates and interest rates are considered to ensure that estimated core inflation is correlated with the abovementioned monetary aggregates and interest rates.

Here a stationarity test also has been conducted to get some intuition about our time series. The augmented Dickey-Fuller test is chosen as a stationarity test that determines whether a time series is stationary or not. Formally, it tests the null hypothesis H_0 that your autoregressive model has a unit root. Therefore, if we seek stationarity (which is usually the case), we want to reject H_0 . Conducted ADF test on both “CPI compared to the same month of the previous year” and “CPI compared to the previous month” time series shows us that if we reject the H_0 hypothesis then the probability that we are mistaken correspondingly would be 55.9% and 8.3%. That is we could not definitely say “CPI compared to the same month of the previous year” time series is stationary process as opposed to “CPI compared to the previous month” time series. In other words, “CPI compared to the same month of the previous year” time series is AR(1) process⁵⁵⁸.

Core inflation estimation: A Kalman filter is used to solve the problem set previously that is to estimate core inflation. The general assumption that has been made here is that w_{k-1} and v_k – random variables that represent the process and measurement noise, are independent of each other, white and with normal probability distribution: $p(w) \sim N(0, Q)$, $p(v) \sim N(0, R)$, where Q and R are

⁵⁵⁸ Աֆյան Դ., ««Բնականոն գնաճի հաշվարկման առանձնահատկությունները Հայաստանի Հանրապետությունում», Տեղեկատվական տեխնոլոգիաներ և կառավարում, Издательство «Энциклопедия-Армения», Ереван 2007, С. 170-179.

process and measurement noise covariances. Talking about the performance of the proposed Kalman Filter model for core inflation estimation $RMSE$ is used as an appropriate metric:

$$RMSE = \sqrt{\frac{1}{n} \sum_{j=1}^n (y_j - \hat{y}_j)^2},$$

where y_j and $\hat{y}_j$ stand for actual⁵⁵⁹ and estimated core inflation. n represents the number of observations (here: routes) in dataset. $RMSE$ is the square root of the average of squared differences between prediction and actual observation. Here $RMSE$ of core inflation estimated by Kalman filter and the one calculated by CBA with “Seasonal Exclude & external shocks adjustment”(SEESA) method is on average 0.6, while $RMSE$ of core inflation estimated by Kalman filter and by the simple “Seasonal Exclude” method is on average 0.4.

In Fig 4 and Fig 5 are represented “CPI compared to the same month of the previous year” (shortly: “CPI Year”) and “CPI compared to the previous month” (shortly: “CPI Month”) time series that was filtered with Kalman filter (red dotted line in Fig 4 and Fig 5). According to above-mentioned efficiency criteria core inflation trend estimated with Kalman filter is at most matched to the actual inflation trend. For CPI Year process and measurement noise covariances are respectively $Q = 0.0081$ and $R = 0.3969$, while for CPI Month are respectively $Q = 0.0177$ and $R = 0.6304$.

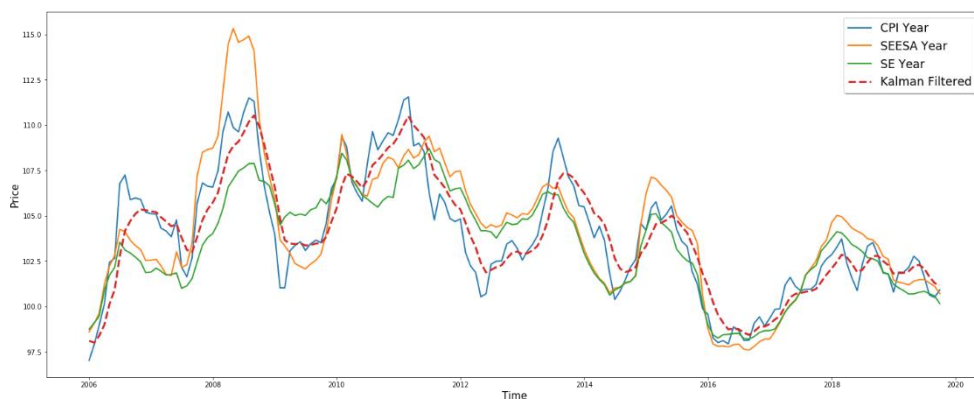


Fig 4. CPI compared to the same month of the previous year (CPI Year) and Core inflation trends: Core inflation is estimated with different methods – Seasonal Exclude & external shocks adjustment (SEESA Year), Simple Seasonal Exclude (SE Year), Kalman filter.

⁵⁵⁹ Here actual core inflation is considered the one that CBA officially published. In other words, core inflation that is calculated by “Seasonal exclude and external shocks adjustment” and simple “Seasonal exclude” methods are our actual data.

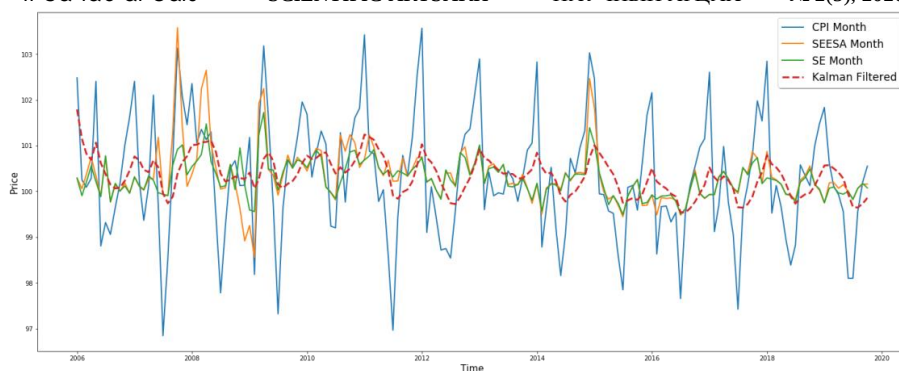


Fig 5. CPI compared to the previous month (CPI Month) and Core inflation trends: Core inflation is estimated with different methods – Seasonal Exclude & external shocks adjustment (SEESA Year), Simple Seasonal Exclude (SE Year), Kalman filter.

Also, the calculated indicator of core inflation should be closely correlated with monetary aggregates and interest rates. The correlations between core inflation estimated by Kalman filter and monetary aggregates are shown in Fig 6.

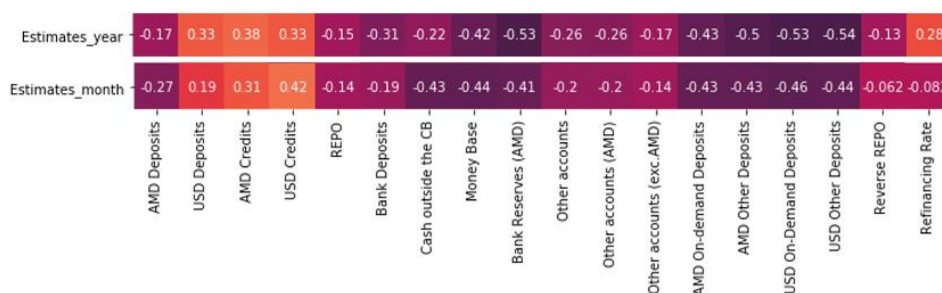


Fig 6. Correlation between monetary aggregates and Kalman filtered core inflation compared to the same month of the previous year (Estimates_year) and the previous month (Estimates_month).

As monetary aggregates here we used the most popular ones in RA. From the Fig 6 represented above we can see that the correlation between Kalman filtered core inflation (either compared to the same month of the previous year or compared to the previous month) is pretty correlated with the “Cash outside the CB”, “Money Base”, “Bank reserves (AMD)” and Deposits. If we compare the results of our Kalman filter model to the ones that CBA monthly calculated and officially published, we can see that our results are correlated with more monetary aggregates. In Fig 7 a correlation between the abovementioned monetary aggregates and CBA core inflation indicators is shown.

Conclusion: Here we represented Kalman filter technique to estimate the core inflation with the appropriate efficiency criteria and compare the results with the officially published core inflation which is calculated by “Seasonal exclude and external shocks adjustment” and simple “Seasonal exclude” methods. The chosen process and measurement noises helped us to construct models that are pretty close to the intuition of core inflation estimation. The average root mean square error of our models and the one that CBA monthly calculates and published is in range [0.4, 0.6]. Talking about the efficiency of the calculated core inflation indicator, it should be said that the Kalman filtered indicator of core inflation is closely correlated with monetary aggregates and interest rates and it's at most matched to the actual inflation trend. Comparison between Kalman filter and Simple Seasonal Exclude (SE Year) and Seasonal Exclude & external shocks adjustment

(SEESA Year) showed that Kalman filter is correlated with more monetary aggregates. The calculated indicator is understandable and, in our opinion, would be acceptable to the people. One of the main disadvantages of the model is that it hasn't some certain economic insight, although, when choosing the process and measurement noises, it should be done taking into account the economic aftereffects.



Fig 7. Correlation between monetary aggregates and core inflation estimated with Simple Seasonal Exclude (SE Year) and Seasonal Exclude & external shocks adjustment (SEESA Year).

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*Երևանի պետական համալսարանի տնտեսագիտության և կառավարման ֆակուլտետի մագիստրոս,
բ.Երևան, Հայաստանի Հանրապետություն*

ԴԱԿԻԹ ԶԱՐԱՄՅԱՆ

*Երևանի պետական համալսարանի տեղեկատվական տեխնոլոգիաների կրթական և հետազոտական կենտրոնի մագիստրոս,
բ.Երևան, Հայաստանի Հանրապետություն*

Տնտեսագիտության ժամանակակից տեսության հիմնարար դրույթներից մեկն այն է, որ տնտեսությունում գների կայունությունը երկարատև ժամանակահատվածում կայուն տնտեսական աճի ապահովման կարևոր նախադրյալ է: ՀՀ-ում, ինչպես նաև մի շարք այլ երկրներում Կենտրոնական բանկերի հիմնական խնդիրը գների կայունության ապահովումն է, և արդյունավետ դրամավարկային քաղաքականություն մշակելու և իրականացնելու նպատակով Կենտրոնական բանկերն իրենց վերլուծությունների ու մոդելների մեջ փաստացի գնաճի փոխարեն հաճախ կիրառում են բնականոն գնաճի ցուցանիշը:

Հոդվածում ներկայացնում ենք ՀՀ-ում բնականոն գնաճի գնահատումը 2006թ.-ից մինչև 2019թ.-ը՝ «Կալման»-ի ֆիլտրով:

Հոդվածի հիմնական նպատակն է ներկայացնել բնականոն գնաճի գնահատումը «Կալման»-ի ֆիլտրի միջոցով՝ համապատասխան արդյունավետության չափանիշները հաշվի առնելով, և արդյունքները համեմատել պաշտոնապես հրապարակված բնականոն գնաճի հետ, որը հաշվարկվում է «Seasonal exclude and external shocks adjustment» (SEESA) և «Seasonal exclude» (SE) մեթոդների միջոցով: Առաջարկվող մեթոդը գնահատվել է համապատասխան արդյունավետության չափանիշներով, իսկ ստացված արդյունքները համեմատվել են պաշտոնապես հրապարակված բնականոն գնաճի ցուցանիշների հետ: Գնահատված ցուցանիշը սերտորեն կապված է դրամական

Հոդվածը նպատակ ունի ցույց տալու, որ Կալմանի ֆիլտրացիան կարող է լավ
այլընտրանք լինել ՀՀ ԿԲ կողմից մշակված SE և SEESA մեթոդներին:

Հիմնաբառեր՝ ԿԲ, գների կայունություն, բնականոն գևաճ, State – Space
մոդելներ, Կալման ֆիլտր, SE, SEESA:

БАЗОВАЯ ИНФЛЯЦИЯ И МЕТОД СГЛАЖИВАНИЯ КАЛМАНА

ТИГРАН КАРАМЯН

*магистр факультета экономики и менеджмента
Ереванского государственного университета,
г.Ереван, Республика Армения*

ДАВИД КАРАМЯН

*магистр информационно-технологического и
образовательно-исследовательского центра
Ереванского государственного университета,
г.Ереван, Республика Армения*

Одним из фундаментальных принципов современной экономической теории считается то, что ценовая стабильность в экономике является важной предпосылкой устойчивого экономического роста в долгосрочной перспективе. В РА, а так же во многих других странах, главная задача центральных банков заключается в обеспечении стабильности цен, и в своих анализах и моделях для разработки и реализации эффективной денежно-кредитной политики центральные банки часто используют уровень базовой инфляции вместо реальной инфляции.

В данном исследовании мы представляем оценку базовой инфляции в РА с 2006 по 2019 годы с использованием фильтра Калмана. Основная цель этой статьи – представить оценку базовой инфляции с помощью фильтра Калмана с соответствующими критериями эффективности и сравнить результаты с официально опубликованными данными базовой инфляции, которая рассчитывается с помощью методов «Seasonal exclude and external shocks adjustment» (SEESA) и «Seasonal exclude» (SE). Предложенный метод был оценен посредством использования соответствующих критериев эффективности, а полученные результаты сопоставлены с официально опубликованными показателями базовой инфляции. Фильтрованный по Калману показатель базовой инфляции тесно связан с денежными агрегатами и процентными ставками и максимально соответствует фактическим тенденциям инфляции.

Цель статьи – показать, что фильтрация Калмана может быть хорошей альтернативой методам SE и SEESA, разработанным СБА.

Ключевые слова: ЦБА, стабильность цен, базовая инфляция, state – space- модели, фильтр Калмана, SE, SEESA.