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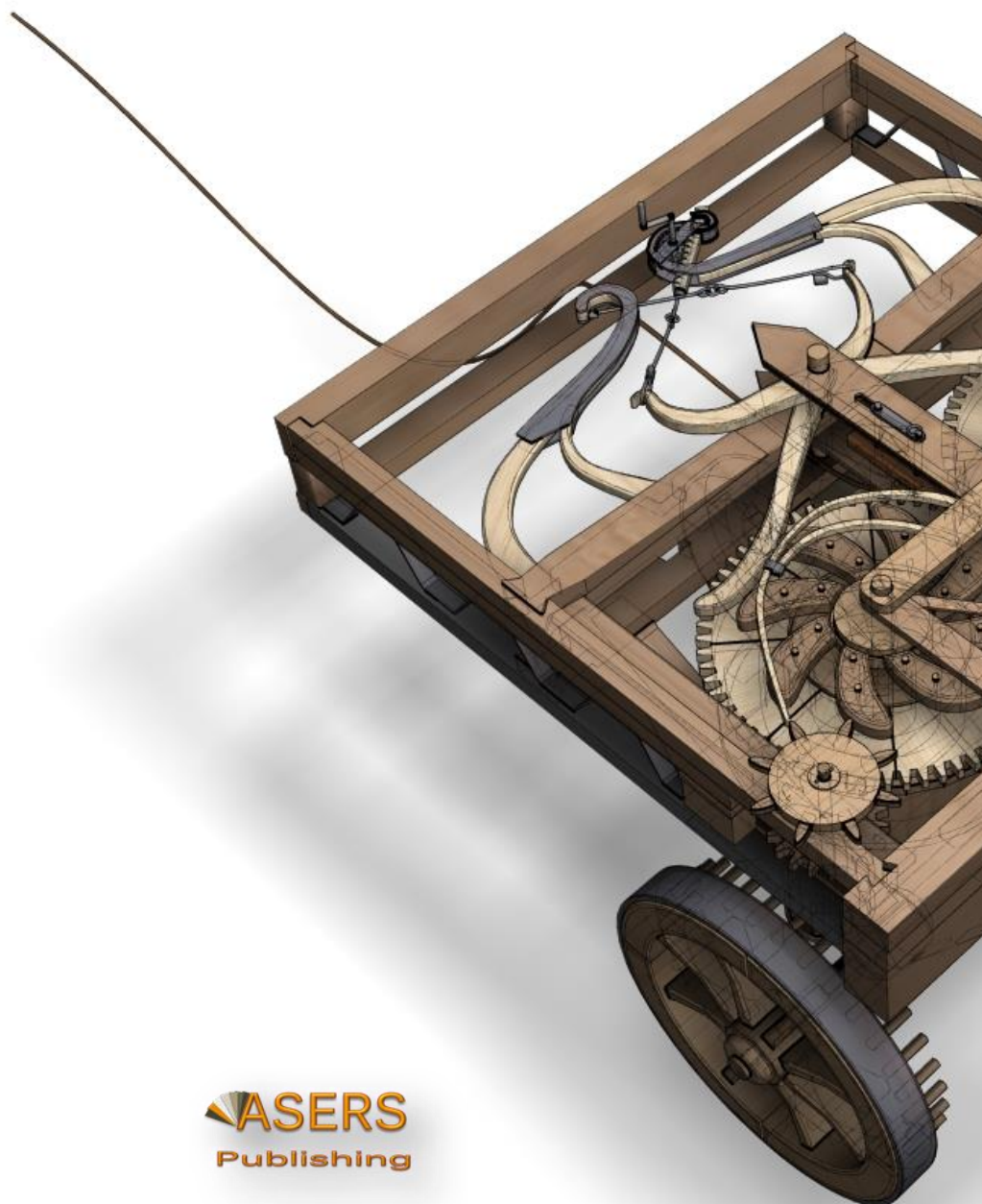
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AN EMPIRICAL STUDY OF FACTORS AFFECTING INFLATION IN REPUBLIC OF TAJIKISTAN

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Abstract:

This paper investigates the core factors affecting the price level in Republic of Tajikistan during 2005 to 2012 by using 'auto regressive distributed lags' and Johansen-Juselius co-integration models. The empirical analysis is based on a dataset of demand pull and cost push inflation indicators. Our findings revealed that in the long run, exchange rate, world wheat prices, world oil prices and labor supply Granger cause the price level. Nevertheless, in the short run, only world wheat price and labor supply has significant impact. In case of demand pull inflation, in the long run, GDP gap, remittances inflow, and real wages are endogenously determined in the system as they significantly affect the price level. But in the short run, GDP gap, remittances inflow, broad money, government expenditure and real wages Granger causes the price level.

Furthermore, there is a bi-directional Granger causality between GDP gap and remittances inflow. Also, real wage Granger causes the government expenditures. The GDP gap Granger causes the real wage, implying the scenario that a major cause of under production is the low level of employment. Finally the price level also Granger causes the real wage, is a reflection of a negative relationship between them.

Keywords: inflation, Tajikistan, cost push, demand pull, ARDL, co-integration.

JEL Classification: E31.

1. Introduction

Throughout the post-Soviet era the actual challenges to the socio-economic stance of Republic of Tajikistan was unstable towards inflation as many other transition economies. The economic backwardness in Tajikistan had recorded two hyperinflation events: the first one was in April'93–December'93 when cumulative inflation was about 3,635.7% and during August'95–December'95, it showed 839.2% (Fischer, Sahay, and Vegh, 2002).

Fundamentally, the main causes of chronological high inflation till 2000 were political turmoil, unhealthy economic conditions, high fiscal deficits, administrative prices and incomplete reconstruction of the state enterprises. In addition, hyperinflation in the economy of Tajikistan attributed non-reliance of population to the domestic currency, financial system and further development of the economy. The vague course policy during the transition time led socio economic chaos and speed up price level astronomically. Nevertheless, the stabilization and liberalization policies for the economic rehabilitation had not been strong enough to avoid hyperinflation during the period under consideration.

It declares constantly that inflation had been reduced from double digit to single but if one looks at the historical trend of inflation in Republic of Tajikistan, the situation is quite reverse, as Republic of Tajikistan enjoyed only short episodes of lower inflation level. Specially, the price level of tradable goods in comparison with the non-tradable goods was more volatile, and contributed to the rising headline inflation process (Figure 1).

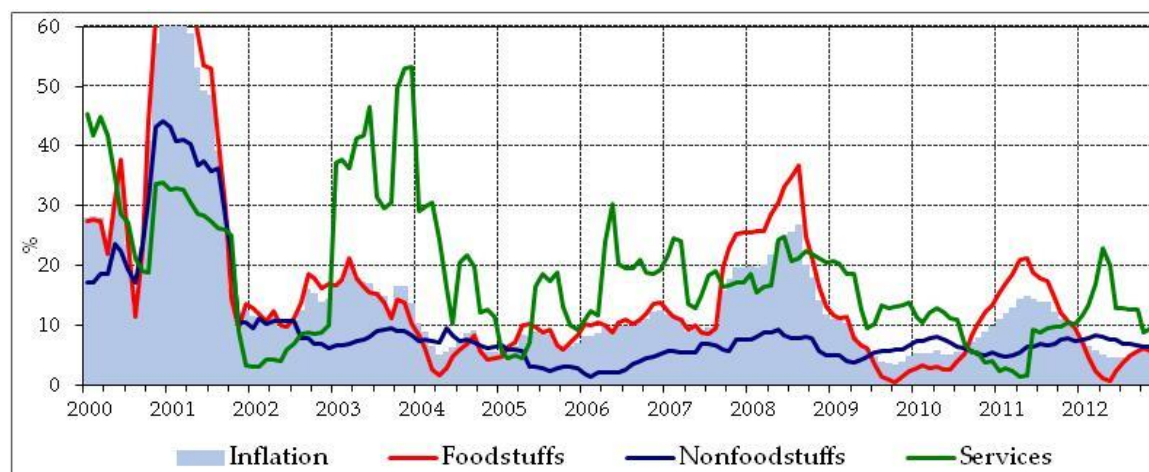


Figure 1. Fluctuation of Annual Inflation in the Republic of Tajikistan during 2000-2012. An increasing trend is significant during 2002-04 and slight decrease afterward

Source: (Author’s compilation of National Bank of Tajikistan’s data).

The volatility of inflation has exposed by the inertial supply and demand shocks. The fluctuations in World oil price have contributed a significant portion in the production costs both for food and non-food goods. It stimulates directly being a component of consumer basket for the measurement of inflation in the country. The prices of consumer goods push inflation upward because Wheat is a major item of Tajikistan’s import and major portion of the consumer’s basket consist food and energy items. It compounded 57.6% from which share of food products is 21.5% and energy 4.7% (Al-Eyd *et al.*, 2012). In addition, continues devaluation of domestic currency (Somoni) against the US dollar during the financial crisis was another factor for the sharp increase in the price level. Moreover, high remittance inflow gave an additional infusion to the behavior of consumers in the Tajik economy.

The tendency of evolution of inflation has some unfavorable internal and global economic conditions as shown in the following table (Table 1).

Table 1. Economic indicators of Tajikistan during 2005-2012

Indicators	Unit	2005	2006	2007	2008	2009	2010	2011	2012
GDP growth	(%)	6.7	7.0	7.8	7.9	3.9	6.5	7.4	7.5
State budget expenditure	(Million Somoni)	1403	1620	3475	5058	5643	6452	8254	9071
Budget (deficit) surplus	(Million Somoni)	12	38	221	282	(100)	101	242	525
Total labor resource	(Thousand People)	3893	4047	4210	4310	4435	4530	4664	4796
Employment	(Thousand People)	2112	2137	2150	2168	2219	2233	2249	2291
Trade (deficit) surplus	(Million USD)	(421)	(324)	(987)	(1863)	(1559)	(1463)	(1930)	(2419)
Exchange rate (average)	(Somoni / USD)	3.1166	3.2984	3.4425	3.4026	4.1427	4.3790	4.6102	4.7627
Broad money	(Million Somoni)	1027	1864	3327	3176	4275	5055	7131	8330

Source: (Author’s compilation on the data of Banking Statistics Bulletin).

The proven danger attached with the volatility inflation as it discourages saving, investment and absorption of purchasing power. The frequent movements in inflation create an unfavorable economic condition by deterioration of businesses as well as consumers' confidence. Similarly, unexpected variation in inflation level begets its magnitude to jump high. Natural, spontaneous inflation changes, replace domestic currency to foreign currency in the public and financial operations, which is one of the original reasons of high dollarization level in Tajikistan. Under volatile inflation process, credit provided by financial institutions have short term, and to depict form an upfront barrier of high nominal interest rate in Tajikistan.

The National Bank of Tajikistan could not adopt inflation targeting regime, but its priority objective is to curb the price stability for the long term. In this regards, the monetary authority prognosis the rate for ensuring years, but the gap between projected and actual inflation was high (Figure 2).

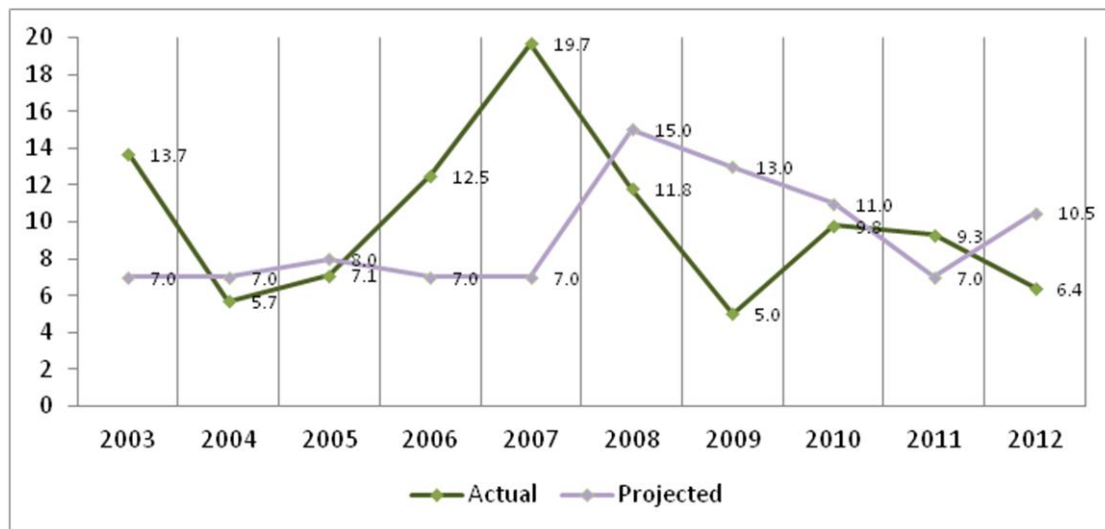


Figure 2. The Gap of actual and projected inflation during the period 2003-2012

Source: (Author's compilation on National Bank of Tajikistan's data).

The multidimensional approach analysis of the inflation process and its speed encourage judging the discretion of economic policies for smoothing volatility of inflation. The inflation in Republic of Tajikistan was exported by various factors so the evaluation of specific episodes of problem would be relatively reliable guidelines for central bank's decisions.

The principle idea of this research is to determine the factors affecting inflation in Republic of Tajikistan during 2005-2012, by applying 'auto regressive distributed lags' (ARDL) model on the basis of cost-push and demand-pull inflation concepts. This study signifies the issue for prompt attention to the analysts and policymakers in Republic of Tajikistan and it will be relatively easy to explain political and economic causes of inflation in Tajikistan. The relevance of this study aims at comparing with previous studies on the relevant subject. The analytical consistency with theoretical concepts of inflation in case of transition economies makes it quite valid. The empirical models are developed according to the indigenous features of the national economic phenomenon in Tajikistan.

This paper is organized as follows. Section 2 includes the literature review of various points raised by other researchers. Section 3 addresses on theoretical background of inflation with controversial views of different schools of thought. Section 4 is based on empirical framework, data description and significant findings. Section 5 represents our conclusions.

2. Literature review

The literature survey consists on previous studies on determinants of inflation in Tajikistan and other transition economies. The limited empirical literature and scanty of analysis on the macroeconomic issues of Tajikistan depend upon the lack of availability of historical data, non-argumentative and inconsistent results of the analysis in the transformation of economic system and structural reforms. In general, the bulky dispute of studies focuses on the approach of an interrelated monetary inflation process in Tajikistan.

Zavkiev (2005) investigated both short run behavior of inflation and long run relationship of prices with their determinants. In the long run, prices are determined by exchange rate, money supply, real-output and interest rates. While in the short run, money supply, GDP growth and interest rate significantly affect the price level. He estimated a model of inflation by the instrumentality of the Johansen co-integration approach and single equation error correction model. The coefficient of adjustment for price level to its long-run equilibrium was high and also, the elasticity of price with respect to exchange rate is the second dominant long run factor affecting the inflation in Tajikistan. Other significant variables, such as real GDP and interest rates are semi-elastic in his conclusions.

On the same grounds Tashrifov (2005) uses the structural Vector Autoregressive (VAR) model to get the dynamic responses of inflation and output with monetary and exchange rate innovations in the economy of Tajikistan for the period 1996 - 2003. The main difference between the short-run and long-run restrictions of his models is that in the short run monetary and exchange rate innovations have a greater impact on variation in inflation, while in the long run these policy innovations are more effective in enhancing growth. Thus, the NBT's monetary and exchange rate policies have contributed significantly in attaining low inflation and high real output of Tajikistan's transitional economy between 1998 and 2003. On the basis of analyses, he concludes that transitional developing economies can adopt monetary and exchange rate policies (in particular money supply, interest rate and nominal exchange rate to attain a low level of inflation.

Recently in the empirical study conducted by Alturki and Vtyrina (2010) demonstrates the significant impact of broad money growth in determining inflation in both the short and long terms in Tajikistan. The analysis also shows the strong impact of the exchange rate and international inflation on local prices. They attributed various transmission mechanisms: interest rate, exchange rate and narrow credit channel by applying the Vector Error Correction Model (VECM) and Autoregressive Moving Average Model (ARMA). Though, they encouraged the limited ability to control the inflation by the National Bank of Tajikistan, and fragile effectiveness of monetary instruments such as inefficient interest rate channels for exerting inflation rate.

On the other hand, National Bank of Tajikistan in many analytical reports on 'Inflation Surveys' during 2009 to 2012, illustrated that non-monetary factors put pressure on prices and core inflation a tendency of stability. As antecedent, the core inflation is not involved in administrative/ tariff increase and seasonal as well as external factors. It composed of the modest change of prices for production under the influence of supply and demand in the domestic market (National Bank of Tajikistan, 2012).

Theoretically, the sources of inflations' phenomena exposure basically by the cost push effects and result of oil or food shocks. After 2007-2008 (Global Financial Crisis) an upsurge in global food and oil prices transmitted into higher domestic food prices in developing economies specially those depends heavily on imports, that is why, sensitivity of global prices in determination of volatility in domestic inflation becomes more relevant. The impact of external factors is substantial as the global food prices push domestic inflation to raise in the developing countries because in the measurement of a basket of consumer's good the share/ weight of food is high. During 2011, the international Wheat prices rose about 99.6% but the domestic prices in Tajikistan increased only 30%-40% (Al-Eyd and Amaglobeli, 2012).

Al-Eyd *et al.* (2012) investigate the implications of high global food prices on the price level in Central Asian countries including Tajikistan and concludes that Tajikistan's economy shows some

significant short-run influence from the global commodity prices especially Wheat price shock. Their study based on (ARDL) model with seven lags and revealed that an increase in aggregate demand, nominal exchange rate depreciation, and global food prices have immediate convertibility on inflation. Moreover, there is an indication of weak institutional framework for monetary policy since monetary transmission appears limited at short horizons in this case. Similarly, the fiscal stance averted pressure on price. They recommend support price stability and guard against pro-cyclicality. A balanced approach is much needed to maintain the essential support to the vulnerable sectors of the society. Existing social safety nets should be employed to protect the most vulnerable groups from the pass-through of higher commodity prices.

Previous studies on inflation concerning with similar economic history, institutional structure and political conditions like Tajikistan allow us to shed light on the possible factors affecting to the upsurge inflation. As various factors revealed instability in price levels, a broad study on inflation with the virtue of multidimensional approach modeling are important for determining the disinflation tools.

After post communism period, shifting from administrative control to price liberalization system many transition economies faced a disease of hyperinflation due to bumpy and inconsistent policies. Nevertheless, the price stability still remains the absolute priority task of stabilization strategy, and some of the countries taking the inflation targeting framework as a satisfactory regime for lowering inflation performance and macroeconomic stability. On the other hand, the precondition economic stance makes irrepressible price volatility due to the exposure of external and internal shocks. In terms of economic specification, economic openness, institutional structure and financial development etc. provoke inflation inertia during the transitory period.

Adigozalov (2009) examines determinant of inflation in Azerbaijan during 2000-2009 by applying co integration modeling. The concept of the model targeted to capture external and internal factors of inflation such as broad money (M3), oil GDP and non-oil GDP, nominal effective exchange rate, credit and deposit rates. The empirical results show an appreciation of domestic currency has multiple effects on inflation. In addition, the elasticity of non-oil GDP is higher than the GDP of oil. Being an exporter of oil, Azerbaijan extract a boom in foreign asset inflow to the economy that affects to the exchange rate while domestic liquidity expansion reinforcing inflation process. The spillover effect of external factor, expressed as higher prices in trading partners and exchange rate depreciation, the lack of independent monetary policy with a combination of pegged exchange rate, contribute to inflation process in the long run. The short term inflation shock that exacerbated by supply side bottleneck manifested as production of long term determinants of inflation in Azerbaijan.

To investigate the impact of globalization and trade openness Meraj (2013) used ARDL approach within ECM-VAR framework and found a causal relationship between GDP and trade (exports and imports) and has positive impact of trade on economic growth in case of Least Developed Countries (LDCs). To study inflation in Georgia, Maliszewski (2003) uses the empirical analysis within the theoretical framework of aggregate demand and supply in three markets i.e. goods, exchange rate and money. He found a strong effect of exchange rate fluctuation on the price level, the behavior of money had also a significant effect in large lag period. The existing supply shocks in agriculture have a significant short-term impact, while import prices of oil have a relatively small impact on inflation. This scenario is common for dollarized and rapidly fluctuated demand for money in the transition economies. Accordingly, the economic history of a country's enduring hyperinflation provide serious challenges for price stabilization policy, considering that fact that general public remind the past event, and economy becomes very sensitive to external and internal shocks.

In the other research segments the variables on the basis of demand pull and cost push theories were driven a structural inflation function as an equilibrium error correction model (Leheyda, 2005). She used co-integration approach, which distinguishing the short-term and long-term effects and develop a general model that embeds with several hypotheses for inflation in Ukraine for the period 1997~2003. She found that in inflationary process the strong effect of exchange rate was in a lag of one month. The unit labor cost contributed in the short term inflation, money demand, purchasing power parity, foreign

prices and mark-up relationships are the factors for long-run upsurge in the price. The Granger causality between the wages and prices uni-directionally runs from the wages to the prices. He proposed the exchange rate transmission mechanism instead of using the other channels like interest rate for the price stability.

Ranaweera (2003) by using an error correlation approach investigated the impact of disequilibrium in domestic markets and external shock on inflation in Uzbekistan for 1994-2000. The Uzbek economy specified the wide gap between the official and market exchange rate, imbalance in foreign exchange market. Nevertheless, the disequilibrium in market is not driven by the prices but foreign exchange market had significant influence on it. The imbalance in the product and money market also caused the price level to go up.

The structural co-integrating VAR has modeled by Kim (2001) to analyze the impact of monetary, labor and external sector to the inflation in Poland during 1990-1999. He pointed out that the labor and external sector are appreciable in inflation pressure. However, after 1994 they have inversely effected. The appreciation of national currency (Zloty) constrained inflation, while a cost push effect has driven excessive wage stimulation. The monetary sector had passive influence to the price fluctuation. He observed that Poland being a transition economy had initially high inflation (about 580% per annum in 1990) but after the successful implementation of stabilization programs for the price stability, the inflation rate significantly declined.

Pahlavani and Rahimi (2009) conducted a study to find the determinants of inflation in Iran by applying ARDL model. Their empirical model is based on the special economic peculiarity which includes variables as GDP, expected inflation, liquidity, imported inflation and the dummy variable presenting the effect of Iran/Iraq war on Iran's economy. The time series data has used for a period of 1971 to 2006. Their results explain that the liquidity, exchange rate, expected inflation rate and the rate of imported inflation granger cause inflation in the Iranian economy. Similarly, the war with Iraq continuing eight years had an effect on the inflation rate in Iran. The expected inflation has the most significant impact on inflation being an endogenous to the system. It stipulates structural challenges, transaction cost, and a lack of exchange market. The second endogenous factor impacted on price level is excessive liquidity which invoked budget deficits. Moreover, another determinant of inflation is the instability of exchange rate, which appeared through unification policy.

In a comparative study of inflation in Bangladesh and India over a period of 1979 -2010, Paul and Zaman (2013) used 'auto regressive distributed lag' (ARDL) approach and found the dominance of monetary effects after counter adjustments of supply shocks. In addition to it, their study reveals that the inflation rate was rapidly rose whenever the money supply grew in Bangladesh than in India, implying the scenario of an inconsistent pattern of money supply from the central banks of both countries. The inflation differential between India and Bangladesh is mainly due to the significant differential in money supply. They also shed light on Friedman's hypothesis that primary factors which affect inflation are monetary factors. The supply shocks were not explicitly expressed in the upsurge of price. The significance level of economic indicators i.e. remittances, world inflation and exchange rate were not high. The estimation did not show the effects of the output gap to the price level in both countries. The dummy variables in the analysis applied to capture the financial crisis of 1990 in India and the fuel price shock in 2008.

Many transitions and developing countries have adopted inflation targeting (IT) framework, restrained money supply and practiced pegged exchange rate regime for the purpose of minimizing the price volatility. However, one of the serious obstacles is a vulnerability to the external and domestic shocks, and limited monetary policy framework to combat with inflation phenomenon. The economies experienced hyperinflation in their past history has structural problems such as independence and transparency of the central banks. Notwithstanding, in consideration with the advantages of IT, an enhanced credibility of the economic policy, weaken the impact of inflation expectation and socioeconomic stability. The developing countries like Armenia, Georgia, Moldova, Albania and Ghana use IT as the anchor of their economic strategy. Similarly, the building blocks of inflation targeting

improve inflation performance and have limited effects on trade-off between inflation and output. This point exhibits in the empirical study on the impact of IT to LIC by difference-in-difference and the propensity score matching approaches. The idea of this study is to define the behavior of economic indicators of inflation and real GDP. They test the inflation fluctuation and growth volatility before and after IT in 10 emerging markets and 29 less income countries who adopted the IT criteria. The results of their analysis revealed that in IT framework the inflation was less volatile, growth variability was not affected and there was very limited evidence of impact on economic growth (Gemayel, Jahan and Peter, 2011).

Worthwhile to note here that the economies who successfully achieved targeted inflation had antecedent macroeconomic stance such as healthy financial institution, developed financial markets, absence of fiscal dominance, independence of the central bank and effective working transmission mechanism. Another important element is existent technical infrastructure and methodology, including macroeconomic data for appropriate modeling, forecasting capability of monetary institute and forecasting ability of possible scenarios / determinant of inflation (Freedman and Ötoker-Robel, 2010).

For an empirical investigation and detailed understanding of the determinants of inflation, the next section covers the theoretical background and reviews of various schools of thought.

3. Theoretical framework

Various economic scholars and practical experiences have justified that inflation remains an actual problem for achieving socio-economic stability and long term economic development especially in transition economies. The restraint of inflationary pressure is the primary purpose of majority of the central banks.

Inflation is an inevitable property of any economy in the world. In fact, it is not a simple rising of the general price level but more complex natural economic phenomenon within a particular economic system. It is an indicator of a healthy economy and fall of the market value (Aurangzeb and Haq, 2012).

“The root of inflation is an endemic reaction of economic policies and diverse factors, and challenge in one of the direction of economy which interferes in price stability. To tackle the lack of consistency between fiscal, monetary and exchange rate policies, structural factors (such as the degree of capital mobility and the existence of wage and price inertia), credibility problems, and the stance of expectations regarding the policies” (Agenor and Montiel, 1999, p. 398). One of the shortcomings in macroeconomic policy is that it deteriorates the economic stability such as inflation volatility in the country. In this connection, investigation is useful in two strands together i.e. the effective policy and the theoretical statement. It is precious to note here that both strands are logical and clearly interlinked. Any stabilization policy should reflect the causal nexus associated with each particular evidential theory (Bastos, 2002).

The theoretical considerations formulated in terms of two aspects i.e. demand-pull and cost-push of inflation make a comprehensive and coherent summary of several explanations for the source of inflation in the short and long run. The controversies surrounding these two differentiated theories of inflation are based on the major debates of various orthodox competing schools of economics and their advocates. Notwithstanding, the stale concepts, they still keep actuality and widely used in empirical and theory implication by contemporary researchers.

Demand-Pull Approach: The traditional and most common type of inflation, generated by forced up inflationary pressures, driven through excess demand for goods and services made up the expression of components of aggregate demand. Initially the advocates of the classical school, Keynesian and Monetarist had devised the different principles to understand the demand pull inflationary process. According to the Keynesians, it is a result of income disturbances and shocks to the economy such as oil price increases or increase in other input factors. In contrast with, the Monetarists convince that it occurs because of excess aggregate demand and inappropriate monetary responses to the economic situations.

According to the Keynesian theory, the demand pull inflation can be interpreted as a positive relationship between inflation and output and negative with unemployment. Hence, an acceleration of employment results in increased aggregate demand, which leads to further hiring by the firms to meet the enhanced demand and to increase the output. But due to the capacity constraints increase in output will eventually become so small that the price of the goods will rise.

With general acceptance of demand pull mechanism is the Keynesian “inflation gap” model, which was originated by John Maynard Keynes (1940) and Arthur Smithies (1942). They explicitly indicate with special reference to the war effects. The integration of inflation pressure is neither the source of excess or “extra” demand nor any interest rate disequilibrium but the additional expenditure incurred by the governments. They posit that as the wages lag behind the prices inflation becomes a redistribution process for which some social class has to pay the income to fill the “inflationary gap”.

The Keynesians school of thought, virtues the occurrence of demand-pull inflation as the lack of production capacity during the phase of excess aggregate demand under the assumption of full capacity utilization or a mismatch in speed of adjustment. On contrary, the Classical economists look at the change of aggregate money supply which serves for the transaction as a source of inflation. They argue that the accelerating money supply grows faster than the ability of the economy to supply the appropriate goods and services. For Monetarists, inflation is exclusively a monetary phenomenon arises from excessive demand. The concept points out in a perfectly competitive economy and in the absence of other externalities, market forces operate through the price mechanism. An optimum allocation of resources is assured when market clearing prices prevail. The Monetarists convince that the money supply is a “dominant, though not exclusive” factor which affects prices in both short-run and in long-run, and output in short run only.

Cost-Push Approach: The higher production costs and productivity maximized, companies cannot maintain the profit margins by producing the same amounts of goods and services. Consequently, the increased costs pass on to the final consumers, causes a rise in the general price level. The long term cost-push effect revives stagflation in the economy. One of the factor which affect the input prices to jump up is the scarcity of raw materials, abrupt increase in world prices, including oil and fuel prices. It also occurs due to the vulnerability to the external economic shocks such as commodity price volatility in the world market and the exchange rate depreciation. The increase in production costs put an inflationary pressure on the shoulders of firms because to hire highly qualified labor force the firms need to increase the wages but successfully transfers this incidence of production cost to the consumers by raising their output prices.

When an economy approaches full employment the reserves of the unemployed gradually disappears which encourage the laborers and their representatives to demand an increase in their wages. In order to prevent this wage increase from eating into profits, employers subsequently raise their output prices and keep the mark-up intact. Eventually, the real wage brings down again to with higher food prices. A demand for real wage resistance leads to a wage-price spirals that propagate through the indexation mechanism. A supply-side shock sparks off a chronic inflation process in a fully employed economy. The depreciation of domestic currency could affect the price of imported goods such as foodstuff, raw materials and capital equipment especially in a small open economy considered to be a price-taker.

4. Empirical approach

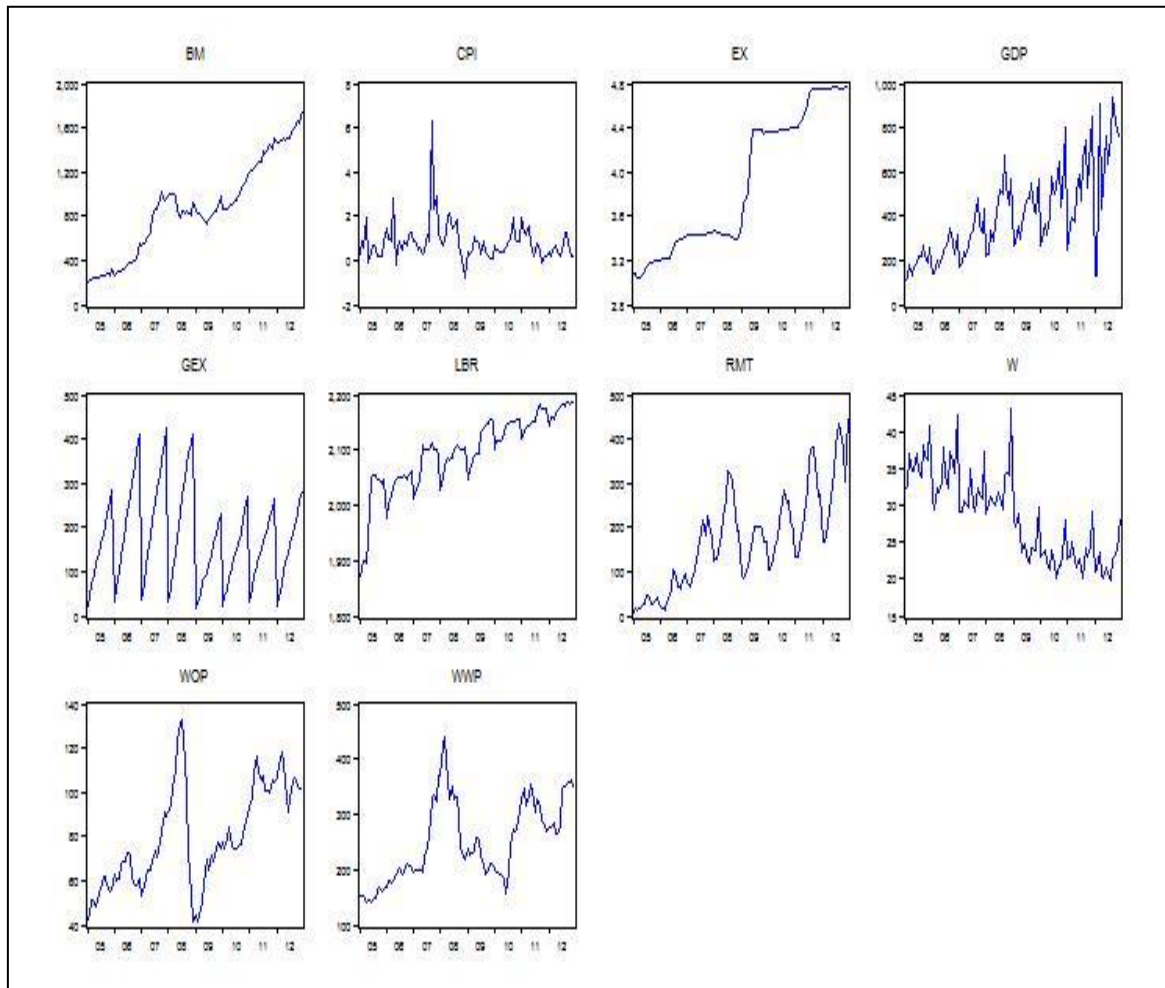
A huge amount of past studies with large scale models explore the conceptual correspondence and empirical estimates to get the structural factors affecting the inflation trend. In this context, a specific economic theoretical study consideration allows the elucidating selection of the variables, which are relevant to spell out inflation within the selected approach. Various quantitative analyses of inflation and complicated approaches have been developed on the basis of the global and domestic economy. Sims (1980) criticized strongly in his macroeconomic models selection and provided the following disadvantages:

- 1) The economic theory is not rich enough to provide a dynamic specification that identifies all of the underlying relationships, and
- 2) The estimation and inference is complicated because endogenous variables may appear on both sides of the equations, causing simultaneity problems. Thus, vector auto regression (VAR) models are the most favorable method for the macro econometric in practice.

4.1 The data

The data set used in this study is of secondary nature and has been collected from various sources like National Bank of Tajikistan and WDI of the World Bank. It is a monthly data related to the factors affecting the price level (both demand and supply side). The dataset comprises consumer price index (CPI), world oil price (WOP), broad money (BM), exchange rate (EX), remittance-inflow (RM), real wage (RW), gross domestic product gap (GDP), world wheat price (WWP), government expenditure (GEX) and economically active population (LBR). The period under consideration is from January'2005 to December'2012; all values are in million U.S dollar except CPI.

We transformed all data series into natural logarithm to get more precise results. Microsoft Excel and econometric software package E-Views have used for the compilation of the data. Figure 3 below shows the graphical trend of all indicators over time.



Source: (Author's estimation).

Figure 3. The graphical pattern of all variables used in this study (BM) represents broad money, (CPI) is consumer price index, (EX) is exchange rate, (GDP) represents output gap, (GEX) is government expenditure, (LBR) is a proxy for labor supplied and measured through economically

active population. While, (RMT), (W), (WOP) and (WWP) represent inflow remittances, real wage, world oil prices and world wheat prices respectively. Since all variables are trending over time, the likelihood of co-integration between them is very high

Table 2. The descriptive statistics of the variables used in this study

	BM	CPI	EX	GDP	GEX	LBR	RMT	W	WOP	WWP
Mean	869.11	0.83	3.90	402.21	174.41	2,095.39	171.48	28.44	79.45	250.23
Median	863.81	0.70	3.50	359.47	163.71	2,101.40	166.35	29.01	74.81	235.43
Max	1,747.63	6.30	4.77	932.68	423.88	2,188.00	451.09	43.13	132.55	439.72
Min	208.15	-0.80	3.04	116.26	18.48	1,871.90	9.45	19.79	41.53	140.88
Std. Dev.	424.04	0.84	0.62	201.97	105.38	69.13	111.18	5.83	22.70	72.81
Skewness	0.12	3.18	0.18	0.73	0.50	-1.11	0.49	0.35	0.30	0.41
Kurtosis	2.10	20.23	1.35	2.75	2.47	4.45	2.54	2.18	2.11	2.18
Jarque-Bera	3.44	1,349.36	11.43	8.69	5.16	28.03	4.68	4.67	4.62	5.38
Probability	0.18	0.00	0.00	0.01	0.08	0.00	0.10	0.10	0.10	0.07
Sum	83,434.53	79.31	374.07	38,612.16	16,743.02	201,157.10	16,462.44	2,729.76	7,627.35	24,022.34
Sum Sq. Dev.	17,082.036.0	67.5	36.7	3,875.254.0	1,055.011.0	453,997.2	1,174,210.0	3,232.6	48,947.3	503,679.7
Observations	96	96	96	96	96	96	96	96	96	96

Source: (Author's estimation).

4.2 The Models

To test the long run relationships between the indicators, one of the best methods in respect with the time series data is autoregressive distributed lag (ARDL) models. The co-integration analysis with ARDL may involve lagged values of the dependent variable, current and lagged values of one or more explanatory variables. This advantage of ARDL compares other regression models, in variables is to examine differing optimal number of lags and could be applied irrespective order of integration. The ARDL model has developed by Pesaran and Shin (1997) and further fine-tuned by Pesaran (2001).

Starting from the general form of auto regressive distributed lag is as below:

$$\Delta y_t = \beta_0 + \sum_{i=1}^n \beta_i \Delta y_{t-i} + \sum_{j=1}^m \gamma_j \Delta x_{t-j} + \psi ECT_{t-1} + \varepsilon_t \text{-----(1)}$$

As for this study we specify two different approaches i.e. one to capture the effects of the supply side determinants and the other to get the relationship of demand side factors with the price level. The ARDL is very convenient empirical tool for multidimensional diagnosis of the determinant catalyst of Tajik inflation with a various lags as well. The theoretical background guides in selection of endogenous of the models in two following approaches:

$$\Delta Lcpi_t = \gamma_0 + \sum_{i=1}^n \gamma_{1i} \Delta Lcpi_{t-i} + \sum_{i=1}^n \gamma_{2i} \Delta Lex_{t-i} + \sum_{i=1}^n \gamma_{3i} \Delta Lwwp_{t-i} + \sum_{i=1}^n \gamma_{4i} \Delta Lwop_{t-i} + \sum_{i=1}^n \gamma_{5i} \Delta Llbr_{t-i} + \alpha_1 Lcpi_{t-1} + \alpha_2 Lex_{t-1} + \alpha_3 Lwwp_{t-1} + \alpha_4 Lwop_{t-1} + \alpha_5 Llbr_{t-1} + \mu_t \text{------(2)}$$

With respect to referred proxy cost push effect, the combination of external supply shocks of global wheat prices (WWP), world oil price (WOP), and domestic factors like exchange rate (EX) and labor supply (LBR) are taken as regressors of through passed inflation in long and short terms. Tajikistan as an importer of wheat and oil remains very sensitive directly and indirectly through its effects on producer / wholesale price inflation to changes in global wheat and oil price. The exchange rate includes a possible capturing exogenous factor through a transmission channel of inflation.

Where Lcpi represents natural log of consumer price index, Lex is natural log of exchange rate, Lwwp is natural log of world wheat price, Llbr is a natural log of labor supply and Lwop is natural log of world oil price, while α and γ are parameters of estimation and μ is stochastic error term.

In proxy demand pulls an output gap (GDP), remittances (RM), real wages (RW) as consumer shock, government expenditure (GEX) and broad money (BM) as a possible monetary factor affecting to inflation rate are selected as endogenous of through passed inflation in the long and short period. The real wage basically has a spiral effect to demand and supply pressure on inflation. The remittances reviving demand pull of inflation.

To capture the demand side effects we specify the following model:

$$\Delta Lcpi_t = \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta Lcpi_{t-i} + \sum_{i=1}^n \beta_{2i} \Delta Lgdp_{t-i} + \sum_{i=1}^n \beta_{3i} \Delta Lrmt_{t-i} + \sum_{i=1}^n \beta_{4i} \Delta Lrw_{t-i} + \sum_{i=1}^n \beta_{5i} \Delta Lbm_{t-i} + \sum_{i=1}^n \beta_{6i} \Delta Lgex_{t-i} + \phi_1 Lcpi_{t-1} + \phi_2 Lgdp_{t-1} + \phi_3 Lrmt_{t-1} + \phi_4 Lrw_{t-1} + \phi_5 Lbm_{t-1} + \phi_6 Lgex_{t-1} + \varepsilon_t \text{----(3)}$$

Where Lcpi represents natural log of consumer price index, Lgdp is natural log of output gap, Lrmt is natural log of remittance, Lrw is natural log of real wage, Lgex is a natural log of government expenditure and Lbm is natural log of broad money, β and ϕ are parameters of estimation and ε is random disturbance term.

4.3 Testing for order of integration

As a first step we check the order of integration in all of our variables because stochastic disturbance followed by the series of a non-stationary series does not allow converging to their long run average value. Therewith, a specious result is returned when we apply regression on non-stationary series to another non-stationary series. In order to test and convert our variables into stationary we used Augmented Dickey-Fuller and Phillips-Perron unit root testing procedures to our variables.

Table 3. Unit Root Testing through two major testing methods i.e. Augmented Dickey-Fuller and Phillips-Perron

Variables	Augmented Dickey-Fuller				Phillips-Perron			
	At Level		Δ		At Level		Δ	
	Constant without Trend	Constant and Trend	Constant without Trend	Constant and Trend	Constant without Trend	Constant and Trend	Constant without Trend	Constant and Trend
Lbm	-1.812	-1.650	-10.380*	-10.529*	-1.792	-1.694	-10.377*	-10.500*
Lcpi	-4.099*	-4.414*	-9.853*	-9.867*	-4.125	-4.308	-11.761*	-12.623*
Lex	-1.178	-3.118	-3.185***	-3.177***	-0.670	-2.146	-5.311*	-5.289*
Lgdp	-2.835***	-0.942	-4.503*	-4.823*	-4.205*	-6.697*	-14.295*	-14.210*
Lgex ^a	-0.570	-1.789	-1.692	-1.619	-5.637*	-5.577*	-22.628*	-22.444*

Llbr	-3.252**	-4.741*	-3.166***	-3.149	-3.251**	-4.730*	-9.515*	-9.578*
Lrmt ^a	-2.175	-3.256	-1.969	-2.083	-2.546	-3.277**	-7.935*	-7.883*
Lrw ^a	-0.911	0.594	-2.406	-2.402	-2.869**	-6.290*	-17.284*	-17.199*
Lwop	-2.689***	-3.726**	-6.239*	-6.218*	-2.444	-2.923	-6.269*	-6.251*
Lwwp	-1.886	-2.263	-7.589*	-7.550*	-1.629	-1.998	-7.546*	-7.506*

Source: (Author's estimation).

^a: significant at 1% level after second differencing in ADF

*, **, *** show 1%, 5% and 10% level

Note: Unit Root Testing in above table show that all the variables are non-stationary and become stationary after first differencing except government expenditures, Remittances inflow and real wage which requires double differencing to make them stationary.

Both 'augmented Dickey-Fuller' (ADF) and 'Phillips-Perron' (PP) tests confirm that all the variables are integrated of order 1 except lgex, lrmt and lrw which are integrated of order 2. In order to make I(1) variables stationary, first differencing is appropriate and for I(2) variables double differencing is required.

4.4 Testing for Co-integration

4.4.1 Model for capturing the determinants of cost push inflation

4.4.1.1. Johansen-Juselius Technique

After getting confirmation about the integration characteristics of our variables, we proceed further, to test the co-integration between them. Two co-integration techniques have used in this study i.e. Johansen-Juselius (1990) and 'auto regressive distributed lag' (ARDL) developed by Pesaran-Smith (2001).

To test the co-integration between variables through Johansen-Juselius (1990) technique, it is required to establish a 'vector auto regression' (VAR) model, in order to identify the number of co-integrating vectors by trace and maximum Eigen value tests' statistics.

As a first step we identify the lag length in our VAR model through the specified criterion. 'likelihood ratio' (LR), 'final prediction error' (FPE), 'Akaike information criterion' (AIC), and 'Hannan-Quinn information criterion' (HQ) proposed two lags. Nevertheless, 'Schwarz information criterion' (SIC) suggests one lag. Initially we choose three lags on the basis of abovementioned criteria for the VAR model of this study. The trace test confirms that our time series is co-integrated (Table 4).

Table 4. Johansen Co-integration (Trace Test)

Hypothesized Co-integrating H ₀	No. of Relationships H ₁	Trace Statistic LR	5% Critical Value	1% Critical Value
r = 0	r > 0	126.131*	69.818	65.730
r ≤ 1	r > 1	65.491*	47.856	45.370
r ≤ 2	r > 2	23.703	29.797	28.80

Source: (Author's estimation); * indicates rejection of H₀ at 1% level. Likelihood ratio test (LR) confirms 2 co-integrating vector.

Table 5. Johansen Co-integration (Maximum Eigen Value Test)

Hypothesized Co-integrating H ₀	No. of Relationships H ₁	Max-Eigen Statistic	5% Critical Value	1% Critical Value
r = 0	r > 0	60.639*	30.31	35.60
r ≤ 1	r > 1	41.788*	23.97	28.65
r ≤ 2	r > 2	19.168	18.04	22.41

Source: (Author's estimation); * indicates rejection of H₀ at 1% level. Max-Eigen Value test indicates 2 co-integrating vectors.

4.4.1.2. Error Correction Term in Vector Auto Regressive Model

After applying Johansen-Juselius Co-integration test we are able to make error correction term which is as below:

$$LCPI = 0.0003*lex+0.0001*lwwp+0.006*lwop+0.0001*llbr$$

The likelihood ratio test confirms that all the regressors in this equation significantly Granger cause the price level. In addition to it, the labor supply and world wheat prices are endogenously determined while exchange rate and world oil price are exogenous to the system.

It also explains that if $LCPI > 0.0001*Lex + 0.0001*Lwwp + 0.006*Lwop + 0.0001*Llbr$, then the price level falls and exchange rate, world wheat price, world oil price and supply of the labor to rise to restore the equilibrium. In the price level each month 58.83% of the discrepancy from the long run equilibrium is corrected.

4.4.1.3. Auto Regressive Distributed Lags (ARDL)

As a first step we check the co-integration between variables by using the 'auto regressive distributed lag' (ARDL) model.

$$\Delta Lcpi_t = \gamma_0 + \sum_{i=1}^n \gamma_{1i} \Delta Lcpi_{t-i} + \sum_{i=1}^n \gamma_{2i} \Delta Lex_{t-i} + \sum_{i=1}^n \gamma_{3i} \Delta Lwwp_{t-i} + \sum_{i=1}^n \gamma_{4i} \Delta Lwop_{t-i} + \sum_{i=1}^n \gamma_{5i} \Delta Llbr_{t-i} + \alpha_1 Lcpi_{t-1} + \alpha_2 Lex_{t-1} + \alpha_3 Lwwp_{t-1} + \alpha_4 Lwop_{t-1} + \alpha_5 Llbr_{t-1} + \mu_t \text{ ----- (4)}$$

From equation (2) we establish the following mode:

If $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 0$ then it signifies that there is no co-integration among the variables.

Table 6. ARDL Co-integration Testing

F TEST VALUE = 5.68	P-value (0.0001)	
CRITICAL VALUE	I(0)	I(1)
5%	2.86	4.01
10%	2.45	3.52
Critical values from table C1-iii of Pesaran <i>et al.</i> (2001)		

The Johansen-Juselius test confirms 2 co-integration vectors in our equation which also confirms by the ARDL test. It rejects the null hypothesis of 'no co-integration' between variables as the estimated F-value lies outside the upper bound of the critical values.

4.4.1.4. Granger Causality in ARDL

After getting the confirmation of co-integration we proceed further and test the Granger causality in our model variables. The empirical results are as below:

Table 7. Granger Causality in ARDL (Likelihood Ratio Test)

Variable	Δ Lcpi	Δ Lex	Δ Lwwp	Δ Lwop	Δ Llbr
Lags Δ Lcpi	1.289(0.287)	0.082(0.969)	0.071(0.974)	1.314(0.277)	0.499(0.684)
Lags Δ Lex	0.386(0.764)	2.106(0.108)	0.775(0.512)	2.003(0.122)	0.221(0.881)
Lags Δ Lwwp	2.894(0.042)	0.629(0.599)	2.566(0.062)	1.001(0.298)	1.051(0.374)
Lags Δ Lwop	0.292(0.831)	0.020(0.996)	0.731(0.537)	3.958(0.012)	0.589(0.624)
Lags Δ Llbr	2.911(0.042)	0.757(0.522)	0.274(0.843)	1.605(0.197)	0.021(0.995)
ECT _{t-1}	2.543(0.055)	0.582(0.661)	-0.013(0.937)	-0.216(0.141)	0.013(0.485)

Note: () indicate p-values of F-statistics and p-values for student t-statistics in case of ECT.

Source: (Author's estimation).

4.4.1.5 Empirical results

To test the factors affecting the price level through the supply side cost push effects by using two econometric approaches i.e. Johansen-Juselius and Auto Regressive Distributed Lags (ARDL). The empirical results of this study are not reflected that in the long run all the right hand side variables Granger cause the price level. Nevertheless, in the short run world wheat price and labor supply Granger cause the price level significantly. This imply the fact that in the case of Tajikistan the world wheat price has gigantic influence because it secondarily affect the domestic wheat price which is a major candidate in the calculation of consumer price index. Secondly, the supply of labor has a huge role in the price level as the rural-urban migration disintegrates the equilibrium in the labor market. Theoretically speaking shortage of labor affects the factor price in the short run and possibly influence the general price level which is also confirms by the Granger causality test of this study.

4.4.2 Model for capturing the determinants of demand Pull inflation

4.4.2.1. Johansen-Juselius Co-integration

We have already established the order of integration between the variables used to capture the demand pull effects. We proceed further by using the equation-3 for the empirical analysis by following the same pattern we used to get the cost push inflation determinants.

We formulate a VAR and used the lag length as specified by the information criteria. All the information criterions i.e. 'likelihood ratio' (LR), 'final prediction error' (FPE), 'Akaike information criterion' (AIC), 'Hannan-Quinn' (HQ) and 'Schwarz information criterion' (SIC) suggest eight lags are appropriate for this VAR. Consequently, we choose eight lags on the basis of abovementioned criteria.

In addition to it we check the appropriation of lag length by using the lag exclusion test to and found all lags are significant so we could not exclude any lag in the VAR.

Table 8. Johansen Co-integration (Trace Test)

Hypothesized Co-integrating H ₀	No. of Relationships H ₁	Trace Statistic LR	5% Critical Value	1% Critical Value
r ≤ 1	r > 1	255.83*	82.18	90.83
r ≤ 2	r > 2	153.04*	58.57	65.73
r ≤ 3	r > 3	79.05*	39.04	45.37
r ≤ 4	r > 4	34.79*	23.37	28.80
r ≤ 5	r > 5	15.41	11.55	15.78

Source: (Author’s estimation); **Note:** * indicates rejection of H₀ at 1% level. Likelihood ratio test (LR) confirms 4 co-integrating vectors

Table 9. Johansen Co-integration (Maximum Eigen Value Test)

Hypothesized Co-integrating H ₀	No. of Relationships H ₁	Max-Eigen Statistic	5% Critical Value	1% Critical Value
r ≤ 1	r > 1	102.79*	36.65	42.05
r ≤ 2	r > 2	73.99*	30.31	35.60
r ≤ 3	r > 3	44.25*	23.97	28.65
r ≤ 4	r > 4	19.37	18.04	22.41
r ≤ 5	r > 5	15.02	11.55	15.78

Source: (Author’s estimation); **Note:** * indicates rejection of H₀ at 1% level. Max-Eigen Value test indicates 3 co-integrating vectors.

4.4.2.2. Granger Causality in Johansen-Juselius Model

We established our error correction term after normalization of variables to get the Granger causality in ECM-VAR in Johansen-Juselius model. The empirical results shown inconsistent pattern as in the short run we could not get any conclusive evidence of Granger causality in our demand pull inflation equation. We further check our results by using ARDL for demand pull effects.

4.4.2.3. Auto Regressive Distributed Lags (ARDL)

We iterate the same procedure which we used in our cost push model for the specification of auto regressive distributed lags (ARDL). Following the equation (3) for the testing of the Granger causality:

$$(3) \implies \Delta Lcpi_t = \beta_0 + \sum_{i=1}^n \beta_{1i} \Delta Lcpi_{t-i} + \sum_{i=1}^n \beta_{2i} \Delta Lgdp_{t-i} + \sum_{i=1}^n \beta_{3i} \Delta Lrmt_{t-i} + \sum_{i=1}^n \beta_{4i} \Delta Lrw_{t-i} + \sum_{i=1}^n \beta_{5i} \Delta Lbm_{t-i} + \sum_{i=1}^n \beta_{6i} \Delta Lgex_{t-i} + \phi_1 Lcpi_{t-1} + \phi_2 Lgdp_{t-1} + \phi_3 Lrmt_{t-1} + \phi_4 Lrw_{t-1} + \phi_5 Lbm_{t-1} + \phi_6 Lgex_{t-1} + \varepsilon_t$$

If $\phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = \phi_6 = 0$ then it signifies that there is no co-integration among the variables.

Table 10. ARDL Co-integration Testing

F TEST VALUE = 2.805		P-value (0.1174)	
CRITICAL VALUE		I(0)	I(1)
5%		2.62	3.79
10%		2.26	3.35
Critical values from table C1-iii Pesaran <i>et al.</i> (2001)			

F/Wald Test of zero restriction.

Source: (Author's estimation).

The empirical results could not establish the co-integration in ARDL as the estimated F-value lies in inconclusive region. Though, we proceed further and check our error correction model to get the idea about co-integration between the variables.

4.4.2.4 Granger Causality in ARDL

After getting the confirmation of co-integration we proceed further and test the Granger causality in our model variables. The empirical results are as below:

Table 11. Granger Causality in ARDL

Variable	$\Delta Lcpi$	$\Delta Lgdp$	$\Delta Lrmt$	ΔLbm	$\Delta Lgex$	ΔLrw
Lags $\Delta Lcpi$	1.228(0.315)	1.061(0.411)	0.293(0.963)	0.746(0.650)	1.967(0.080)	1.920(0.080)
Lags $\Delta Lgdp$	9.877(0.000)	7.436(0.000)	4.540(0.008)	0.543(0.656)	1.869(0.152)	3.784(0.018)
Lags $\Delta Lrmt$	6.715(0.000)	2.141(0.072)	3.912(0.004)	0.596(0.703)	1.427(0.231)	0.583(0.743)
Lags ΔLbm	6.697(0.003)	0.781(0.465)	0.390(0.679)	0.164(0.849)	0.249(0.780)	0.131(0.877)
Lags $\Delta Lgex$	12.879(0.001)	1.755(0.193)	0.122(0.728)	0.483(0.491)	0.144(0.706)	0.0005(0.982)
Lags ΔLrw	5.506(0.025)	0.135(0.714)	0.924(0.342)	0.016(0.899)	18.813(0.000)	0.356(0.554)
ECT _{t-1}	0.870(0.000)	-0.866(0.000)	-0.370(0.016)	0.011(0.781)	0.103(0.743)	-0.279(0.000)

Source: (Author's estimation).

Note: () indicates p-values of F-statistics and p-values for student t-statistics in case of ECT Likelihood Ratio Test.

Conclusions

Over a few years inflation remains a big problem for the economy of Republic of Tajikistan so that this study investigates the prime factors affecting the price level by using the econometric techniques namely 'auto regressive distributed lags' (ARDL) and Johansen-Juselius co-integration within the VAR framework. We used the dataset which comprises the demand pull and cost push inflation indicators. We used monthly data for a period of 2005 to 2012 for Granger causality tests to know the exact impact of demand and supply side factors to the price level.

To test the factors affecting the price level through the supply side cost push, our empirical results suggest that in the long run exchange rate, world wheat prices, world oil prices and labor supply are endogenously determined in the system as their error correction terms are significant except broad money and government expenditures. Nevertheless, in the short run world wheat price and labor supply Granger cause the price level significantly. This implies the fact that in the case of Tajikistan the world wheat price has gigantic influence because it secondarily affect the domestic wheat price which is a major candidate in the calculation of consumer price index. Secondly, the supply of labor has a huge role in the price level as the rural-urban migration disintegrates the equilibrium in the labor market. The shortage of labor affect the factor prices in the short run and possibly influence the general price level which also confirms the Granger causality in their relationship.

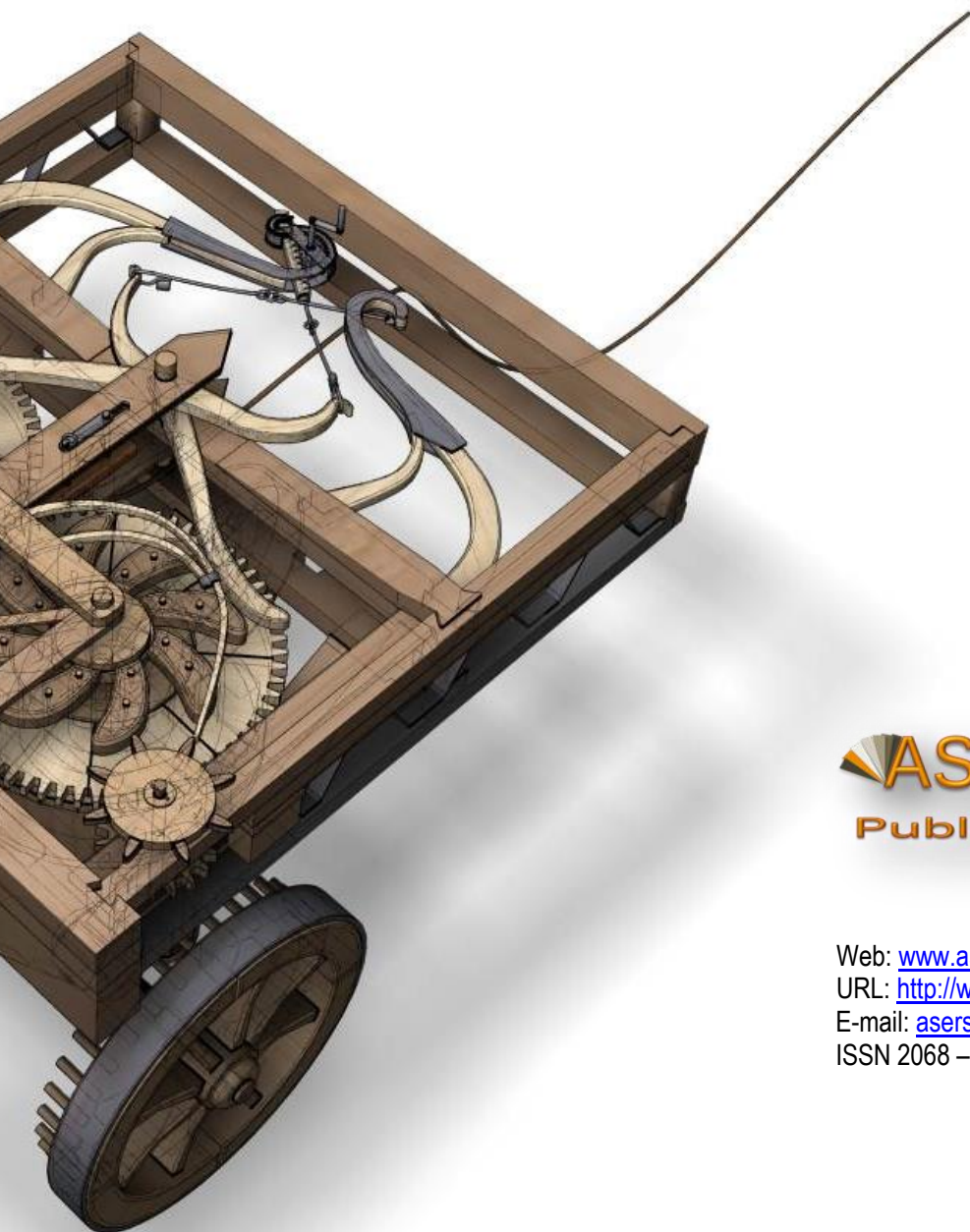
For Demand side determinants of inflation, our results are quite consistent and suggest that in the long run, GDP gap, remittances inflow, and real wages are endogenously determined in the system as they significantly affect the price level. But in the short run, GDP gap, remittances inflow, broad money, government expenditure and real wages Granger causes the price level. Furthermore, there is a bi-directional Granger causality between GDP gap and remittances inflow. Also, real wage Granger causes the government expenditures implying more fiscal burden on government. The GDP gap Granger causes the real wage, implying the scenario that a major cause of under production is the low level of employment. Finally the price level also Granger causes the real wage, is a reflection of a negative relationship between them.

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