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# “MOLIYAVIY TEXNOLOGIYALAR” ILMIY ELEKTRON JURNALI TAHRIRIYAT KENGASHI RAISI

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**MUNDARIJA**

1.	Шаисламова Наргиза Кабиловна	Тижорат банклари рискларини баҳолашда стресс-тест усулидан самарали фойдаланиш	7
2.	Ashurova Nargiza Chori qizi	O‘zbekiston turizm xizmatlari bozorida gastronomik turizmi rivojlantirishning asosiy yo‘nalishlari	19
3.	Mamatqulov Avazbek Axmadaliyevich	Oliy ta‘lim muassasalarida ichki audit tizimini raqamlashtirish mexanizimini takomillashtirish	24
4.	Sobirov Otabek Olimjonovich	Boshqaruv hisobini tashkil etishning konseptual asoslari	36
5.	Rustamov Maqsud Suvonqulovich, Boqiyeva Zuhra Soxibjon qizi	Iqlim o‘zgarishining iqtisodiyotga ta’siri	41
6.	Xalimov Shaxboz Xalimovich	Qishloq joylarida turizm xizmatlarini rivojlantirishning xorij tajribalari	48
7.	Kenjayev Ikrom Ergashboyevich	Hududlarda investitsiya mexanizmlarini takomillashtirishning institutsional va moliyaviy omillari	53
8.	Rustamov Maqsud Suvonqulovich, Normatov Muslimbek No‘rbo‘ta o‘g‘li	Kredit riski	60
9.	Курбонов Саид Акбарович	АҚШ федерал резерв тизими (ФРТ) ва унинг иктисодиётга таъсири	67
10.	Bekmurodova Feruza Azamat kizi, Kadambaeva Charos Masharip kizi	Economic cooperation practices and development trends in Middle Eastern countries	73
11.	Mardonova Malika Asatilloevna	Xavfsiz turizm tushunchasining nazariy-uslubiy asoslari	80
12.	Alimov Baxodir Batirovich	Rivojlangan sug‘urta kompaniyalarining moliyaviy holati va samaradorlik ko‘rsatkichlari tahlili	85
13.	Narziyev Abror Baxtiyorovich	Moliyaviy bozorlardagi volatillik dinamikasining GARCH modellari asosida empirik tahlili	95
14.	Xoldorova Kamola Jamoliddin qizi, Murodova Dilnoza Choriyevna	O‘zbekistonda tijorat banklarini transformatsiya qilishning dolzarb masalalari	106
15.	Юсупов Бехзод Юсуп угли	Финтех-ориентированная модель комплексной оценки кредитоспособности корпоративных клиентов и её влияние на эффективность банковских решений	112
16.	Ташбаева Рано Гайбуллаевна, Ташбаев Улугбек Ванситович	Цифровая оценка конкурентоспособности предприятий HoReCa на основе Open Data и онлайн-платформ (на примере г. Ташкента)	120
17.	Баракаев Отабек Отакулович	Ўзбекистонда аудиторлик хизматлар бозорининг 2020-2025 йилларга тахлили ва уни такомиллаштириш йўналишлари	127
18.	Muradov Botir Hayat	Yevropa iqtisodiyotining yashil transformatsiyasida iqlim o‘zgarishi bilan bog‘liq fizik va moliyaviy risklar tahlili	140
19.	Isroiljonov Murodil Qosimjon ugli	Household Consumption, Imports, and Gross Capital Formation in Uzbekistan: Evidence from an ARDL Model	148
20.	Чориева Нигина Қахрамановна	Классик иктисолий назариялар асосида тадбиркорлик субъектларининг экспорт салоҳиятидан фойдаланиш самарадорлигини ошириш хусусиятлари	155





21.	Chintemirova Diyora Shuxrat qizi	Hududlar kesimida kichik biznes va xususiy tadbirkorlik faoliyatining rivojlanish tendensiyalari	160
22.	Artikov Ne'matulla Abdusalamovich	Soliqli daromadlar oshishida sheringning iqtisodiy imkoniyatlari	166
23.	Кузиева Динора Баходировна	Узоқ муддатли активларни баҳолаш тартибини такомиллаштириш	173
24.	Умарова Гулзодахон Қодирбековна	Кичик бизнесни муқобил молиялаштиришнинг илғор хорижий тажрибалари	181
25.	Murtozayeva Zarnigor Komol qizi	Tashabbusli budget mablag'larini ijtimoiy ehtiyojlar asosida manzilli taqsimlash mexanizmlarini takomillashtirish	187
26.	Baytanov O'ralboy Miraqul o'g'li	Sanoat korxonalarida mahsulot sifatini boshqarishning zamonaviy metodologik yondashuvlari	193
27.	Mardonov Akromjon Nusrat ogli	The impact of fiscal policy on the national economy	201
28.	Ostonaqulov Dilshod Ismatilla o'g'li	O'zbekiston respublikasining aholi hayot sifati va iqtisodiy o'sish o'rtasidagi bog'liqlikni statistik baholash	206
29.	Babaxanova Nozima Saidakbarovna	Milliy fond bozorida aksiyalarni ommaviy joylashtirish mexanizmlarini transformatsiya qilish yo'llari	213
30.	Tilabov Nasrulla Tashmuratovich	O'zbekistonda davlat qarz portfelini risk-diyagnostika asosida boshqarish metodologiyasini takomillashtirish	220
31.	Rahmonova Durdona Hasan kizi	Effective management of investment opportunities and regional economic diversification: evidence from the kashkadarya region	226
32.	Xamdamov Omonullo Ne'matullayevich	Kapital bozorida moliyaviy resurslar jalb qilishning xalqaro amaliyot tajribalari	233
33.	Achilov Dilshod Marufovich	Innovatsion faoliyatning moliyaviy ta'minot manbalari va ularni samarali boshqarish yo'llari	244
34.	Baratova Zumrat Xalmetjanovna	Innovatsion faoliyat bilan bog'liq moliyaviy risklarni boshqarish	253
35.	Mavlyanova Yulduzxon Turg'unovna	Moliyaviy resurslarni samarali boshqarishda ERP (Enterprise Resource Planning) mexanizmidan foydalanish istiqbollari	261
36.	Ishniyazov Otabek Baxodirovich	Bank faoliyatida risklarning turlari, ularni samarali boshqarish	268
37.	Baxriddinov Kamoliddin Baxriddin o'g'li	Aksiyadorlik jamiyatlarida investitsiyaviy qaror qabul qilish amaliyotining tahlili	275
38.	Qudratova Feruza Nasriddinovna	Financing decisions and value creation in an emerging economy: Evidence from the capital structure of Uzauto Motors	283
39.	Xasanov Komil Mutalibjanovich	Chiqindilarni boshqarishda yevropa ittifoqi tajribasi va uni o'zbekiston sharoitida qo'llash	591
40.	Orzukulova Zumrad Abdukhalik kizi, Azimova Nozimakhon Alisher kizi	Strategic brand management: review of keller's brand equity model and Aaker's brand identity system	297
41.	Ollokulova Feruza Mansurovna	Davlat xususiy sheriklik rivojlanishining xorij tajribasi va undan O'zbekiston amaliyotida foydalanish imkoniyatlari	302
42.	Umurzakova Dildora Sultonmaxmudovna	Raqamli iqtisodiyot sharoitida ayollar bandligiga doir muammolarning asosiy yo'nalishlari	310
43.	Jo'rayeva Zarifa Bahodir qizi	Tijorat banklarida kredit xizmatlari amaliyotining dolzarb masalalari	317





44.	Tureev Azizbek Abatovich	Qoraqalpog‘iston Respublikasida mevachilik tarmog‘ini klasterlashning iqtisodiy samaradorligini baholash	324
45.	Mirzataev Muratbaevich	Salamat Ekologik muammolar sharoitida qishloq xo‘jaligi barqarorligini ta‘minlashda smart texnologiyalardan foydalanishning ilmiy-uslubiy asoslari	329
46.	Komekova Gulzira Sharbaevna	Raqamlashtirilgan logistika tizimlari asosida sabzavotchilik mahsulotlari bozorining samaradorligini oshirish yo‘llari	335
47.	Qidirmiyazov Sherniyazovich	Ajiniyaz Qoraqalpog‘iston Respublikasida qurilish sohasining rivojlanish holati va sun‘iy intelkt asosida xizmat kursatishni rivojlantirish istiqbollari	340
48.	Розиков Жалил Жалолович	Вопросы реформирование бухгалтерского учета в сельском хозяйстве	346
49.	Karimov Gapardjonovich	Eminjon Sanoat korxonalarida moliyaviy tahlil axborot tizimini takomillashtirish masalalari	351
50.	Toshev Nurbek Janon o‘g‘li	Qashqadaryo viloyatida turizm samaradorligi indeksi (TEI) asosida mintaqaviy turizm rivojlanishi dinamikasini baholash	359
51.	Kurbonova Malika Akhmad kizi	Comprehensive methodology for assessing the effectiveness of digital economy technology implementation in regional economic development	365
52.	Isakova Naima Ikromjonovna	Xizmat ko‘rsatish korxonalarida turizmni rivojlantirish uchun strategik marketing dasturini ishlab chiqish va uni takomillashtirish yo‘llari	371
53.	Sultanova Nigora Xikmatxo‘ja qizi	Xarajatlar hisobida ABC va BSC tizimlari integrativ tahlili	377
54.	Muminova Parvina Ilhom qizi	Bank majburiyatlari hisobi va ichki auditini takomillashtirish	383
55.	Abduraxmonova Alimov Baxodirovich	Munisa, Ulug‘bek Raqamli iqtisodiyot sharoitida xizmat ko‘rsatish korxonalarida biznesni rivojlantirish tamoyillari va bosqichlari	389
56.	Axmedov Shoymurod Azamat o‘g‘li	Tijorat banklarida investitsiya loyihalarini moliyalashtirish samaradorligini takomillashtirish yo‘llari	395
57.	Xamdamov Komilovich	Shavkat Aholini ijtimoiy himoyalash moliyaviy mexanizmi samaradorligini baholashning nazariy-metodologik asoslari	402
58.	Ruziyev G‘anisher Usarovich	Soliqlar vositasida tadbirkorlikni rivojlantirish va bandlikni ta‘minlash orqali daromadlarni oshirish hamda kambag‘allikni qisqartirish masalalari	411
59.	Atamuratova Muzafarovna	Gulrux Kichik biznes tizimlarining iqtisodiy mohiyati va ularni modellashtirish bo‘yicha zamonaviy xorij tajribasi	419
60.	Mirzayeva Charos G‘ayrat qizi	Savdo va xorijiy investitsiyalarning iqtisodiy o‘shisdagi o‘rni: Janubiy Koreya va O‘zbekiston misolida qiyosiy ekonometrik tahlil	424
61.	Toshpulatov Akromovich	Davron Islom moliyasida risklarni boshqarish	437
62.	Amir Xudaykulov	Moliyaviy hisobotning xalqaro standartlariga muvofiq EBITda indikatorini hisobga olishning o‘ziga xos xususiyatlari	451





## HOUSEHOLD CONSUMPTION, IMPORTS, AND GROSS CAPITAL FORMATION IN UZBEKISTAN: EVIDENCE FROM AN ARDL MODEL

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**Abstract:** *Gross capital formation plays an important role in economic growth and productive expansion in developing economies. This study examines the relationship between gross capital formation, household consumption expenditure, and imports of goods and services in Uzbekistan using quarterly data from 2016Q1 to 2025Q4. The study employs the Autoregressive Distributed Lag (ARDL) approach together with the Augmented Dickey–Fuller (ADF) unit root test and bounds cointegration test. The empirical results indicate that household consumption expenditure and imports have positive and statistically significant effects on gross capital formation in the long run.*

**Keywords:** *Gross capital formation, household consumption expenditure, imports, ARDL model, Uzbekistan.*

## ПОТРЕБЛЕНИЕ ДОМОХОЗЯЙСТВ, ИМПОРТ И ВАЛОВОЕ КАПИТАЛООБРАЗОВАНИЕ В УЗБЕКИСТАНЕ: ДАННЫЕ МОДЕЛИ ARDL

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**Аннотация:** *Валовое капиталоеобразование играет важную роль в экономическом росте и производственной экспансии в развивающихся странах. В данном исследовании изучается взаимосвязь между валовым капиталоеобразованием, потребительскими расходами домохозяйств и импортом товаров и услуг в Узбекистане с использованием квартальных данных за период с 1 квартала 2016 года по 4 квартал 2025 года. В исследовании используется подход авторегрессионной модели с распределенными лагами (ARDL) в сочетании с расширенным тестом Дики-Фуллера (ADF) на единичный корень и тестом коинтеграции границ. Эмпирические результаты показывают, что потребительские расходы домохозяйств и импорт оказывают положительное и статистически значимое влияние на валовое накопление капитала в долгосрочной перспективе.*

**Ключевые слова:** *Валовое накопление капитала, потребительские расходы домохозяйств, импорт, модель ARDL, Узбекистан.*

## O‘ZBEKISTONDA UY XO‘JALIKLARI ISTE‘MOLI, IMPORT VA YALPI KAPITAL SHAKLLANISHI: ARDL MODELIDAN DALILLAR

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*Annatsiya. Yalpi kapital shakllanishi rivojlanayotgan iqtisodiyotlarda iqtisodiy o'sish va ishlab chiqarishni kengaytirishda muhim rol o'ynaydi. Ushbu tadqiqotda 2016-yil 1-choragidan 2025-yil 4-choragigacha bo'lgan choraklik ma'lumotlardan foydalangan holda O'zbekistonda yalpi kapital shakllanishi, uy xo'jaliklari iste'mol xarajatlari va tovarlar va xizmatlar importi o'rtasidagi bog'liqlik o'rganiladi. Tadqiqotda kengaytirilgan Dickey-Fuller (ADF) birlik ildiz testi va chegaralar kointegratsiyasi testi bilan birgalikda avtoregressiv taqsimlangan kechikish (ARDL) yondashuvi qo'llaniladi. Empirik natijalar shuni ko'rsatadiki, uy xo'jaliklari iste'mol xarajatlari va importi uzoq muddatda yalpi kapital shakllanishiga ijobiy va statistik jihatdan sezilarli ta'sir ko'rsatadi.*

*Kalit so'zlar: Yalpi kapital shakllanishi, uy xo'jaliklarining iste'mol xarajatlari, import, ARDL modeli, O'zbekiston.*

## Introduction

Gross capital formation is an important indicator of economic growth and productive expansion in developing economies. Higher levels of investment contribute to increased production capacity, infrastructure development, and industrial growth. Therefore, understanding the factors affecting investment activity is important for effective economic policymaking. In Uzbekistan, gross capital formation is influenced by domestic demand conditions and external trade-related factors. Household consumption expenditure may stimulate investment by increasing aggregate demand, while imports of goods and services may support investment activity through the supply of machinery, equipment, and intermediate production inputs. Although many studies have examined the determinants of investment in developing countries, empirical evidence for Uzbekistan remains limited, particularly using quarterly macroeconomic data and modern time-series econometric methods. In addition, the relationship between household consumption, imports, and gross capital formation in Uzbekistan has not been sufficiently explored in the existing literature. This study examines the relationship between gross capital formation, household consumption expenditure, and imports of goods and services in Uzbekistan using quarterly data from 2016Q1 to 2025Q4. The study employs the Autoregressive Distributed Lag (ARDL) approach to investigate the long-run relationship and equilibrium adjustment process among the variables.

## Literature Review

The relationship between household consumption, imports, and gross capital formation has become one of the central topics in macroeconomic research, particularly in emerging and transition economies. Recent studies emphasize that household consumption acts as a key driver of aggregate demand and economic expansion, while imports and investment influence production capacity, technological modernization, and long-term growth trajectories. In the case of Uzbekistan, economic liberalization and increasing integration into international markets have intensified interest in understanding these macroeconomic interactions through econometric approaches such as the Autoregressive Distributed Lag (ARDL) model.

Several scholars have examined the role of household consumption in stimulating economic growth and domestic demand. According to Mankiw, consumption expenditures remain the largest component of GDP and significantly determine macroeconomic stability in developing economies [1]. Similarly, Keynesian theory highlights that increases in household income lead to higher marginal propensity to consume, thereby supporting investment and production growth [2]. Recent empirical evidence confirms that consumption-led growth models are particularly relevant for transition economies where domestic demand constitutes a substantial share of economic activity [3].

Imports also play a critical role in economic development by providing access to foreign technology, intermediate goods, and capital equipment. However, excessive import dependence





may weaken domestic production and worsen trade balances. Krugman and Obstfeld argue that imports contribute positively to productivity when economies utilize imported capital and technology efficiently [4]. In Central Asian economies, including Uzbekistan, trade liberalization reforms have increased import volumes, especially for machinery and industrial inputs necessary for modernization [5]. Empirical studies further suggest that imports and domestic consumption are closely interconnected, as rising consumer demand often increases dependence on imported goods [6].

Gross capital formation is widely recognized as a fundamental determinant of long-term economic growth and structural transformation. Solow’s growth framework emphasizes capital accumulation as a major factor influencing productivity and output expansion [7]. Recent research on developing countries indicates that investment in infrastructure, industrial production, and technological innovation strengthens macroeconomic sustainability and employment generation [8]. In the context of Uzbekistan, economic reforms aimed at improving the investment climate have stimulated growth in fixed capital formation, particularly in manufacturing, energy, and transportation sectors [9].

Methodologically, the ARDL model has become one of the most preferred econometric approaches for analyzing long-run and short-run relationships among macroeconomic variables. Pesaran et al. developed the ARDL bounds testing approach, which is suitable for small sample sizes and variables integrated at different orders [3]. Recent studies applying ARDL models to transition economies demonstrate its effectiveness in identifying equilibrium relationships between consumption, imports, investment, and economic growth indicators. Therefore, applying the ARDL framework to Uzbekistan provides an opportunity to evaluate both dynamic and equilibrium interactions among household consumption, imports, and gross capital formation.

In addition, diagnostic and stability tests are conducted to evaluate the reliability, consistency, and overall validity of the estimated model results.

## Results

This section presents the empirical findings of the study. The analysis begins with descriptive statistics and unit root testing, followed by ARDL estimation, bounds cointegration testing, and diagnostic analysis. The results are interpreted in the context of gross capital formation dynamics in Uzbekistan.

### Descriptive Statistics

The descriptive statistics of the variables used in the study are presented in Table 2. The analysis is based on 40 quarterly observations covering the period from 2016Q1 to 2025Q4. All variables are expressed in natural logarithmic form.

Table 2.

**Descriptive Statistics of Variables**

Variable	Obs	Mean	Std. Dev.	Min	Max
$\ln Y$	40	10.800	0.813	9.126	12.032
$\ln X1$	40	11.583	0.630	10.321	12.740
$\ln X2$	40	10.820	0.937	8.927	12.048

The mean value of the logarithm of gross capital formation is 10.800, while household consumption expenditure and imports of goods and services have mean values of 11.583 and 10.820, respectively. Among the explanatory variables, imports exhibit relatively higher variability, as indicated by the standard deviation of 0.937. This suggests that imports experienced greater fluctuations during the sample period compared to household consumption expenditure. Overall, the descriptive statistics indicate sufficient variation in the variables, making them suitable for time-series econometric analysis.





### Unit Root Tests

Before estimating the ARDL model, the stationarity properties of the variables were examined using the Augmented Dickey–Fuller (ADF) unit root test. The tests were conducted at levels with a deterministic trend and at first differences without a trend. The purpose of the unit root analysis was to determine the order of integration of the variables and verify the suitability of the ARDL methodology. The results of the ADF tests are presented in Table 3.

Table 3.

**Augmented Dickey–Fuller Unit Root Test Results**

Variable	Model Specification	Lag Length	Test Statistic	p-value	Conclusion
lnY	Level with trend	4	-2.010	0.5962	Non-stationary
lnX1	Level with trend	4	-2.967	0.1415	Non-stationary
lnX2	Level with trend	4	-2.761	0.2118	Non-stationary
$\Delta \ln Y$	First difference without trend	2	-7.444	0.0000	Stationary
$\Delta \ln X1$	First difference without trend	2	-16.591	0.0000	Stationary
$\Delta \ln X2$	First difference without trend	2	-3.297	0.0150	Stationary

The ADF tests at levels with deterministic trends and four lags indicate that all variables are non-stationary in levels because the null hypothesis of a unit root cannot be rejected at conventional significance levels. However, after first differencing with two lags and without trend, all variables become stationary. Therefore, all variables are integrated of order one,  $I(1)$ . Since none of the variables are integrated of order two, the ARDL bounds testing approach is appropriate for the empirical analysis.

### ARDL Estimation Results

After confirming that all variables are integrated of order one, the ARDL model was estimated to examine the relationship between gross capital formation, household consumption expenditure, and imports of goods and services in Uzbekistan. The optimal lag structure was selected using the Akaike Information Criterion (AIC), with a maximum of two lags imposed on each variable. The selected specification was ARDL(1,0,0) which produced the minimum AIC value of -33.317. Preliminary estimations revealed severe multicollinearity between exports and imports. Therefore, exports of goods and services were excluded from the final specification in order to improve model stability and coefficient reliability. The estimated ARDL results are presented in Table 4.

Table 4.

**ARDL Estimation Results**

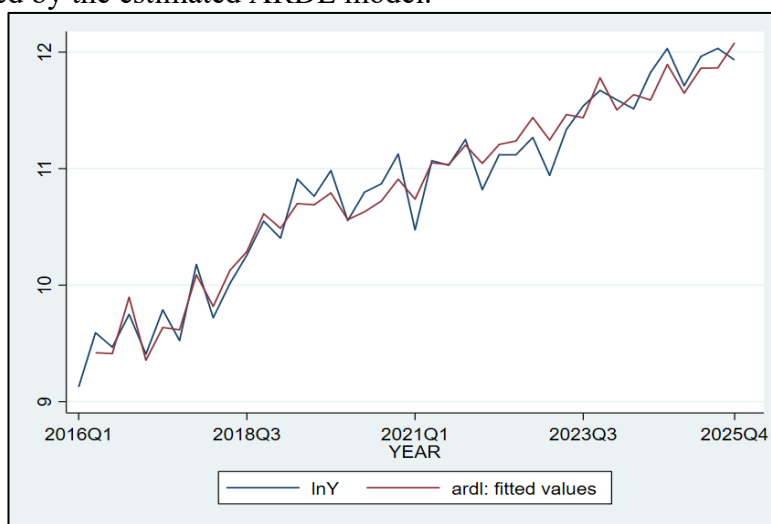
Variable	Coefficient	Std. Error	t-Statistic	p-value
lnX1	0.619	0.109	5.70	0.000
lnX2	0.462	0.073	6.32	0.000
$ECM_{t-1}$	-0.995	0.095	-10.47	0.000
Constant	-1.366	0.578	-2.36	0.024

The results indicate that household consumption expenditure and imports of goods and services have positive and statistically significant effects on gross capital formation in the long run. A 1% increase in household consumption expenditure is associated with approximately a





0.62% increase in gross capital formation, while a 1% increase in imports is associated with approximately a 0.46% increase in gross capital formation. The error correction coefficient is negative and statistically significant, confirming the existence of a stable long-run equilibrium relationship among the variables. The estimated coefficient of -0.995 indicates a rapid adjustment toward long-run equilibrium following short-run deviations. The selected ARDL(1,0,0) specification does not include statistically significant short-run differenced terms. Therefore, the estimated model primarily captures the long-run relationship among the variables, while short-run adjustments are reflected through the error correction mechanism. Figure 1 presents the actual and fitted values generated by the estimated ARDL model.



**Figure 1. Actual and Fitted Values of Gross Capital Formation**

The fitted values closely track the actual series throughout the sample period, indicating a strong overall model fit and satisfactory explanatory performance.

**Bounds Cointegration Test**

The existence of a long-run relationship among the variables was examined using the Pesaran, Shin, and Smith (2001) bounds cointegration test. The results are presented in Table 5.

Table 5.

**ARDL Bounds Cointegration Test Results**

Test Statistic	Value
F-statistic	42.970
t-statistic	-10.467

Critical Values	I(0) Lower Bound	I(1) Upper Bound
10%	3.360	4.379
5%	4.128	5.271
1%	5.931	7.336

The calculated F-statistic substantially exceeds the upper critical bound values at the 1%, 5%, and 10% significance levels. Similarly, the calculated t-statistic is more negative than the upper critical bound values. Therefore, the null hypothesis of no long-run relationship is rejected, confirming the existence of cointegration among gross capital formation, household consumption expenditure, and imports of goods and services. The bounds test results support the existence of a stable long-run equilibrium relationship among the variables included in the ARDL model.

**Diagnostic and Stability Tests**

To evaluate the reliability of the estimated ARDL model, several diagnostic and stability tests were conducted. These tests examined the presence of serial correlation, heteroskedasticity,





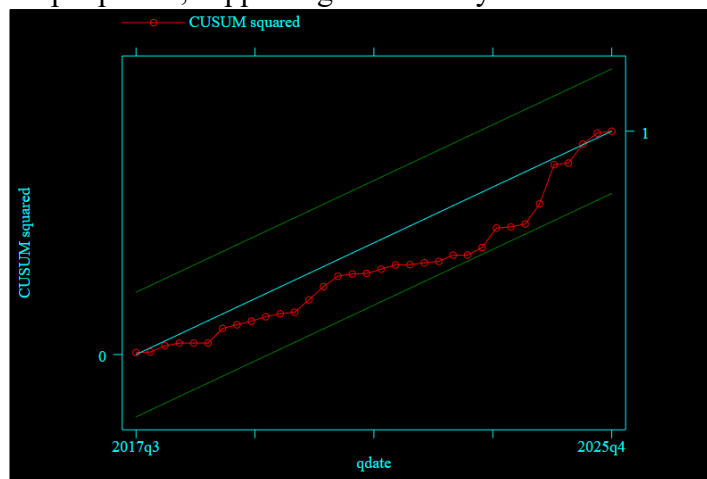
residual normality, and parameter stability. The results are summarized in Table 6.

Table 6.

**Diagnostic and Stability Test Results**

Test	Null Hypothesis	p-value / Result	Conclusion
Breusch–Godfrey LM Test	No serial correlation	0.3660	No serial correlation
Breusch–Pagan Test	Homoskedasticity	0.6437	No heteroskedasticity
Skewness/Kurtosis Test	Residuals are normally distributed	0.1853	Residuals are normally distributed
CUSUM of Squares Test	Parameter stability	Within critical bounds	Stable model

The Breusch–Godfrey LM test provides no evidence of serial correlation in the residuals, indicating that the lag structure of the model is adequately specified. The Breusch–Pagan test indicates constant error variance, suggesting the absence of heteroskedasticity. The skewness and kurtosis test indicates that the residuals are approximately normally distributed. Furthermore, the CUSUM of Squares stability test shows that the recursive residuals remain within the critical bounds throughout the sample period, supporting the stability of the estimated coefficients.



**Figure 2. CUSUM of Squares Stability Test**

Overall, the diagnostic results do not indicate serious violations of the major econometric assumptions, supporting the reliability and stability of the estimated ARDL model.

**Discussion**

The empirical findings indicate that household consumption expenditure and imports of goods and services are important determinants of gross capital formation in Uzbekistan during the period 2016Q1–2025Q4. The ARDL results show that a 1% increase in household consumption expenditure is associated with approximately a 0.619% increase in gross capital formation, while a 1% increase in imports is associated with approximately a 0.462% increase in gross capital formation in the long run. The positive effect of household consumption expenditure suggests that stronger domestic demand encourages firms to expand productive capacity and increase investment activity. Similarly, the positive relationship between imports and gross capital formation reflects the importance of imported machinery, industrial equipment, and intermediate goods in supporting investment and industrial development. The bounds cointegration test confirmed the existence of a stable long-run relationship among the variables. In addition, the negative and statistically significant error correction coefficient indicates a strong adjustment toward long-run equilibrium following short-run deviations. Although the estimated ARDL(1,0,0)





specification does not reveal strong short-run dynamic effects, the error correction mechanism suggests that temporary disequilibrium gradually converges toward the long-run path over time. Overall, the diagnostic and stability tests support the reliability of the estimated ARDL model, and the findings suggest that strengthening domestic demand and supporting productive imports may contribute positively to investment growth in Uzbekistan.

This study examined the relationship between gross capital formation, household consumption expenditure, and imports of goods and services in Uzbekistan using quarterly data from 2016Q1 to 2025Q4 and the ARDL approach. The empirical results showed that household consumption expenditure and imports have positive and statistically significant effects on gross capital formation in the long run. The estimated coefficients indicate that a 1% increase in household consumption expenditure increases gross capital formation by approximately 0.619%, while a 1% increase in imports increases gross capital formation by approximately 0.462%. The bounds cointegration test confirmed the existence of a stable long-run relationship among the variables, while the negative and statistically significant error correction coefficient indicated that short-run deviations adjust toward long-run equilibrium over time. Furthermore, the diagnostic and stability tests revealed no serious econometric problems, suggesting that the estimated ARDL model is reliable and stable. Overall, the findings suggest that strengthening domestic demand and supporting productive imports may contribute positively to investment growth in Uzbekistan.

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