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Injection and Leakage Shocks in the Macroeconomy: A Factor-Augmented SVAR Analysis of Output and Employment in Bangladesh

Mohammad Masud Alam*
Mohammed Anwar Hossain Bhuyan**
Apu Chandra Das***

Abstract

This paper examines the output and employment effects of two aggregate demand shocks, namely injections and leakage shocks, in Bangladesh. Motivated by the Keynesian injections–leakages framework in the circular flow of national income, the study estimates injection and leakage factors using Principal Component Analysis and identifies shocks in a sign-restricted structural vector autoregression over the period 1980–2023. The impulse response functions show that injection shocks raise output and employment, while leakage shocks have larger and more persistent effects over the 10-year horizon. For both shocks, the effects tend to revert to the steady-state lines over the periods, although a dominant medium-term trend is evident. Additionally, forecast error variance decomposition consistently supports the findings from impulse responses, showing that leakage shocks explain a larger portion of fluctuations in both GDP growth and employment than injection shocks. In aggregate demand-side policy management, the findings suggest that the primary drivers of macroeconomic fluctuations in Bangladesh are leakage factors. In contrast, the effectiveness of expanding aggregate demand through injections and the fiscal multiplier is subject to structural adjustments.

Keywords: *Aggregate Demand Shocks · Injections and Leakages · Output and Employment Dynamics · Structural VAR · Bangladesh Economy*

JEL Classification Codes: *E12 · E32 · C32 · O11 · J23*

Introduction

This paper focuses on an aggregate demand-side issue: how GDP growth and employment are affected by fluctuations in the injection and leakage factors,

* Professor, Department of Economics, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh; Email: masudalam-eco@sust.edu, ORCID ID: https://orcid.org/0000-0003-1262-6943

** Student, MBA, Jahangirnagar University, AVP (Credit, CRM-3), The Premier Bank PLC, Dhaka, Bangladesh

*** MSS Student, Department of Economics, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh. Email: apud0896@gmail.com. ORCID: 0009-0005-1761-8653

with investment, government spending, and exports on the injection side, and savings, taxes, and imports on the leakage side. The primary motivation comes from Keynesian macroeconomic theory, where the circular flow of national income framework shows how an economy's output and employment can change with changes in injections and leakage forces (Keynes, 1936; Mankiw, 2019). The aggregate demand-centered macroeconomic policy of the injections-leakages framework is widely discussed in theoretical macroeconomics, but empirical studies of developing economies such as Bangladesh remain limited. In Bangladesh, we observed that rapid economic growth, accelerated by expansionary fiscal policies, has also been accompanied by adverse macroeconomic shocks arising from leakage factors. We focus on the dynamics and interaction between injection and leakage factors and ask to what extent changes in injection-driven expansion versus leakage-induced constraints drive growth fluctuations.

In this study, we aim to address this question by constructing composite indicators for injection and leakage factors. We employ PCA for dimensionality reduction and examine the macroeconomic effects of these factors using a sign-restricted structural VAR (SVAR). The SVAR approach allows us to identify and compare the dynamic effects of injection and leakage shocks on output and employment.

Building upon the traditional Keynesian circular flow model, this study enhances the injections–leakages framework by integrating contemporary macroeconomic variables. On the injections side, factors such as financial development, remittance inflows, and the accumulation of human capital increase the usefulness of investments and imports, thereby enhancing aggregate demand. On the leakage side, exchange rate volatility and macroeconomic uncertainty increase income withdrawals by augmenting imports, boosting precautionary savings, and increasing fiscal burdens.

The significance of this work is that it centers around the composition and quality of aggregate demand rather than individual macroeconomic drivers. Most of the existing empirical studies focus on growth and treat them as separate variables, such as capital formation, trade openness, or inflation, but do not distinguish explicitly whether they are expansionary or contractionary forces within a unified framework. Although structural vector autoregression (VAR) models (Sims, 1980) are now standard tools for analyzing macroeconomic dynamics and sign-restriction approaches have allowed for obtaining much more informative structural identification (Uhlig, 2005; Mountford & Uhlig, 2009), all of this literature misses a direct connection to the Keynesian injections–leakages mechanism. Consequently, the balance of power between expansionary versus contractionary demand-side forces has been less discussed, especially in developing country settings.

This study offers three main contributions to fill this gap. First, it operationalizes the Keynesian injections–leakages framework by creating composite indices of injection and leakage factors through principal component analysis (PCA), which allows for summarizing the joint dynamics of several macroeconomic variables without imposing arbitrary weights (Stock & Watson, 2002). Second, it inserts these into a sign-restricted VAR framework, such that shocks with the correct signs are consistent with injection and leakage shocks under the theory. Third, it provides new empirical findings on the dynamic impact and relative significance of such shocks in Bangladesh during 1980–2023, thus contributing to both empirical macroeconomics and development policy analysis.

We use principal component analysis (PCA) to derive two latent factors, injections and leakages, based on the underlying variables (investment, government expenditure, exports, remittances as injections; savings, taxes, and imports variables as leakages). These variables are then included in a sign-restricted structural VAR model to examine the dynamic effects. The factor-augmented methodology allows us to condense high-dimensional macroeconomic information, and the sign-restriction approach permits a theoretically founded way to identify structural shocks without imposing many restrictive contemporaneous ordering assumptions (Bernanke et al., 2005; Uhlig, 2005).

We summarize our key findings as follows. For the 10-year horizon, our estimated impulse response functions (IRFs) show that injection shocks lead to positive, instantaneous changes in output and employment, consistent with the Keynesian multiplier process. However, the effects are temporary, although persistent, and return to equilibrium over time as aggregate demand and supply adjust towards their equilibrium levels. Leakage shocks, in contrast, have negative persistence and a greater effect in magnitudes as they dominate the macroeconomic dynamics. Consistent with the IRFs, the forecast error variance decomposition also shows that shocks originating from the leakage explain a significantly larger fraction of variation in both GDP growth and employment than do injection shocks. We relate our results to the structural asymmetry in the Bangladesh economy, where contractionary leakage forces dominate medium-term macroeconomic dynamics.

Consistent with Keynesian theory, our results are significant: IRFs show that aggregate demand shocks produce temporary expansions that eventually return to equilibrium. However, the persistent impact of leakage shocks also signals that macroeconomic frictions, including taxes, external imbalances, and savings behavior, act to undermine the effectiveness of aggregate demand expansion on national output (Fischer, 1993; Aghion et al., 2009). For the Bangladesh economy, our findings suggest that structural adjustments and a balanced approach to injections and leakages should complement macroeconomic demand stabilization through consumption, investment, or external inflows. In the empirical literature, we find that responses to demand shocks are consistent with the VAR literature by Galí (1999) and Uhlig (2005), showing that the effects of demand shocks tend to be temporary and converge towards the steady state.

Literature Review

Our study related to three strands of literature. In the group of growth and productive drivers, we relate our study to the Neoclassical and endogenous growth models that emphasize capital accumulation, human capital, and openness as key drivers (Solow, 1956; Romer, 1990; Lucas, 1988; Mankiw et al., 1992). However, a major shortcoming of both neo-classical and endogenous growth models is that they neglect short-run demand-oriented fluctuations and macroeconomic imbalances. While the classical view emphasizes the role of supply-side factors in determining output, Keynesian macroeconomic theory treats demand as a critical driver of output and employment, especially in the short term. The circular flow of income model identifies injections that increase aggregate demand, such as investment, government spending, and exports, and leakages that decrease aggregate demand, including savings, taxation, and imports.

Our paper also focuses on macroeconomic instability, where the literature examines the drivers of inflation, exchange rate volatility, and fiscal imbalances, all of which reduce growth by increasing uncertainty and distorting incentives (Fischer, 1993; Aghion et al., 2009). On the demand side, many of these instability factors are potential leakages from the economy. Such factors include inflationary pressures that erode real purchasing power and distort consumption and investment decisions, as well as exchange rate volatility, which disrupts both trade flows and external balances. Again, high levels of imports are a direct leakage from domestic demand, reducing the multiplier effect of expansionary policies. Fiscal shortfalls, such as high taxes or poor public expenditure, can further stifle aggregate demand.

From a methodological perspective, our study relates to the structural VAR (Sims, 1980), which is widely used in the macroeconomic literature, and we chose Uhlig's (2005) sign restriction to identify the shock. Sign-restricted VAR approaches allow identification based on theoretical restrictions aligned with the Keynesian expansion rather than strict ordering assumptions (Uhlig, 2005; Mountford & Uhlig, 2009). The parallel growth of factor-based approaches, especially those employing principal component analysis (PCA), has become widespread to capture large amounts of information from datasets (Stock & Watson, 2002). The factor-augmented VAR (FAVAR) models extend standard VAR models with latent factors that account for the covariation across a large number of macroeconomic variables (Bernanke, Boivin, & Eliasz, 2005).

Those techniques remedy the dimensionality problem and offer a more optimal picture of the macroeconomy.

However, we observed that the literature integrating factor-based methods with the Keynesian injections–leakages framework is relatively limited. Also, SVAR models have been widely applied to demand shock studies, but generally do not distinguish between expansionary injection shocks and contractionary leakage shocks, particularly in the context of the Bangladesh economy. We find a lack of empirical studies that bridge theory and empirical applications in the Bangladesh economy, and our study focuses on the empirical applications of the factor-augmented SVAR approach. We attempt to fill this gap in the literature using data on the Bangladesh economy.

Conceptual Framework

The investigation of injections and leakages shocks and their effects on output and employment is theoretically grounded in the Keynesian circular flow framework (Keynes, 1936), where the equilibrium level of output Y is maintained in identity with the aggregate demand as follows:

$$Y = C + I + G + (X - M)$$

In the IS-LM framework, the equilibrium is achieved when:

$$I + G + X = S + T + M$$

In an open economy setting with consumption, investment, taxes, and government, the expenditure multiplier can be expressed as[1]:

$$k = \frac{1}{MPS + MPM + MPT}$$

Where MPS (marginal propensity to save), MPT (tax rate), and MPM (marginal propensity to import) denote leakages from the circular flow. Keynesian theory suggests that an increase in injections is associated with higher output through the expenditure multiplier. There is an inverse relationship between the size of the expenditure multiplier and the size of leakages: high leakages weaken the multiplier effect, which in turn lowers the overall impact on GDP and employment (Keynes, 1936).

This framework of injection leakages is deeply rooted in and expands on various branches of macroeconomic theory. The multiplier mechanism, through which injections increase output and employment via aggregate demand, provides the basic logic for expecting that injection shocks should have expansionary effects and leakage contractionary effects (Keynes, 1936). Accordingly, we set out to test whether injection shocks have stronger expansionary effects than leakage effects. This view complements neoclassical and endogenous growth

[1] We refer interested readers to Appendix 3 (A3) for the detailed derivation of the expenditure multiplier.

models, such as those of Lucas (1988) and Romer (1990), which suggest that productive capacity increases through investment and human capital accumulation, supporting the long-term effects of injections. At the micro level, Jorgenson (1963) argues that investment decisions are most sensitive to expectations and uncertainty, suggesting that increased uncertainty weakens the channels of injection and reinforces contractionary forces. Likewise, Tobin (1965) identifies inflation as a source of distortion that reduces real income and unsettles saving and investment behavior, thereby constituting a leakage from the circular flow. Finally, in a small-open-economy framework, Obstfeld & Rogoff (1998) show that exchange rate fluctuations and trade deficits affect the extent of leakages from exports and imports, which, in turn, deepen leakages, especially in developing countries.

Research Questions and Hypotheses

We address our first objective by asking how injections and leakages can be empirically measured using macroeconomic data. Second, we focus on the relative impacts of demand-side shocks in the Bangladesh economy, examining the dynamic effects of injection shocks on output, prices, and employment. How do leakage shocks differ in magnitude and persistence? We naturally ask which has a greater impact, expansionary injection effects or contractionary leakage effects.

Based on our research questions and theoretical motivation, we hypothesize that injection shocks have a positive impact, whereas leakage shocks negatively affect output and employment. We next examine whether injection shocks have stronger real effects than leakage shocks on impact and in the short term, but leakage shocks could become more dominant in the medium term. However, due to the recent dominance of aggregate supply-side factors in the Bangladesh economy, such as energy supply shocks from the Russia-Ukraine war, pressure on the USA dollar's currency reserves, and upward trends in cost-push inflationary pressures, leakage shocks could have significant and lasting effects.

Data

We construct an annual time-series dataset for Bangladesh covering the period 1980–2023. The availability of several series drives the choice of the time horizon, and we find that this time span allows us to capture both structural changes and cyclical dynamics in the Bangladesh economy. In particular, capturing this dynamic is important when examining the interplay between injection and leakage forces, and using an annual frequency helps our estimation by reducing short-term volatility that could mask underlying trends.

We compiled all the series from multiple sources. Real output and employment variables are obtained from the Penn World Table (PWT), and the remaining injections and leakages variables used to construct injection and leakage factors are collected from the World Development Indicators (WDI) and the Bangladesh Bank databases. The Penn World Table (PWT) "employment" variable is not designed to explicitly measure informality, yet it does include informal workers to the extent they are captured in national accounts and labor force statistics. According to the data construction, PWT does not distinguish between formal and informal employment. It simply reports an aggregate employment level. In line with the empirical macroeconomic literature, we assume this construction includes both formal and informal workers, as informal workers remain "employed" if they produce goods and services. To capture the expansionary side of the Bangladesh economy, we include investment (INV), government expenditure (GOV), exports (EXP), and remittances (REM) variables as our injections into the circular flow of income. In the leakage side, we include imports (IMP), savings rate (SAV), and tax revenue ($TAXREV$).

Real output is measured using GDP at constant prices. To ensure stationarity and consistency with the literature in interpreting the responses to a shock, output is transformed into a growth rate using log differences:

$$gdp\_growth_t = \Delta \ln (GDP_t) = \ln (GDP_t) - \ln (GDP_{t-1})$$

We measure employment as the employment-to-population ratio, expressed as a percentage. Because this variable is already in rate form, we transform this series using first differences, which measure changes in employment in percentage points.

$$emp\_change_t = EMP_t - EMP_{t-1}$$

Table 1. Summary Statistics

	n	mean	sd	min	max	skew	kurtosis
Investment	44	0.687	57.253	-182.989	138.814	-0.319	1.512
GOV	45	11.315	4.698	3.396	20.162	0.149	-1.028
EXP	45	5.042	0.626	4.031	6.238	0.096	-0.996
REM	45	4.982	2.535	1.867	10.592	0.791	-0.652
IMP	45	17.712	4.479	11.698	27.949	0.719	-0.464
SAV	45	18.817	5.501	2.051	27.27	-0.571	0.36
Tax Revenue	44	11.998	6.595	-11.968	24.672	-1.007	2.646
GDP growth	43	5.556	1.823	1.223	8.678	-0.137	-0.803
EMP-POP ratio	44	35.812	3.01	30.97	43.11	0.701	0.01

Summary statistics of the variables are reported in Table 1. GDP growth averages 5.56% with moderate volatility, while the employment–population ratio is relatively stable at 35.8%. Investment exhibits higher variability than other injection variables, whereas government expenditure and exports appear more stable. Among leakages, imports, and savings, the latter show moderate dispersion, while tax revenue shows greater volatility. Overall, most variables display near-symmetric distributions with mild skewness.

We employ the Augmented Dickey–Fuller test, and the results indicate that the variables are non-stationary at levels. To ensure stationarity and align with standard practice in VAR-based studies, we first-differenced log(GDP) and the employment-population ratio; the injection and leakage factors are also first-differenced before estimation.

Methodology

Construction of Injection and Leakage Factors

We examine the Keynesian distinction between injections and leakages using a factor-based, sign-restricted vector autoregression (SVAR) framework. In this framework, we construct two composite indices using principal component analysis (PCA). The use of composite factors is motivated by the need to reduce dimensionality in the injections and leakages variables (Belviso & Milani, 2005; Bernanke, Boivin, & Eliasz, 2005; Mumtaz & Surico, 2009; Alam, 2024). The PCA approach captures the joint behavior of several macroeconomic variables rather than any single indicator. Following the standard factor-augmented approach, we define the full set of our variables as:

$$X_t = \{INV_t, GOV_t, EXP_t, REM_t, IMP_t, SAV_t, TAXREV_t\}$$

The first group $(INV_t, GOV_t, EXP_t, REM_t)$ represents injection-related variables, and the second group $(IMP_t, SAV_t, TAXREV_t)$ captures leakage-related variables. The selection of variables is motivated by the standard macroeconomic theory of the Keynesian circular flow framework, in which injections consist of investment, government expenditure, and exports. Our selected factors directly add to aggregate demand (AD) in the Bangladesh economy (Keynes, 1936; Mankiw, 2019), including remittances, which are also included as a key injection variable given their substantial contribution to AD components (World Bank, 2023; Rahman, 2012).

Injection Factor

The injection vector is defined as $Z_t^{(I)} = [INV_t, GOV_t, EXP_t, REM_t]$ These variables capture the transmission channels through which demand is injected into the economy. For example, our private investment reflects capital formation and the expansion of productive capacity, and government expenditure represents fiscal stimulus and public demand. We notice that all of our chosen variables are measured in different units and on different scales. We standardized each series as:

$$\tilde{Z}_{it} = \frac{Z_{it} - \mu_i}{\sigma_i}$$

where μ_i and σ_i denote the mean and standard deviation of the variable i, respectively. Standardization ensures comparability across variables and, methodologically, helps prevent any single series from dominating the index due to differences in scale (Stock & Watson, 2002).

Principal component analysis is then applied to the standardized variables. The justification for selecting PCA in our study is several reasons. First, our literature review suggests using a data-driven method to extract common variation among correlated variables without imposing arbitrary weights. Second, PCA reduces dimensionality while preserving as much information as possible, making it particularly suitable for estimating a single series of shock factors to examine our expansionary and contractionary effects on the Bangladesh economy, where variables often move together (Jolliffe, 2002). The first principal component, which mostly captures the largest share of common variation across the series, is used to construct the injection factor:

$$IF_t = w_1\widetilde{INV}_t + w_2\widetilde{GOV}_t + w_3\widetilde{EXP}_t + w_4\widetilde{REM}_t$$

where the weights w_i are the factor loadings associated with the first principal component. In a similar manner, we also define the leakage vector and standardize it using the same transformation, $Z_t^{(L)} = [IMP_t, SAV_t, TAXREV_t]$ and the first principal component is extracted as the leakage factor:

$$LF_t = v_1\widetilde{IMP}_t + v_2\widetilde{SAV}_t + v_3\widetilde{TAXREV}_t$$

here v_i are the corresponding factor loadings.

Based on our PCA construction of IF_t and LF_t, we assume that an increase in the injection factor (IF_t) is therefore interpreted as an expansionary impulse. In contrast, the leakage factor (LF_t) indicates a rise in income withdrawals from the circular flow through channels such as imports, savings, and tax revenues, and we interpret it as a contractionary shock. From a Keynesian perspective, such changes in aggregate demand, transmitted through the multiplier mechanism, lead to responses in output and employment (Keynes, 1936; Solow, 1956; Romer, 1990).

In the context of Bangladesh, our distinction between injection and leakage shocks is particularly relevant, as the economy has experienced strong growth driven by investment, exports, and remittance inflows, while also facing increasing pressures from imports, fiscal constraints, and savings dynamics. By summarizing these forces into two composite factors, our analysis captures the balance between expansionary and contractionary forces in aggregate demand management more integratively.

Sign-Restricted VAR Framework

We employ a sign-restricted structural VAR (SVAR) approach to identify structural shocks. We justified our chosen approach as suitable for our data set and theoretical settings where theoretical priors are more specific and clearer, but contemporaneous relationships are complex (Uhlig, 2005; Mountford & Uhlig, 2009). We let the reduced form VAR be expressed as:

$$Y_t = A(L)Y_{t-1} + u_t$$

where u_t is the reduced-form residuals with the covariance matrix Σ_u. The structural representation is given by:

$$Y_t = A(L)Y_{t-1} + B\varepsilon_t$$

where ε_t is a vector of orthogonal structural shocks and B matrix shows the contemporaneous impact such that:

$$\Sigma_u = BB'$$

Since B is not always uniquely identified, additional restrictions are required. Following Uhlig (2005), we identify using sign restrictions on impulse responses over a short horizon. As we mentioned, the identification strategy is motivated by and originated in the theoretical interpretation of injections and leakages within the circular flow framework. Table 2 shows that an injection shock represents an expansion in demand-side drivers, while a leakage shock reflects an increase in income withdrawals and macroeconomic frictions.

Table 2. Sign Restrictions for Injection and Leakage Shocks

Variable	Injection Shock (+1 SD in IF_t)	Leakage Shock (+1 SD in LF_t)
Output growth (gdp_growth_t)	≥ 0 (positive response)	≤ 0 (negative response)
Employment change (emp_change_t)	≥ 0 (positive response)	≤ 0 (negative response)
Injection factor (IF_t)	≥ 0 (positive shock)	Unrestricted
Leakage factor (LF_t)	Unrestricted	≥ 0 (positive shock)

Notes: The table reports the sign restrictions used to identify structural shocks in the sign-restricted SVAR framework. A positive injection shock corresponds to a one-standard-deviation increase in the injection factor and is assumed to generate expansionary effects on output and employment. In contrast, a positive leakage shock represents an increase in leakage-related factors and is expected to produce contractionary effects. The responses of non-target factors are left unrestricted to allow endogenous adjustments within the system, consistent with standard practice in sign-restricted VAR identification (Uhlig, 2005; Mountford & Uhlig, 2009).

A positive injection shock is expected to increase output and employment growth, as shown in Table 2, reflecting the direct effects of higher investment, government spending, exports, and remittance inflows. We expect this effect to be strongest in the short run, consistent with the Keynesian multiplier mechanism (Keynes, 1936). In contrast, a positive leakage shock is expected to reduce output growth and employment. In Bangladesh, recent episodes of rising import costs due to pressure on U.S. dollar currency reserves, oil supply shocks, exchange rate pressures, and inflationary trends suggest that leakage shocks could have significant and lasting effects.

Results and Discussion

Before we present our results, we need to address a few methodological concerns, even though our sign restrictions in Table 2 are theoretically consistent. We note that our shocks are constructed from PCA-based factors, and we then impose sign restrictions on them. Given that the first step is data-driven via PCA and the second is structural via SVAR, we acknowledge that we are implicitly examining "double-identified" shocks. Identifying a double shock, which is also common in the SVAR literature, requires that the shocks be mutually orthogonal. The next concern is whether the constructed IF and LF are truly exogenous and structural shocks. To address concerns about exogenous shocks, we use a decomposition approach: the leakage factor is orthogonalized with respect to the injection factor, and the leakage shock is defined as the residual from a linear projection of the leakage factor onto the injection factor.

While principal component analysis (PCA) is used to summarize the common variation in injection and leakage variables, it, by itself, does not yield structural shocks. Rather, PCA provides a reduced-form representation that may still reflect endogenous responses within the system. To address this concern, we impose structural identification through a sign-restricted SVAR framework, where economically motivated restrictions distinguish injection and leakage shocks based on their theoretical effects on output and related variables.

In addition, to mitigate potential simultaneity between the constructed factors, we orthogonalize the leakage factor with respect to the injection factor. Specifically, the leakage shock is defined as the residual from projecting the leakage factor onto the injection factor. This procedure ensures that the identified leakage shock captures innovations that are not contemporaneously explained by injection dynamics. Therefore, the identification of structural shocks relies on the combination of (i) dimensionality reduction via PCA, (ii) orthogonalization to reduce contemporaneous dependence, and (iii) theory-consistent sign restrictions within the SVAR framework.

In Table 3, the PCA results indicate that the first principal component captures a substantial share of the variation in both factors, explaining approximately 47.5% of the variation in the Injection Factor (IF) and 44.5% in the Leakage Factor (LF). For the IF, remittances and government spending exhibit the highest positive loadings, suggesting they are the primary drivers of injection dynamics, while investment and exports contribute to a lesser extent. In contrast, the LF is mainly driven by imports (positive loading) and savings (negative loading). The leakage factor shows an opposing influence within the leakage structure, with tax revenue playing a relatively minor role. We present our results to support the validity of the constructed factors for summarizing key macroeconomic components.

Table 3. Factor Loadings and Principal Component Analysis (PCA)

VARIABLE	LOADING	VARIANCE EXPLAINED BY PC1 OF INJECTIONS	VARIABLE	LOADING	VARIANCE EXPLAINED BY PC1 OF LEAKAGES
INVESTMENT	0.375	0.475	Imports	0.675	0.445
GOVERNMENT SPENDING	0.603	0.475	Savings	-0.713	0.445
EXPORTS	0.315	0.475	Tax Revenue	0.189	0.445
REMITTANCES	0.630	0.475			

Notes: Loadings correspond to the first principal component (PC1) derived from standardized growth rates of the respective variables. The reported variance explained indicates the proportion of total variation captured by PC1. Positive (negative) loadings imply that the variable moves in the same (opposite) direction as the constructed factor.

In Figure 1, we present our key findings for the four IRFs. The shock is measured as one std. dev and we consider a 10-year horizon for the impacts of shocks. The IRFs in the upper panel show that an injection shock produces an immediate and positive response in both output and employment. At impact (horizon 0), GDP growth increases by approximately 0.5 percentage points, while employment rises by about 0.6 units. For both the GDP and employment, although they show a decline in the next periods, a rise is also evident in year 3 for GDP and in year 1 for employment. In subsequent periods, responses gradually decline, and GDP growth changes from roughly 0.5 to 0.4, then to 0.3, and finally to 0.2. For the 10-year horizons, the IRF of employment shows a similar downward path. We observe that although the response magnitude diminishes, it remains positive throughout the horizon. Consistent with the Keynesian expansion, this pattern indicates that the IF shock has a transitory but persistent expansionary effect, supporting our first hypothesis. The declining trend suggests that a gradual adjustment in the AD, short-run aggregate supply, moves toward equilibrium rather than a reversal of the initial impact.

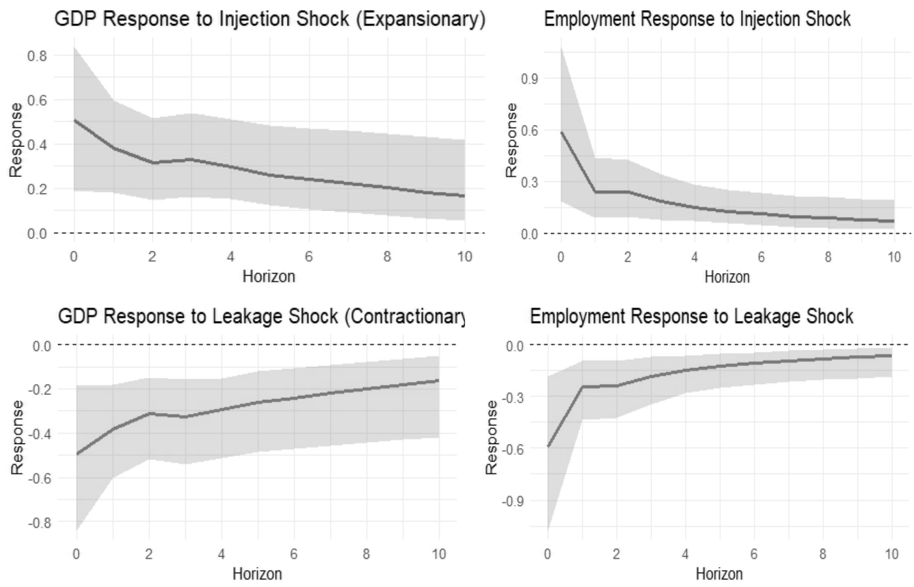

Figure 1. Impulse Response Functions

Figure 1: Impulse Response Functions (IRFs). For 10-year horizons, the impulse response functions (IRFs) in the upper panel show a positive but transitory increase in output and employment to a one std. dev injection shocks, and the lower panel shows leakage shocks generate a negative but gradually dissipating contraction.

The lower panel of Figure 1 shows that the leakage shock exhibits a contractionary pattern. At impact, GDP falls by approximately −0.5, while employment declines by around −0.6. These negative responses on impact for both key variables suggest that the identified leakage factor drives a withdrawal demand from the system, such as savings, taxation, or import leakages. Similar to our injection shock, the response magnitude diminishes over time, and the IRFs tend to return to the steady-state line. The IRF of GDP evolves from about −0.5 to −0.3 in year 2, and then, from year 3 onward, the responses change from −0.2 to −0.1, while employment shows a similar trajectory over the 10-year horizon. The responses of both GDP growth and employment remain below zero but move steadily toward the equilibrium path, indicating that the contraction from the aggregate demand shock is temporary and gradually dissipates.

We compare our findings and the consistency of observed dynamics with empirical work on demand-driven fluctuations. For example, Blanchard and Perotti (2002) show that positive fiscal shocks lead to immediate increases in output that gradually diminish and go back to the steady state. Similarly, Jordi Galí (1999) finds that demand-side fluctuations cause short-run expansions in output and employment through the AD-AS transmission channels, with fading effects over the horizons. Our findings are also consistent with those of Faust (1998) and Uhlig (2005), who employ sign-restricted VARs focusing on demand shocks and find that the shocks display strong effects on GDP and employment, followed by gradual reversion towards the steady state. Our results for both shocks are also consistent with structural features of Bangladesh's economy, because demand-side shocks in our SVAR estimation tend to generate short- to medium-run fluctuations that diminish as the AD-AS friction-adjustment drives the economy to the steady state. We find that the Bangladesh economy regularly exhibits limited absorptive capacity and adjustment frictions in response to aggregate demand and supply shocks, and that external balances play a very limited role in adjusting to these shocks. So, our results support the view that macroeconomic policy adjustments in the Bangladesh economy are not intended to achieve a permanent shift in the full-employment level of output.

Forecast Error Variance Decomposition

Table 4 and Figure 2 show the contributions of both injection and leakage shocks to the forecast-error variances of GDP growth and employment over a 10-period horizon. We find that two patterns emerge in Table 3.

First, our leakage shocks dominate the variance of both output and employment across the 10-year horizons. For GDP, leakage shocks account for approximately 22–26 percent of forecast error variance, compared to a much smaller 5.7–6.3 percent contribution from injection shocks. A similar pattern holds for employment, where leakage shocks explain around 17–21 percent, while injection shocks contribute only about 4–5 percent. Second, it is observed that the contribution of leakage shocks increases gradually, whereas the share of injection shocks remains relatively stable. For example, the share of leakage shocks in GDP variance rises from 22.4 percent at impact to over 26 percent by horizon 10, suggesting that contractionary forces rooted in leakage factors have a more persistent effect on the transmission of shocks to GDP and labor markets. In contrast, the fractions of injection shocks remain modest and only marginally increase over 10-year horizons.

Table 4: Forecast Error Variance Decomposition (FEVD)

Horizon	GDP_Injection	GDP_Leakage	EMP_Injection	EMP_Leakage
0	5.80	22.43	3.81	16.99
1	5.74	23.81	4.28	17.69
2	5.81	24.23	4.59	18.96
3	6.03	24.61	4.71	19.52
4	6.08	24.97	4.86	20.03
5	6.12	25.22	4.94	20.43
6	6.18	25.54	5.05	20.76
7	6.22	25.83	5.10	21.03
8	6.28	25.96	5.17	21.25
9	6.28	26.07	5.20	21.41
10	6.29	26.15	5.21	21.53

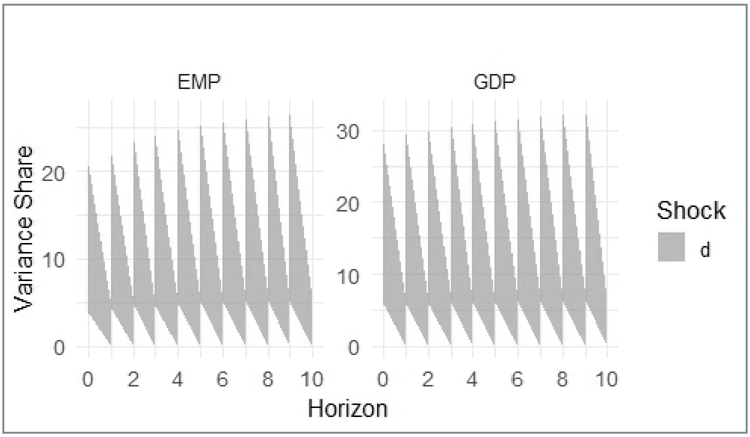

Figure 2. Forecast Error Variance Decomposition (FEVD)

Figure 2. Forecast Error Variance Decomposition for both GDP and Employment. The FEVD shows the variance decomposition for the 10-year horizon. The figure shows how much of the variation in GDP and employment is explained by injection (IF) and leakage (LF) shocks over a 10-period horizon. It highlights the relative importance of these shocks over time. Leakage shocks account for a larger share of fluctuations than injection shocks, particularly at longer horizons.

We also present the historical decomposition (HD) in Table A1 (appendix) and Figure 3 to assess how IF and LF shocks have contributed to fluctuations in GDP growth and employment over time. We find that leakage shocks persistently reduce GDP, particularly during periods of economic stress. As observed, the early 1990s show pronounced negative effects, with GDP leakage contributions as low as −0.06, indicating substantial contractionary pressure. For injection shocks, we find a moderate effect, generally smaller in magnitude, but with stronger leading impacts in certain periods. This leading trend is observed in the mid-2010s, when positive contributions to GDP (e.g., around 0.04 in 2015) suggest phases of demand expansion driven by increased investment and remittance inflows. For both infection and leakage shocks, we find that the patterns are somewhat more volatile but broadly consistent across employment.

Our findings in FEVD (Table 3), the historical decomposition (Table A1, appendix), and Figure 3 support the IRF results. We find that injection shocks generate positive, immediate effects, but the IF shock's contribution to overall variability is limited. Leakage shocks emerge as the major source of macroeconomic variation in the Bangladesh economy over the medium horizon. The asymmetry in our IRFs, HD, and FEVD suggests that leakage shocks, driven by negative demand pressures and factors such as savings, taxation, and imports, play a more dominant role in shaping the responses of GDP and job creation than expansionary shocks.

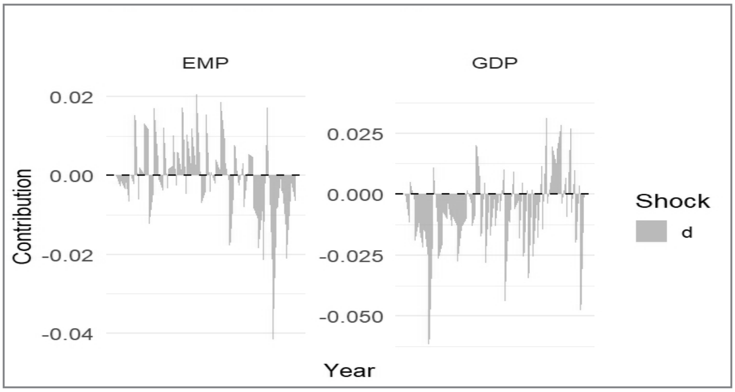

Figure 3. Historical Decomposition

The figure of historical decomposition shows how the IF and LF shocks emerge over time. The figure shows the time-varying contributions of injection (IF) and leakage (LF) shocks to fluctuations in GDP growth and employment. The decomposition shows how demand-side disturbances evolve. Injection shocks contribute intermittently to expansions, whereas leakage shocks are more frequently associated with contractionary episodes.

Conclusion

In this paper, we empirically examine the Keynesian injections–leakages framework by combining PCA-based factor construction with a sign-restricted SVAR approach. Using annual data for Bangladesh from 1980 to 2023, we derive latent injection and leakage factors and investigate their dynamic effects on GDP growth and employment. A methodological contribution of this study is the combination of factor-augmented techniques with theory-consistent identification, which captures high-dimensional macroeconomic interactions while allowing a clear structural interpretation of demand-side shocks.

We show that injection shocks have a positive but transitory effect on output and employment, supporting Keynesian demand theory and consistent with previous SVAR evidence. In contrast, leakage shocks reduce output and employment and exert a larger, dominant effect on medium-run macroeconomic fluctuations in Bangladesh than injection shocks. The relatively stronger leakage effects suggest that structural leakages, such as imports, taxes, and savings, act as a countercyclical force in the transmission mechanism of expansionary policies, affecting economic growth and employment in the short run. We argue that sustainable macroeconomic stabilization policies in Bangladesh should be balanced by incentivizing injections and systematically reducing leakages.

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Appendix

Table A 1. Historical Decomposition

Year	GDP_Injection	GDP_Leakage	EMP_Injection	EMP_Leakage
1985	0	0	0	0
1986	-0.01408	0.005597	-0.00285	-0.00127
1987	-0.00187	-0.01937	-0.00347	-0.00135
1988	-0.01162	-0.01539	-0.0083	0.00019
1989	-0.02384	-0.01462	-0.00292	0.015353
1990	-0.02761	-0.06167	-0.01263	0.002266
1991	-0.01006	0.012382	0.000421	0.013309
1992	-0.01677	-0.02685	0.011481	-0.01269
1993	-0.01949	-0.00712	-0.00312	0.017869
1994	-0.01066	-0.00304	0.00224	-0.00091
1995	-0.01532	-0.00889	-0.00435	0.012883
1996	-0.01355	-0.02841	-0.00338	0.001568
1997	-0.01163	-0.0131	0.002348	0.010964
1998	-0.01031	0.001943	-0.00685	0.006095
1999	-0.00339	-0.01327	0.000211	0.017288
2000	-0.00752	0.020294	-0.01162	0.010819
2001	0.00348	-0.01746	0.001378	0.012513
2002	0.011662	-0.02966	0.000485	0.02178
2003	0.006294	-0.01796	-0.00388	-0.0072
2004	0.001433	-0.01359	-0.00361	0.016672
2005	0.002657	-0.00783	-0.00894	0.00108
2006	0.014501	-0.04564	-0.0028	0.004167
2007	-0.00269	-0.01254	0.001449	0.019076
2008	0.00945	-0.00633	0.009638	0.003389
2009	-0.0025	-0.0196	-0.00241	-0.01769
2010	0.012292	-0.02553	-0.00265	0.007902
2011	0.010354	-0.03436	-0.00487	-0.0028
2012	0.013568	-0.02675	0.004678	-0.00846
2013	0.000928	-0.01954	0.002941	0.005605
2014	0.018953	-0.01682	0.004723	-0.00811
2015	0.042873	-0.00442	-0.01133	-0.019
2016	0.010239	0.020206	-0.00668	-0.02312
2017	0.010837	0.018078	0.017403	0.007632
2018	0.030962	-0.00438	-0.02117	-0.0429
2019	0.007031	-0.01095	-0.01039	-0.00848
2020	0.02723	-0.00857	0.001499	-0.00387
2021	0.015836	-0.02003	-0.015	-0.02188
2022	0.010781	-0.04766	-0.00294	-0.00158
2023	0.01351	-0.01795	-0.00758	0.002343

A 2. Identification Algorithm

Following the approach of Uhlig (2005) and consistent with the economically meaningful identification, our estimation follows a simulation-based procedure and algorithm below:

I. Estimate the reduced-form VAR and obtain residuals and Σ_u.

II. Compute the Cholesky decomposition of Σ_u as an initial factorization.

III. Generate candidate structural matrices by applying random orthonormal rotations.

IV. For each candidate draw, compute impulse response functions (IRFs).

V. Retain only those draws that satisfy the imposed sign restrictions over a specified horizon (e.g., 4–6 periods).

VI. Construct median IRFs and confidence bands from the accepted draws.

A 3. We start from the income identity:

$Y = C + I + G + (X - M)$

Now specify behavioral functions:

Consumption: $C = C_0 + c(Y - T)$

Taxes (proportional): $T = tY$

Imports: $M = mY$

Where: c= MPC; t= marginal tax rate (MPT); m= marginal propensity to import (MPM)

Plug everything into Y: $Y = C_0 + c(Y - tY) + I + G + X - mY$

Expand consumption:

$Y = C_0 + c(1 - t)Y + I + G + X - mY$

Now collect terms in Y:

$Y - c(1 - t)Y + mY = C_0 + I + G + X$

Factor out Y:

$Y[1 - c(1 - t) + m] = C_0 + I + G + X$

We solve for equilibrium income

$$Y = \frac{1}{1 - c(1 - t) + m} \cdot (C_0 + I + G + X)$$

We express in leakage form and rewrite using: $MPS = 1 - c$; $MPT = t$; $MPM = m$

Expand denominator:

$$1 - c(1 - t) + m = 1 - c + ct + m$$

Substitute:

$$= (1 - c) + t + m = MPS + MPT + MPM$$

Now the multiplier becomes:

$$k = \frac{1}{MPS + MPT + MPM}$$