Savings, Investment, Terms of Trade, and Sustainability of the Internal Approach: 1993 - 2019.

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Abstract

Welfare measures and their assessment involve a set of indicators that, as economic thought evolves, are subject to critique. Nonetheless, the ultimate debate focuses on the quality of life and the conditions fostered by each economy. Using data from the period 1993 to 2019, this paper presents an analysis of the current account and terms of trade, highlighting the significance of these variables, as they encompass important flows and contribute to shaping market conditions and the resulting benefits. The study employs both Vector Error Correction (VECM) and Structural Vector Error Correction (SVECM) models to explore the interplay between external dynamics and their effects on the economy. The findings reveal that an export price shock has an expansive effect on investment, yet its impact on savings becomes marginally significant over time. Unexpected shocks on investment are roughly 38% reliant on external factors, of which an average of 32% is attributable to export prices, underscoring the tight correlation between investment and international market dynamics. Notably, the results indicate that external dynamics primarily exert short-term effects. Consequently, despite periods of robust growth, reduced unemployment, and poverty reduction, these indicators have not proven to be sustainable in Peru.

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1 Introduction

It is overly simplistic to discuss economic development solely based on per capita income. Nowadays, factors such as education, health, technology, infrastructure, and political systems play crucial roles that extend beyond the scope of sustainable development goals. Economic analysis has evolved alongside human thought. For instance, the rapid advancement in production methods, influenced significantly by the relevance of international trade in policy-making, reflects this evolution. Empirical evidence and the progression of economic analysis reveal a profound connection between domestic and external economic cycles, especially in Emerging Market Economies (EMEs). The global dynamics of today are markedly different from those of 40 years ago. Milestones such as the end of World War II, the fall of the Berlin Wall, the Global Financial Crisis (GFC), and the COVID-19 pandemic, among others, have been pivotal in economic history. They necessitate a shift in economic thinking, thereby directly influencing the conditions under which economies operate.

From a historical perspective, EMEs have been significantly impacted by the constant shifts in international conditions. Countries like China, the U.S., Canada, Germany, South Korea, and Japan have bolstered their positions as major global commodity buyers. Concurrently, EMEs like Mexico, Peru, Chile, Colombia, and the Philippines are increasingly seeking strategic trade partnerships to enhance their roles as commodity suppliers. These conditions directly influence the evolution of economic analysis, making the study of the interaction between international dynamics (terms of trade) and the relationship between savings and investment (current account) crucial for the analysis of market conditions, especially in EMEs due to the significance of international trade. As Peru's economic position has evolved towards promoting strategic trade partnerships and private investment, it is necessary to question whether these strategies have fulfilled their role in the pursuit of improved living conditions for the population.

Crucially, analyzing welfare goes beyond merely considering per capita income. It is vital to scrutinize the broader conditions influencing welfare indicators, given the significant impact of political and economic structures on policy-making. Over recent decades, the Peruvian economy has been characterized by robust macroeconomic indicators and ratings, thanks to prudent monetary policy management by the Central Reserve Bank of Peru (BCRP) and an increasing emphasis on fiscal outcomes, evidenced by the establishment of the Fiscal Council. Similarly, it is important to focus on the poverty reduction figures in Peru, particularly over the last 20 years. However, emerging hidden processes and concerning outcomes are shaping our outlook on development. An example is the increase in poverty levels in the wake of the COVID-19 pandemic, from an average of

20% to 27.5%.

Therefore, the question arises: do global supply and demand conditions, given today's trade dynamics and Peru's economic policies (which emphasize incentives for private investment and strengthened international market ties), yield positive effects on the path to improved welfare?

This document seeks to establish a theoretical framework to examine how current international dynamics (characterized by terms-of-trade fluctuations and their interaction with variables such as savings and investment) affect economic conditions and the pursuit of enhanced welfare. Specifically, it aims to enrich the literature on poverty dynamics and macroeconomic indicators in a country like Peru, i.e., a small, open economy with limited global influence.

The document offers a brief review of the literature on poverty conditions, economic growth, and terms of trade. It then presents the characteristics of the unidimensional approach to poverty adopted in Peru and an analysis of the current account and terms of trade, demonstrating their presence in all series through various unit root tests. We also present the results of the cointegration test by Johansen (1995), employing a Vector Error Correction Model (VECM) and a Structural Vector Error Correction Model (SVECM) to dissect the relationship between the current account (as reflected in the savings-investment gap) and the terms of trade, defined as the difference between the export price index and import price index. The findings suggest that, despite periods of high economic growth and reduced unemployment rates, the sustainability of these indicators remains in question.

2 Literature Review

Yamada (2022) scrutinizes the interplay between economic conditions and welfare in Peru, focusing on inequality, poverty, social mobility, education, and healthcare against the backdrop of strengthened macroeconomic fundamentals. This raises the question of whether macroeconomic stability has had lasting impacts on the welfare indicators of the Peruvian population. The author elaborates on the measurement of monetary poverty in Peru, dividing the period into three segments: from 1985 to 1997, during which the country's poverty rate was 38%, escalated to 57% amidst the inflationary crisis of the late 1980s, but decreased to 51% in 1997 amid the structural reforms implemented in the 1990s. The second segment spans from 1997 to 2004, marking the start of measurements through surveys by Peru's National Institute of Statistics (INEI), with poverty increasing to around 54% against the backdrop of the 1998 Russian Crisis.[1] The third

[1]The author emphasizes Peru's high exposure to the external sector, noting its significant credit

segment covers 2004 to 2019, where data from the National Household Survey (ENAHO)[2] shows a reduction in poverty incidence to 20% by 2019. It is noteworthy to mention the lack of a unique poverty concept due to diverse perspectives adopted over time. In line with poverty conceptualization Verdera (2007) points out the absence of a comprehensive economic theory on poverty, and Cozzubo Chaparro (2015), referencing Haughton y Khandker (2009), defines poverty from a monetary perspective as insufficient income or consumption to remain above a minimum threshold. Complementing the literature, Carranza (2022) links economic growth to monetary poverty figures, presenting three phases of the Peruvian economy in recent years: stabilization from 1990 to 2002 with an average real GDP growth of 3.1% and a poverty rate between 57% in 1990 and 54% in 2002; growth acceleration from 2003 to 2011, with real GDP growth around 6.3% and a significant poverty reduction to 28% by 2011; and growth moderation from 2012 to 2019, with a slowdown in real GDP growth to 3.8% and a poverty reduction to 20%. The author underscores the macroeconomic strengths of the Peruvian economy in the last phase but questions the reasons behind the slowdown, focusing on the deterioration of terms of trade and variability in economic policies.

The terms of trade play a crucial role in analyzing the evolution of shocks and resulting conditions in the Peruvian economy. Works by Chávez y Rodriguez (2021) and Rodríguez y Vassallo (2021) emphasize the significance of terms of trade for the Peruvian economy and the benefits generated by trade partnerships and connections with major commodity buyers, using Time-Varying Parameter Vector Autoregressive (TVP-VAR) models and stochastic volatility. The authors highlight the importance of investment as a driving and expansive force in the Peruvian economy. Aquino y Espino (2013) presents the relationship between terms of trade and the savings-investment gap through a Structural Vector Autoregressive (SVAR) model, demonstrating the significance of external dynamics in the Peruvian economy. They analyze the validity of the Harberger-Laursen-Metzler effect[3] for Peru between 1950 and 2013, concluding that the effect holds in the short term but dissipates over time due to the predominance of investment in the economy. Mendoza y Collantes (2018) identify a 54% influence of external factors on the variability of private investment, with export prices as the main channel connecting Peru to the global economy. Similarly, employing the cointegration approach by Johansen (1995), Rodríguez *et al.* (2018) seek to verify the existence of long-term relationships of variables such as con-

dollarization level and vulnerability to capital reversals throughout the second segment.

[2]The ENAHO has been conducted in Peru since 1995 but has been carried out continuously in both urban and rural areas only since 2003.

[3]In economic theory, the Harberger-Laursen-Metzler effect refers to the phenomenon where an improvement in the terms of trade leads to a positive income effect, benefiting savings and consequently improving the savings-investment ratio (i.e., the current account balance). This effect is named after the work of Harberger (1950) and Laursen y Metzler (1950).

sumption, investment (public and private), output, and terms of trade, analyzing the role of terms of trade in the fluctuations of the Peruvian economy using quarterly data from 1992 to 2007 and identifying a high sensitivity of the main macroeconomic variables to external factors, especially commodity price increases. Likewise, Dancourt *et al.* (1997) evaluate the significance of external shocks in the development of macroeconomic conditions for Peru, noting that six of the recessions experienced by the Peruvian economy between 1950 and 1996 coincide with adverse external shocks, concluding that recession periods are marked by inflation acceleration and balance of payments crises, emphasizing the role of external shocks in explaining Peru's economic performance.

3 Poverty, Savings-Investment, and Terms of Trade

3.1 The Poverty Approach

The methodology for measuring poverty spans from the unidimensional perspective employed by INEI[4] to the more complex, multidimensional approaches. Since 2007, INEI has published the annual Evolution of Monetary Poverty report, which presents poverty statistics using data from ENAHO. INEI classifies individuals as poor if their household's per capita spending fails to cover basic goods and services, and as extremely poor if it falls below the threshold for a basic food basket. This analysis draws on data from Carranza (2022) for the period 1993 to 2003 and from ENAHO for 2004 to 2019, categorized into three stages of international integration: reduced (1993-2002), increased (2003-2012), and moderating (2013-2019).

Table 1 shows a marked reduction in the poverty rate from 55% to 20% during 2003-2019, alongside stable macroeconomic indicators. However, this progress has recently been undermined, underscoring the ongoing struggle to achieve lasting poverty reduction. The COVID-19 pandemic has intensified these challenges, creating disruptions in key areas such as investment, savings, and inequality, further complicating the fight against poverty.

[4] Peru's National Statistics Institute.

Table 1

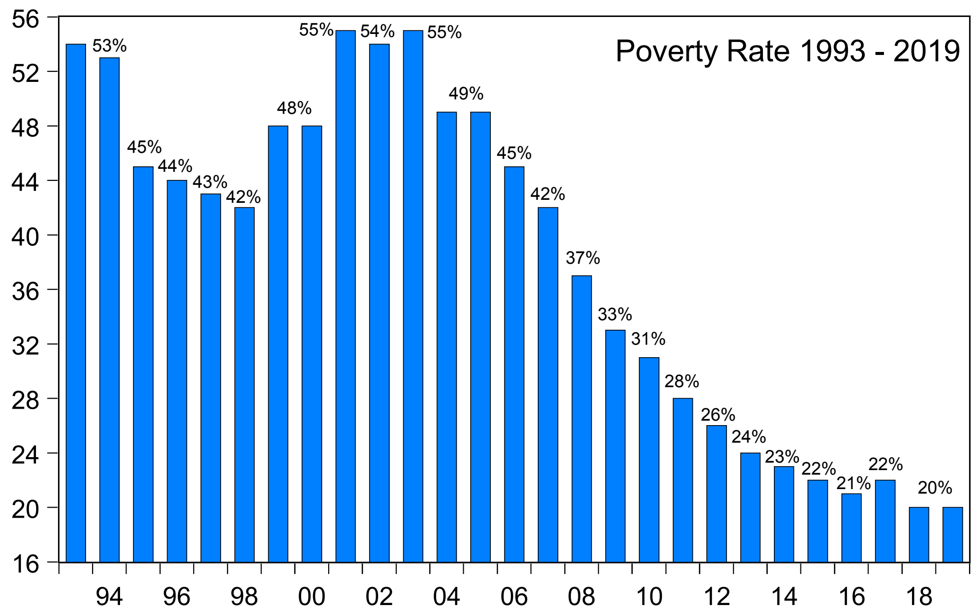
Poverty Rate, 1993-2019 (Percentage of the population that does not cover the cost of the Basic Consumption Basket)

Year	Poverty Rate	Year	Poverty Rate	Year	Poverty Rate
1993	54%	2002	54%	2011	28%
1994	53%	2003	55%	2012	26%
1995	45%	2004	49%	2013	24%
1996	44%	2005	49%	2014	23%
1997	43%	2006	45%	2015	22%
1998	42%	2007	42%	2016	21%
1999	48%	2008	37%	2017	22%
2000	48%	2009	33%	2018	20%
2001	55%	2010	31%	2019	20%

Note: Stages of international integration: reduced (1993-2002), increased (2003-2012), and moderating (2013-2019). Source: Carranza (2022) and ENAHO.

Figure 1

Peru: Poverty Rate, 1993-2019



Source: Carranza (2022) and ENAHO.

It is essential to note that the multidimensional poverty approach, based on the principles proposed by Sen (2000), extends beyond mere monetary income insufficiency to include deprivation of capabilities and conditions necessary for freedom, influencing social development. For Peru, multidimensional poverty is not solely mitigated by robust macroeconomic indicators or expanded social programs but hinges on market conditions and leveraging external dynamics. Building foundations to support job creation, sustainable entrepreneurship, greater inclusion, enhanced financial literacy, and increased industrialization are critical for market sustainability.

The responsibility for development and welfare extends beyond government action and economic policy-making. Peru's reliance on external dynamics critically affects job creation and, consequently, income levels that may contribute to welfare beyond mere subsistence. Since 2003, Peru's strategy has involved engaging in free trade agreements (FTAs) with major commodity importers like China and the U.S., promoting investment to boost competitiveness and capitalize on global trade benefits, reflected in reduced unemployment and poverty rates.

Table 2 outlines period-specific characteristics and stylized facts for the Peruvian economy, and Table 3 shows the decrease in monetary poverty and unemployment rates, highlighting a growth deceleration in the last period of analysis:

Table 2
Characteristics and Key Events by Period

Period	Characteristics	Administration	Key Events (*)
1993-2002	Limited international integration. Structural reforms, industrialization, and low financial inclusion.	Alberto Fujimori (1990-2000) Valentín Paniagua (2001)	El Niño Phenomenon Russian Crisis Structural Reforms
2003-2012	Increased international integration. Commodity price boom.	Alejandro Toledo (2001-2006) Alan García (2006-2011)	FTAs with the U.S., China. GFC
2013-2019	Moderating international integration. Drop in commodity prices, deceleration in the U.S. and China.	Ollanta Humala (2011-2016) Pedro Pablo Kuczynski (2016-2018) Martín Vizcarra (2018-2020)	Drop in commodity prices Deceleration in China

(*) Key developments for the Peruvian economy.

Table 3
Monetary Poverty, Unemployment, and GDP Growth

Period	Monetary Poverty	Unemployment	GDP Growth
1993 - 2002	49	7.77	4.41
2003 - 2012	40	4.40	6.21
2013 - 2019	22	3.89	3.05

The data represent average rates for each period. The poverty rate indicates the percentage of the population that cannot cover the cost of the Basic Consumption Basket. The unemployment rate is the proportion of individuals who are unable to find work and belong to the Economically Active Population. Source: ENAHO, BCRP.

From 2000 onwards, Peru benefited from high commodity prices and pursued an aggressive strategy of entering into FTAs, positively impacting income (notably from 2005Q1 to 2007Q4) and creating greater competitiveness demands involving higher employment quality and conditions.

As a small, open economy, from 2003 to 2012, Peru was compelled to enhance productivity due to the competitive demands stemming from increased trade relations, especially with countries like China and the U.S. As the world's leading consumers of commodities, their business cycles directly influence Peru's economy, and trade with them necessitates higher productivity levels, translating into better employment conditions and income generation.

However, the current approach to measuring poverty in Peru overlooks certain welfare-related indicators, rendering it restrictive and marginally relevant for analysis. Focusing solely on monetary poverty masks various outcomes that subjectively and quantitatively impact the population's welfare, from limited financial inclusion to the quality of investment and public spending. In summary, Peru lacks a multidimensional poverty indicator as well as a comprehensive framework for analyzing variables affecting welfare. In recent decades, while benefiting from largely favorable external conditions, Peru has been governed by short-term policies associated with unsustainable politically-driven social programs.

Peru's economy is recovering from the severe impacts of COVID-19-related emergency measures, with post-2020 figures providing little cause for optimism. Especially, the performance of unemployment and poverty indicators underscores the limited sustainability and resilience of the Peruvian economy.

3.2 Terms of Trade, Savings, and Investment

The terms of trade indicate the purchasing power of domestically produced export goods. They reflect the effects of external dynamics and influence economic agents' decisions. Additionally, Rojas-Suárez (2022) highlights that the current account best measures a country's external financing needs, offering insights into its commercial and financial interrelations with the global economy. Both variables are highly evaluative, as they encompass important flows and contribute to shaping market conditions and the resulting benefits.

Given Peru's growing trade interrelation with the world and its active stance on private investment promotion since the 1990s, the analysis focuses on the current account through the savings-investment approach. This perspective provides insights into Peru's position and the international context, considering the evolving global economic cycle. The current account position ($CC \equiv S_t - I_t$) represents the gap between savings (S_t) and investment(I_t). Characterized as a small, open economy, Peru shows external dependence and typically runs a current account deficit[5]

Since the 1990s, Peru has focused on promoting investment, making external savings (S_E) pivotal to balancing the difference between investment and national savings. As Figures 2 and 3 illustrate, the 1990s were marked by a high current account deficit and low terms of trade. The deficit levels in the 1990s exceeded those of the post-GFC period. Reduced international integration and political turmoil domestically led to an increased current account deficit due to dwindling external financing sources.[6] Improvements in income and consequently in the current account, with periods of surplus, began in 2000,[7] attributed to a continuing search for FTAs and the implementation of sound macroeconomic policies.

Peru has typically experienced current account deficits. However, a surplus scenario emerged from 2005Q1 until the end of 2007, associated with an intensified search for, and adherence to, FTAs aimed at promoting Peru's development and international trade, alongside a more stable political landscape, higher commodity prices, and a framework supporting private investment as an economic driver. Notably, from 2008 onwards, the current account has consistently shown deficit scenarios, which widened between 2013

[5]The Peruvian economy frequently experiences current account deficits ($-CC_t$), indicating periods when external savings are positive. This reflects a situation where the economy is accumulating net liabilities with the rest of the world, i.e., $S_E = I_t - S_t > 0$.

[6]Calderón *et al.* (2000) assess the sustainability of the current account in Peru over the period 1950-1994.

[7]The shifts observed since 2000 primarily stem from monetary policy reform, increased trade integration with the global market, and a surge in both demand for and prices of major commodities, notably during the period from 2000 to 2011. These developments boosted national income and improved the savings-investment gap. Additionally, there was a marked decline in the poverty rate, from 55% in 2003 to 26% by 2012.

and 2015, a period when commodity prices fell, along with deceleration in the U.S. and China.

Figure 2
Peru: Current Account, 1993-2019

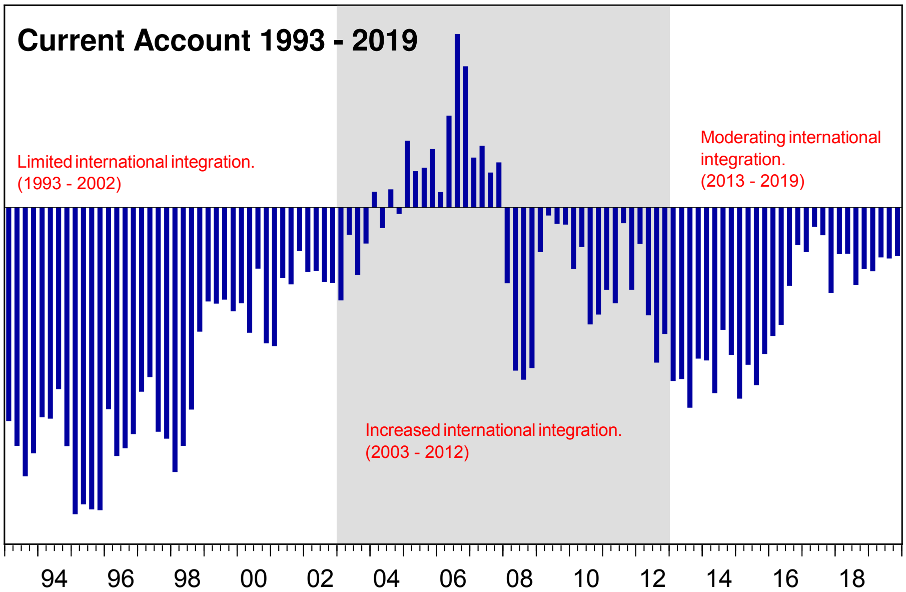


Figure 3
Peru: Savings - Investment, Terms of Trade

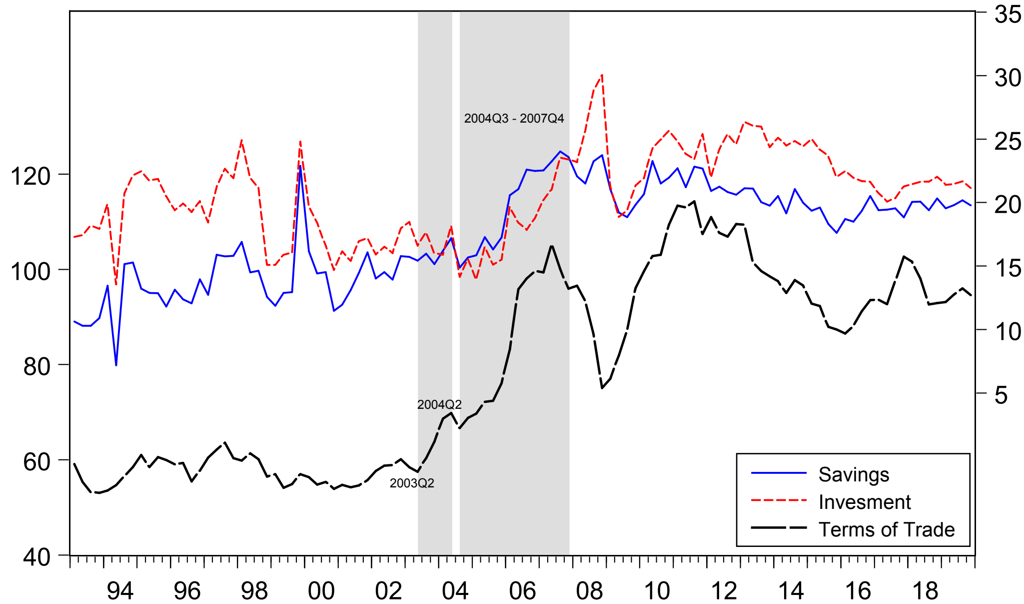
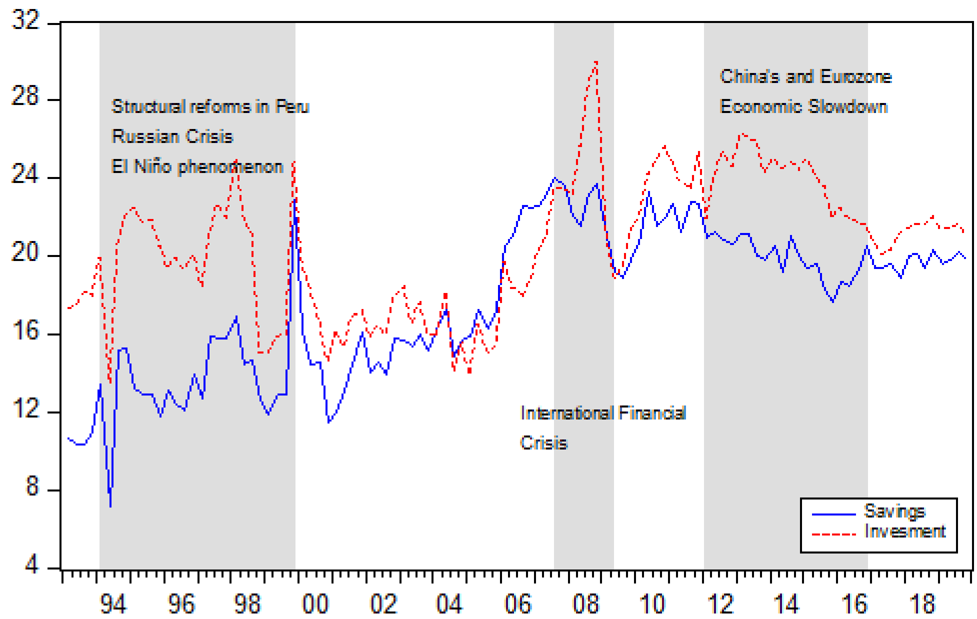


Figure 4
Peru: Savings and Investment, 1993-2019



3.2.1 The Model

The terms of trade index (TOT_t) is calculated as the ratio between the export price index (IPX) and the import price index (IPM):

$$Ln\ TOT_t \equiv Ln\ IPX_t - Ln\ IPM_t$$

We focus on aggregate output (Y_t), consumption ($C_t = C_0 + \alpha Y_t$), savings ($S_t = S_o + sY_t$), exports (X_t), and imports ($M_t = \mu Y_t$), setting aside government spending (G_t) and transfers due to their political nature. The current account (CC_t) reflects trade in goods and services with the world, emphasizing the role of external savings ($S_E = M_t - X_t$) and national savings ($S_N = Y_t - C_t$), yielding the economy's total savings:

$$S_t = S_N + S_E = Y_t - C_t - X_t + M_t$$

Since the trade balance largely composes the current account, it simplifies to:

$$CC_t = Y - C_t - I_t = X_t - M_t$$
$$CC_t = S_t - I_t = X_t - M_t$$

Following Uribe y Schmitt-Grohé (2017), the export value (X_t),[8] expressed as a function of import prices, with q_t representing export volume, is given by $X_t = TOT_t.q_t$. This illustrates how shifts in the terms of trade can necessitate increased exports to sustain import levels, directly impacting income.[9] Furthermore, negative shocks to import prices, particularly for essential imported inputs like oil, corn, and wheat, can significantly raise costs, affecting both the income and savings of households and businesses. Starting from national income:

$$Y_t = \frac{C_t + I_t + TOT.q_t}{1 + \mu - \alpha}$$

the relationship between terms of trade and the current account is outlined as:

$$\begin{aligned}
CC_t &= S_t - I_t = X_t - M_t = TOT_t.q_t - \mu Y_t \\
CC_t &= X_t - M_t = TOT.q_t - \frac{\mu(C + I + TOT_t.q_t)}{1 - \alpha + \mu} \\
CC_t &= X_t - M_t = TOT.q_t - \frac{\mu C_t}{1 - \alpha + \mu} - \frac{\mu I_t}{1 - \alpha + \mu} - \frac{\mu TOT.q_t}{1 - \alpha + \mu} \\
CC_t &= X_t - M_t = \frac{1 - \alpha}{1 - \alpha + \mu} TOT.q_t - \frac{\mu(C_t + I_t)}{1 - \alpha + \mu}
\end{aligned}$$

This equation, incorporating the marginal propensity to save (s), where $s = 1 - \alpha$, captures the dynamics between savings, investment, and terms of trade:

$$CC_t = S_t - I_t = X_t - M_t = \frac{s}{s + \mu} TOT q_t - \frac{\mu(C_t + I_t)}{s + \mu} \tag{1}$$

analyzing the dynamics of Peru's economy through equation (1), key insights emerge:

- Equation (1) illustrates that an improvement in terms of trade[10] positively impacts the current account balance. Import price (IPM) shocks, viewed as detrimental to the terms of trade, contrast with export price (IPX) shocks, which are beneficial. Equation (1) shows their direct influence on the savings-investment gap.
- Enhancements in the terms of trade directly improve national income, highlighting the Peruvian economy's exposure to global price shifts, particularly in the mining sector. The sector's significance is magnified by the global demand for commodities,

[8] Consider the terms of trade as indicating how many units of imported goods can be purchased with one unit of exported goods.

[9] In real terms.

[10] Empirical evidence suggests that IPX shocks are primarily associated with the demand for commodities by highly industrialized countries, whereas IPM shocks relate to the prices of oil, corn, and wheat, among others. Studies such as Nolazco *et al.* (2016) link the price dynamics of major minerals to IPX shocks and the price of oil to IPM shocks.

driving increased capital investment toward resource exploitation. Ascarza Mendoza (2017) characterizes the commodity supply curve as inelastic, indicating that mining investments are highly responsive to global price trends, with market adjustments to external demand shifts immediately affecting prices.

- A surge in export goods (q_t) fosters a favorable current account position. The analysis suggests that unexpected positive investment shocks can strain the current account, underscoring how investment promotion policies extend beyond national income effects to influence Peru's standing in the global market and its current account performance.
- Given that Peru is a small, open economy, domestic policies wield limited influence on the global economy.

3.3 The Econometric Model

A Vector Error Correction Model (VECM) describes how variables adjust in response to deviations from long-term equilibrium, while a Structural Vector Error Correction Model (SVECM) facilitates the analysis and quantification of variable interactions. A SVECM identifies both contemporaneous and long-term impact matrices. We initiate our analysis with a reduced-form VAR model:

$$X_t = A_1 X_{t-1} + A_2 X_{t-2} + ... + A_p X_{t-p} + \Phi D_t + u_t \tag{2}$$

where X_t is a Kx1 vector, $(A_1, A_2, ..., A_p)$ are KxK coefficient matrices, D_t is a vector of deterministic components, and u_t is a Kx1 vector with zero mean and covariance matrix $E(u_t u_t^{'}) = \Sigma_u$, representing innovations in reduced form.

Transforming the VAR model (1) into a vector error correction form:

$$\triangle X_t = \Pi X_{t-1} + \Gamma_i \triangle X_{t-i} + ... + \Gamma_k \triangle X_{t-(p-1)} + \Phi D_t + u_t \tag{3}$$

where Π is a KxK matrix indicating endogenous variable lags, and Γ_i measures transitory effects. The behavior of the VECM is governed by the characteristic polynomial:

$$A(z) = (1-z)I_p - \Pi - \sum_{i=1}^{p-1} \Gamma_i (1-z) z^i \tag{4}$$

It is essential to acknowledge that $\triangle X_t$ signifies variables in their differenced form, which guarantees stationarity on one side of equation (3). However, to ensure stationarity across the equation, the properties of the Π matrix must be carefully assessed. The rank of Π, denoted as $rk(\Pi)$, reflects the number of linearly independent rows it contains, i.e., the number of linear combinations possible within the matrix. Based on this, and following the structural analysis proposed by Lütkepohl (2006), three scenarios emerge:

- *i)* $rk(\Pi) = K$, indicating all K linearly independent combinations are stationary. Consequently, deviations of X_t around its deterministic component are stationary, typically represented by VAR models in their reduced form.

- *ii)* $rk(\Pi) = 0$, where no linear combination can render ΠX_t stationary, corresponding to a differenced VAR model.

- *iii)* $0 < rk(\Pi) = r < K$, meaning the Π matrix lacks full rank. In this scenario, matrices α and β' exist such that $\Pi = \alpha\beta'$, making $\alpha\beta' X_{t-p}$ stationary.

Assuming scenario *iii)* and referring to equation (4), if $z = 1 \rightarrow A(1) = \Pi = 0$, the rank of Π is incomplete and equal to $r < K$, implying that Π can be decomposed as $\Pi = \alpha\beta'$, where α and β are matrices of order (Kxr) with columns of full rank.

An nx1 vector of variables X_t is considered cointegrated if there exists at least one n-element non-zero vector $\beta_i(1, 2, ..., r)$ with a cointegration rank r, where $\beta_i' X_t$ is stationary and β_i is the cointegration vector. Notably, α pertains to the adjustment speed of each variable to deviations from long-term cointegration relationships, and β' is the coefficient matrix with r cointegration relationships. Thus, utilizing a Type B model as outlined by Lütkepohl (2006), the VECM can be organized as follows:

$$\triangle X_t = \alpha\beta' X_{t-1} + \Gamma_i \triangle X_{t-i} + ... + \Gamma_k \triangle X_{t-(p-1)} + \Phi D_t + B\varepsilon_t \tag{5}$$

where $\beta' X_{t-1}$ is considered a stationary linear combination, meaning $\Pi X_{t-1} = \alpha\beta' X_{t-1}$ acts as the error correction mechanism.

The reasoning applied to structural models can be extended to VECM (now considered as SVECM). It is important to note that the cointegration properties of the series are not used to identify structural disturbance constraints. In equation (5), $B\varepsilon_t = u_t$ y $\varepsilon_t \sim N(0, I_K)$, facilitating the analysis of structural shocks:

$$\Sigma_u = E[u_t u_t'] = BE[\varepsilon_t \varepsilon_t']B = B\Sigma_\varepsilon B' \tag{6}$$

Assuming $\Sigma_\varepsilon = I_K$ yields $\Sigma_u = BB'$, noting the need to identify $K(K-1)/2$ linearly independent constraints in B. Additionally, considering the decomposition proposed by Beveridge y Nelson (1981) para X_t:

$$X_t = \Xi \sum_{i=1}^{t} u_i + \sum_{j=0}^{\infty} \Xi_j^* u_{t-j} + y_0^* \tag{7}$$

where X_t is decomposed into parts integrated of order one and zero. $\Xi \sum_{i=1}^{t} u_i$ represents long-term shocks, capturing common stochastic trends, with the Ξ matrix being of reduced rank K-r and accounting for cointegration relationships. Thus, Ξ is defined as:

$$\Xi = \beta_{\perp}[\alpha_{\perp}^{'}(I_K - \sum_{i=1}^{p-1} \Gamma_i)\beta_{\perp}]^{-1}\alpha_{\perp}^{'} \tag{8}$$

Identifying transitory and permanent shocks. Our focus is on capturing long-term effects and identifying shocks, which leads us to define equation (7) as follows:

$$X_t = \Xi B \sum_{t=1}^{t} \varepsilon_i + \sum_{j=0}^{\infty} \Xi_j^* B \varepsilon_{t-j} + y_0^* \tag{9}$$

The ΞB matrix, with rank K-r, where r denotes the cointegration relationships, implies that there are K-r common stochastic trends driving our system. Understanding the rank of ΞB allows us to deduce that r of the structural errors exert transitory effects, and K-r of them have permanent impacts. This suggests that up to r columns of ΞB can be set to zero. Thus, the K existing structural shocks can be categorized into K-r permanent shocks and r transitory shocks.[11] Moreover, ΞB represents the matrix of long-term shocks, while B denotes the matrix of contemporaneous shocks.

It is feasible to integrate the decomposition proposed by Beveridge y Nelson (1981) with the dynamics between VECM error terms and structural innovations, as $\Xi B \sum_{t=1}^{t} \varepsilon_t$ encapsulates common stochastic trends or, in other words, the long-term impacts of structural innovations. Meanwhile, Ξ^*, being integrated of order zero, is presumed to have a bounded cumulative effect that converges to zero as $j \to \infty$.

Identification is achieved through constraints on long-term multipliers, assuming that permanent components are not correlated with transitory ones. The KxK long-term multiplier matrix will include a column of zeros for the variable affected only by transitory shocks. Economic theory plays a crucial role in setting these constraints, while the short-term matrix is considered without restrictions.

[11] The number of transitory shocks will match the number of cointegration relationships.

4 Empirical Approach

4.1 Unit Root Tests

The first step in time series analysis involves assessing the presence of unit roots,[12] a critical factor in determining the series' characteristics and guiding the selection of an appropriate econometric model. It is noteworthy that macroeconomic series often exhibit trends or are influenced by lasting innovations, typifying them as non-stationary. Initial examinations, as presented in Table 6, rely on the pioneering tests developed by Dickey y Fuller (1979), Said y Dickey (1984), and Phillips y Perron (1988). These tests reveal that both IPX and IPM exhibit unit roots. Advancements in unit root analysis, particularly aimed at addressing the diminished power of traditional tests, are reflected in the methodology applied in Table 7, showcasing the approach suggested by Ng y Perron (2001). The latter utilizes M-type statistics that offer a lower distortion level in the presence of serial correlation errors, thereby enhancing the reliability of unit root detection.

The use of M-type statistics, as discussed by Romero-Ávila y Usabiaga (2012), instills confidence that the non-rejection of the null hypothesis of stationarity is not merely due to the conventional tests' lack of statistical power. Table 8 further explores this concept through the application of the Generalized Least Squares (GLS) method for detrending, as proposed by Perron y Rodríguez (2012). This methodological choice underscores the benefits of employing M-type tests for their enhanced power for detrending. The consistency of unit root presence in IPX and IPM is confirmed in Tables 7 and 8, though the findings for investment and savings show variability. The approach proposed by Perron y Rodríguez (2012), which accommodates structural breaks, maintains the assumption of non-trivial effects on test power. The analysis is broadened with the test proposed by Cavaliere *et al.* (2011), illustrated in Table 9, employing bootstrap critical values. The advantage of this approach lies in its independence from specific parametric volatility models, supporting the unit root hypothesis across all examined series.

4.2 Empirical Evidence: Savings-Investment, Terms of Trade

4.2.1 Cointegration

The results indicate that all series are consistent with the unit root hypothesis. The next step is to determine whether these series are cointegrated, aiming to establish if they

[12] A time series comprises observations of a variable's values over time, confronting researchers and policymakers with challenges such as trends or sustained innovations. The importance of time series analysis for both research and policy design has fostered a rich body of literature; e.g., Nelson y Plosser (1982) and Phillips y Perron (1988), which have significantly influenced analytical methods and debate in the field.

move together and if the differences between them are stable, as cointegration suggests a long-term relationship. We consider the Johansen (1995) approach, which posits that series are cointegrated if there is at least one linear combination that becomes stationary, typically applied in settings where all system variables are $I(1)$. This method employs a maximum likelihood estimation approach, utilizing both the trace test and the maximum eigenvalue test. According to Hjalmarsson y Österholm (2007), building on Johansen (1995), the tests are defined as:

$$J_{traza} = -T \sum_{i=r+1}^{n} Ln(1 - \hat{\lambda_i})$$

$$J_{max} = -TLn(1 - \hat{\lambda_{r+1}})$$

where T represents the sample size and $\hat{\lambda_i}$ is the ith canonical correlation. Conceptually, it is important to recognize that canonical correlation primarily seeks to identify the relationships between two sets of variables and their joint validity in predicting multiple dependent variables.

The findings reveal cointegration among IPX, IPM, private investment, and private savings. However, when evaluating the vector including IPX, IPM, public and private investment, and public and private savings, there is no evidence of cointegration, leading to the exclusion of public variables from the analysis. Furthermore, empirical evidence suggests that public variables are largely influenced by political decisions aimed at short-term objectives. Tables 11 and 12 show the results considering two lags and excluding public variables, while Table 13 displays the outcomes for all variables.

4.2.2 Econometric Model

The initial findings from the VAR model indicate that the series are integrated of order 2 (p=2), and the Johansen (1995) test reveals at least one cointegration relationship (r=1). The presence of a unit root across all series, coupled with at least one cointegration link, allows for the implementation of both a VECM and a SVECM.[13]

4.2.3 Initial Results, VECM

Given that the VAR model incorporates p lags, the corresponding VECM will have $p-1$ lags. Our initial approach aims to identify the cointegration vector and adjustment coefficients β' and α, respectively. With savings positioned as the most endogenous

[13]Given the presence of cointegration among series, alternative approaches should not be overlooked, as discussed by Park (1992) and Montalvo (1994). Additionally, in building the VECM and SVECM we considered Lütkepohl (2006) and Pfaff (2008).

variable in our ordering, the VECM is structured as follows:

$$\triangle X_t = \underbrace{\Pi}_{\alpha\beta'} X_{t-1} + \Gamma_1 \triangle X_{t-1} + u_t \tag{10}$$

where:

$$\Pi = \alpha\beta' = \begin{pmatrix} \alpha_{IPX} \\ \alpha_{IPM} \\ \alpha_I \\ \alpha_S \end{pmatrix} (\beta_{IPX}\ \beta_{IPM}\ \beta_I\ \beta_S)$$

and the cointegration equation is:

$$S_{t-1} = -2.59\ I_{t-1} + 15.97\ IPX_{t-1} - 8.31\ IPM_{t-1} + 25.54 \tag{11}$$

For a nuanced interpretation, it is important to analyze the coefficients in equation (11), particularly noting the signs of IPM (-8.31), IPX (15.97), and investment (-2.59). The results suggest that a 1% variation in IPM will lead to a -8.31% adjustment in the non-deterministic component of savings. Similarly, a 1% change in IPX will alter the non-deterministic savings component by 15.97%. The directional consistency of these coefficients aligns with economic theory, highlighting the impact of IPM on savings due to its direct influence on import prices and inflation,[14] negatively affecting savings and, consequently, public welfare. This underscores the critique of trade policy design in small, open economies like Peru. Conversely, IPX is found to exert positive effects on savings, thus influencing welfare. Complementing the cointegration equation, the adjustment coefficient vector is:

$$\alpha = \begin{pmatrix} \alpha_{IPX} \\ \alpha_{IPM} \\ \alpha_I \\ \alpha_S \end{pmatrix} = \begin{pmatrix} -0.0020 \\ -0.00026 \\ -0.16 \\ -0.12 \end{pmatrix}$$

In response to deviations from the trend, investment adjusts for 16% of the imbalance each period, IPX by 0.20%, and IPM by merely 0.002%. The slight adjustments from IPX and IPM reflect their reliance on market forces and external dynamics. Over the long run, the variables are vulnerable to temporary shifts, with investment significantly correcting collective imbalances. A variable is deemed weakly exogenous if it shows no adjustment to long-term equilibrium deviations. The results indicate that all coefficients of the α vector are significant, leading to the conclusion that the variables are strongly exogenous or adjust to short-term deviations.

[14] Exchange rate pass-through.

4.2.4 SVECM Analysis

Our structural examination utilizes equation (5) and the MA decomposition proposed by Beveridge y Nelson (1981):

$$X_t = \Xi B \sum_{t=1}^{t} \varepsilon_i + \sum_{j=0}^{\infty} \Xi_j^* B \varepsilon_{t-j} + y_0^* \tag{12}$$

The ΞB matrix represents long-term shocks and has a reduced rank $(K - r)$. The contemporaneous effects of structural errors are contained in the B matrix. With $K = 4$ and $r = 1$ in a system with r cointegration relations, we have $K - r = 3$ shocks with permanent effects and $r = 1$ with transitory effects, implying that at most $r = 1$ columns in ΞB can be set to zero. To identify structural shocks in the SVECM, given $K = 4$, we need $4(4 - 1)/2 = 6$ linearly independent restrictions. The depictions of long-term (ΞB) and short-term (B) shock matrices, with $r = 1$ leading to a zeroed column in ΞB, are as follows:

$$\Xi B = \begin{bmatrix} * & 0 & 0 & 0 \\ * & * & * & 0 \\ * & * & * & 0 \\ * & * & * & 0 \end{bmatrix}; B = \begin{bmatrix} * & * & * & * \\ * & * & * & * \\ * & * & * & * \\ * & * & * & * \end{bmatrix} \tag{13}$$

The short-term matrix is unrestricted as it identifies transitory shocks. It is necessary to link the shocks through economic theory, considering equation (5) and understanding that $u_t = B\varepsilon_t$. Our structural analysis focuses on sensitivity to structural shocks $[\varepsilon^{IPX}, \varepsilon^{IPM}, \varepsilon^{I}, \varepsilon^{S}]$ within the proposed order $[IPX_t, IPM_t, I_t, S_t]$.

The assumed ordering is based on a lower triangular matrix, arranging variables from least to most endogenous. The savings shock (ε^S) is deemed transitory (i.e., its entire column is zeroed in the long-term matrix), while shocks to the export price index (ε^{IPX}), the import price index (ε^{IPM}), and investment (ε^I) are considered permanent. IPX and IPM are seen as the least endogenous variables because their dynamics are more influenced by external factors.

Additionally, Uribe y Schmitt-Grohé (2017) outline several empirical regularities showing that in EMEs, exports are more volatile than imports, and investment fluctuates more than consumption across all proposed scenarios. These insights position IPX as the variable most influenced by external dynamics, followed by IPM, which is linked to the decisions of domestic economic agents.

Tables 4 and 5 display the effects of shocks in the short and long term, respectively.

Notably, ε^{IPX} and ε^{IPM} predominantly impact investment. Moreover, the results show that the influence on investment is more significant than on savings, regardless of whether the shocks are positive or negative.

Table 4
Short-term shock matrix

	ε^{IPX}	ε^{IPM}	ε^{I}	ε^{S}
IPX	0.04169	0.01414	0.00000	0.01931
IPM	0.01040	0.02171	-0.00419	0.00293
I	-1.01198	-0.09168	0.73589	1.44536
S	-0.47263	-0.26662	-0.83027	1.06431

Note: The ordering considers IPX as the least endogenous variable.

Table 5
Long-term shock matrix

	ε^{IPX}	ε^{IPM}	ε^{I}	ε^{S}
IPX	0.0793	0.0000	0.0000	0.0000
IPM	0.0344	0.0244	-0.0028	0.0000
I	0.3774	0.0683	0.3324	0.0000
S	0.0033	-0.4365	-0.8589	0.0000

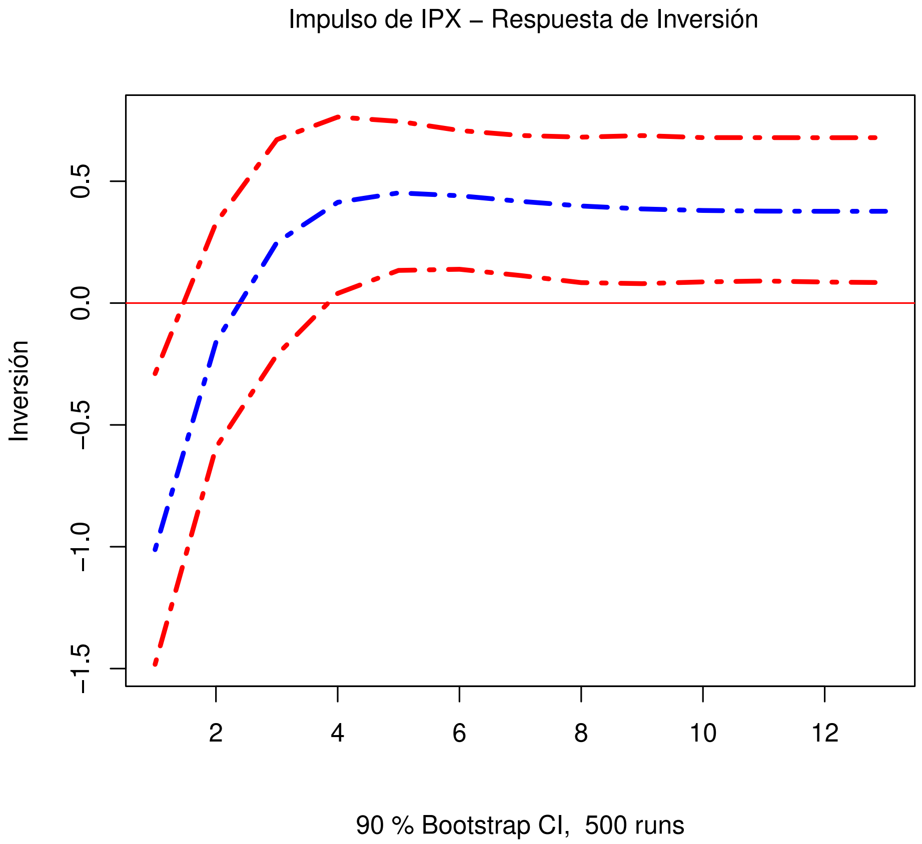
Note: The ordering considers IPX as the least endogenous variable.

4.2.5 Impulse Response Function

a) IPX shock (ε^{IPX}): A positive ε^{IPX} has a significant effect on investment, resulting in a narrowing of the savings-investment gap in the initial two quarters. The analysis indicates that starting in the third quarter, investment growth surpasses savings growth, inducing an expansive effect. This impact of the IPX shock on savings is predominantly short-term in nature and could be analyzed through various perspectives, ranging from the intertemporal consumption function to the relatively minor role of savings in the Peruvian economy. Figures 5 and 6 show the predominance of investment over time.

The impact of external shocks on income is predominantly short-term, making welfare measures unsustainable. From the fourth quarter onward, the response to an IPX shock results in an approximate 0.4% increase in investment, whereas the reaction in savings consistently remains below 0.1% across all periods. The global context significantly influences Peru's economy, as evidenced during the high-growth period, marked by current account surpluses, the GFC, and a commodity price boom.

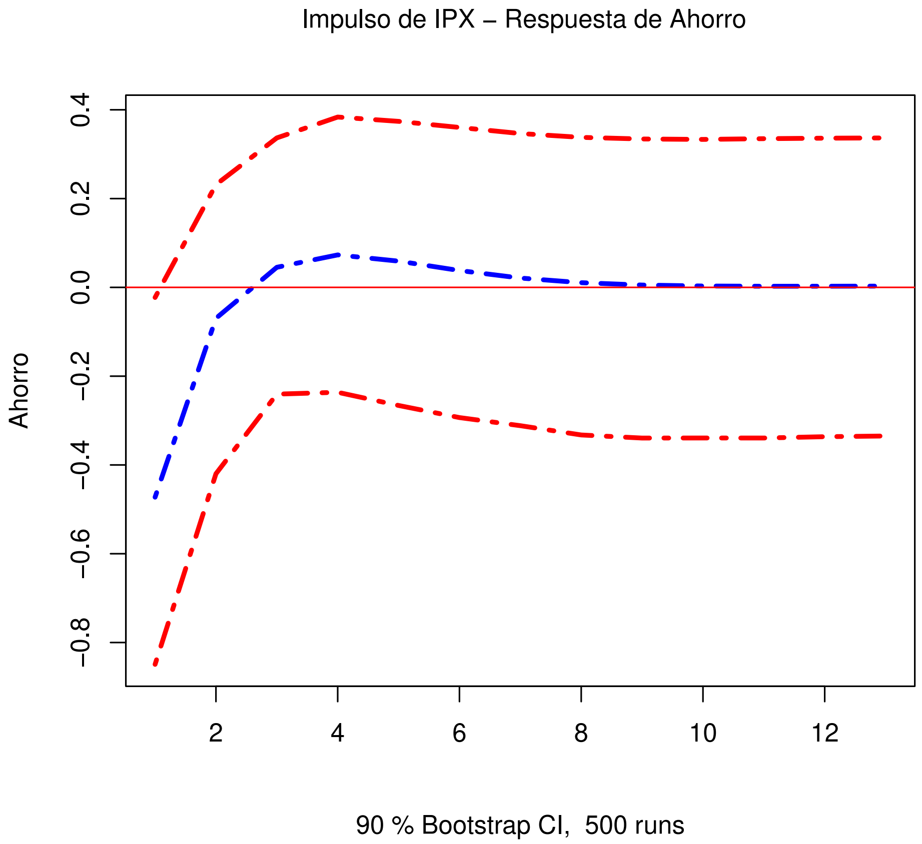
Figure 5
IPX Shock: Investment Response



Note: The impulse response functions were analyzed using the bootstrap method at 90% confidence. The reference period is quarterly.

From 2002 to 2007, export prices increased more significantly than import prices, a trend linked to global economic expansion. EMEs assumed a more significant role during this period, marked by higher growth rates and a beneficial shift in the terms-of-trade index, predominantly driven by the IPX. Consequently, the post-2003 to 2013 period saw Peru's growth rates dwindle to around 3%, illustrating the transient impact of external shocks on the economy. This vulnerability is primarily attributed to the unsustainable nature of savings and the economy's sensitivity to commodity price fluctuations. Figure 6 demonstrates the negligible impact (less than 0.1% across all periods) of the IPX impulse on savings.

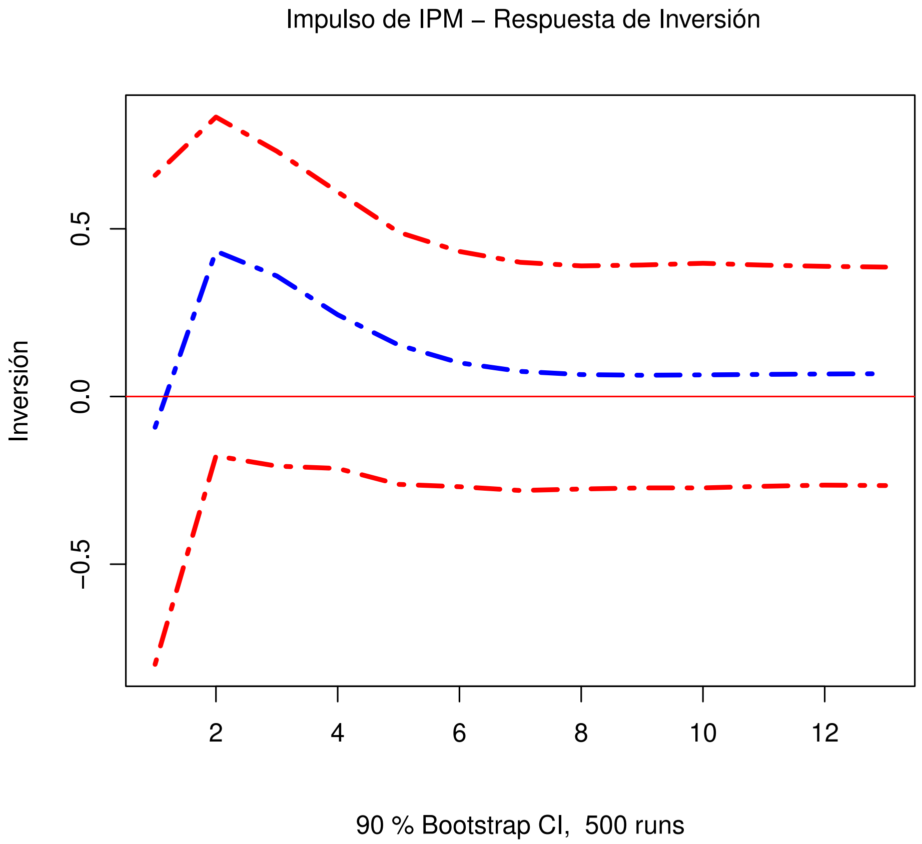
Figure 6
IPX Shock: Savings Response



Note: The impulse response functions were analyzed using the bootstrap method at 90% confidence. The reference period is quarterly.

b) IPM shock (ε^{IPM}): ε^{IPM} contracts investment in the short term and exerts minimal influence on savings. Fluctuations in the terms of trade, triggered by ε^{IPM}, affect household income and, consequently, savings; and compel firms to optimize their investment strategies.

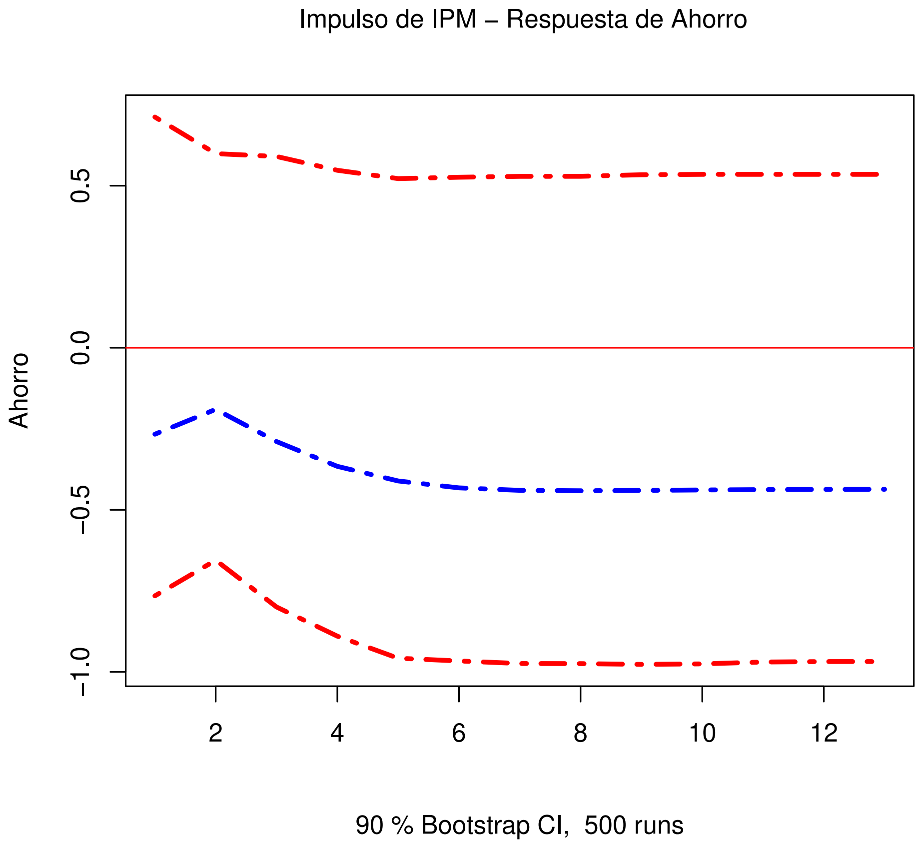
Figure 7
IPM Shock: Investment Response



Note: The impulse response functions were analyzed using the bootstrap method at 90% confidence. The reference period is quarterly.

The results reveal that an IPM shock positively affects investment until the second quarter before gradually declining, with limited relevance to savings. Our focus is predominantly on short-term effects due to the dynamics of the terms of trade.

Figure 8
IPM Shock: Savings Response



Note: The impulse response functions were analyzed using the bootstrap method at 90% confidence. The reference period is quarterly.

Many locally produced goods require imported inputs, so ε^{IPM} affects households and businesses by increasing the cost of inputs, capital goods, and imported consumer goods. These IPM shocks directly influence the price movements of commodities such as oil, corn, and wheat, impacting the domestic market dynamics and the decisions of economic agents. This affects both business and household expectations, with the investment channel showing the most significant reaction. Figures 7 and 8 demonstrate that ε^{IPM} worsens the terms-of-trade index, with investment responding most significantly to the impact generated by external dynamics, albeit only in the short term.

c) Error variance decomposition: Error variance decomposition quantifies the percentage contribution of each variable to overall volatility in the presence of shocks, correlating the prediction error variance of each variable with the model's unexpected shocks. This analysis, spanning a 20-quarter horizon, examines the effects of ε^{IPX} and ε^{IPM} on savings and investment. Disaggregating the terms of trade and current account for variance decomposition helps identify which variable is the primary source of uncertainty. Table 18 shows ε^{IPX} and ε^{IPM} contribute about 32.81% and 5.35%, respectively, to the variability in investment. For savings, as detailed in Table 19, ε^{IPX} and ε^{IPM} contribute an average of 2.85% and 13.79%, respectively. This suggests that variability in savings is more influenced by domestic shocks, especially investment expansion, with IPM shocks emerging as a significant uncertainty factor for savings. At the same time, ε^{IPX} is identified as a critical source of uncertainty for investment, with its impact growing over time. These results are consistent with Aquino y Espino (2013), who highlight the impact of IPX shocks on investment variability, and with Mendoza y Collantes (2018), who find that external factors account for 54% of the variability in private investment, pinpointing export prices as a key channel between private investment in Peru and the global economy.

5 Conclusions

Welfare measures and their assessment involve a variety of indicators that, as economic thought evolves, are subject to critique and framed within abstract and objective viewpoints. Yet, the ultimate debate revolves around quality of life and the conditions in each economy. Peru adopts a unidimensional approach to poverty measurement, which gauges poverty status based on household monthly per capita expenditure. This approach faces criticism for overlooking aspects related to healthcare, access to technology, education, financial inclusion, labor conditions, and job creation. These variables align with sustainable development goals and poverty reduction efforts. However, EMEs are often constrained by the market characteristics of their economies.

Over the past 30 years, the Peruvian economy has navigated scenarios marked by developments like the establishment of BCRP autonomy and a growing engagement with the world's largest commodity consumers. In recent years, the Peruvian economy has notably developed its market and emphasized policies that promote private investment and international trade. As a small and open economy, Peru is significantly influenced by major global economic events, particularly through their impact on metal and oil prices.

This document examines the current account (savings-investment gap) and terms of trade (export and import price indices) in detail. Terms of trade reflect the effects of external dynamics and influence economic agents' decisions, and the current account provides insights into a country's trade and financial interrelations with the rest of the world. This paper seeks to analyze both variables, as they encompass important flows and contribute to shaping market conditions and the resulting benefits.

Since 2000, the Peruvian economy has benefited from high commodity prices alongside a strategic shift towards expanding FTAs, thereby enhancing income, reducing unemployment, and improving productivity. This improvement necessitates that Peruvian businesses refine their production strategies to remain competitive. A critical question arises regarding the optimal utilization of the commodity boom by Peruvian policymakers. While there was a notable decrease in monetary poverty from 2003 to 2019, the sustainability of this reduction is questioned, particularly in light of the adverse impacts post-COVID-19 pandemic.

Unit root tests reveal non-stationarity in the series, and the test by Johansen (1995) identifies at least one cointegration relationship among the variables. This finding underpins the subsequent analysis using a VECM and SVECM, as detailed in the appendices.

The Johansen (1995) cointegration test indicates a long-term association among private savings, private investment, IPX, and IPM, while public savings and investment are excluded. The VECM analysis highlights that IPM's influence on savings —through its direct impact on imported goods' prices and inflation— detrimentally affects welfare. The cointegration equation shows that IPM's long-term fluctuations have a significant effect on the non-deterministic component of savings, pointing to the challenges in policy design regarding the economy's response to external fluctuations. The critique extends to the broader context of trade integration, which exacerbates vulnerability to external dynamics without a robust domestic market to buffer these effects. Despite extended periods of economic growth, the limited sustainability of welfare indicators is largely due to Peru's vulnerability to external shocks. Additionally, the minor IPM and IPX adjustments in the long-term relationship underscore their market-driven nature and closer association with external dynamics. Hence, the durability and resilience of domestic indicators hinge on strategic policy decisions, highlighting that public variables do not exhibit a long-term correlation.

Positive terms-of-trade shocks improve the current account in the short term, enhancing the savings-investment gap up to the second quarter. Specifically, IPX shocks create significant benefits to the Peruvian economy, whereas IPM shocks cause distortions in savings. Variance decomposition reveals that savings uncertainty is mainly associated with IPM shocks, while IPX shocks predominantly affect investment, with external factors accounting for approximately 38.16% and 16.64% of investment and savings variance, respectively. The uncertainty induced by IPX and IPM shocks on the Peruvian economy has primarily short-term effects. A critical conclusion is that an unanticipated positive terms-of-trade shock benefits savings and investment. However, the benefits from these effects are not reflected in the welfare measures implemented by successive governments.

Generally, in response to IPM and IPX shocks, investment emerges as the dominant channel, heavily dependent on internal and external aggregate production movements. The push for private investment and its connection with broader trade agreements demanding higher competitiveness from Peru leads to adverse effects on savings.[15] The increasing demand for raw materials from the U.S. and China has necessitated further development and specialization in mining projects, creating significant employment opportunities in large-scale investment projects.

Terms-of-trade shocks significantly impact the Peruvian economy. However, domestic market conditions and short-term economic policy do not create an environment conducive to maintaining a growth trend that can promote a sound and sustainable welfare outlook.

The impacts of external shocks are predominantly short-term in nature, with investment responding with an approximate 0.4% increase to an IPX shock from the fourth quarter onwards, while savings' response remains below 0.1% across all periods. The Peruvian economy experienced its most significant growth between 2003 and 2013, a critical period for assessing Peru's interaction with the global economy, including current account surpluses, the GFC, and a commodity price boom, all of which directly contributed to unemployment reduction and monetary poverty alleviation. However, the COVID-19 pandemic underscored the unsustainability of these outcomes.

This research can be a basis for a more comprehensive analysis. It is crucial to acknowledge the interconnected impacts of shocks on consumption, government spending, and other macroeconomic variables, making this study an initial step toward broader inquiry. The relevance of terms of trade, especially post-2000, underscores the need for further exploration into their effects on GDP, unemployment, productivity, investment, savings, poverty, and other macroeconomic variables. Peru's exposure and sensitivity are increasingly linked to external rather than domestic policies and developments.

A future research agenda should include: i) developing an economic model for enhanced structural identification, incorporating sign restrictions and changing parameters;[16] and ii) adding a block of variables to account for international interest rates, BCRP monetary policy rates, and the evolution of the prices of oil and other significant commodities for Peru. Questions for further research revolve around whether market conditions induced by high demand for commodities have genuinely favored the Peruvian economy and whether the policies implemented have been appropriate and sustainable in terms of welfare.

[15] The global economy's response to major commodity price changes from 2012 to 2016 serves as a pertinent example. These fluctuations adversely affected the terms of trade, leading to a gradual annual decrease in trade gains. Consequently, more exports were required to purchase foreign goods and services, necessitating higher investment rates and resulting in reduced savings.

[16] Refer to Chávez y Rodriguez (2021) and Rodríguez y Vassallo (2021).

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A Appendices

A.1 Unit Root Tests

Table 6
Dickey-Fuller and Phillips-Perron Unit Root Tests

Augmented Dickey-Fuller Test			
Variable	W/ Intercept	W/ Intercept & Trend	W/o Intercept & W/o Trend
IPX	-1.1427	-1.7044	1.1562
IPM	-0.8646	-1.9952	1.7093
Priv. Investment	-4.3717***	-4.9922***	-0.3585
Priv. Savings	-2.3282	-4.8869***	0.7049
Phillips-Perron Test			
Variable	W/ Intercept	W/ Intercept & Trend	W/o Intercept & W/o Trend
IPX	-0.8788	-1.4750	1.4050
IPM	-0.9248	-1.5389	1.7269
Priv. Investment	-4.2827***	-4.9391***	-0.2586
Priv. Savings	-3.3844	-4.8956***	0.6658
Critical Values$^{(i)}$			
1%	-3.4925	-4.0460	-2.5869
5%	-2.8886	-3.4523	-1.9438
10%	-2.5813	-3.1516	-1.6147

*Nota: (i) One-tailed p-value proposed by MacKinnon (1996). A statistic lower than the critical value leads to the rejection of the null hypothesis of the presence of a unit root, *,**,*** indicate rejection of the null hypothesis at 1%, 5%, and 10% levels.*

Table 7
Ng-Perron Unit Root Test

		Intercept				Intercept & Trend			
		MZ_α^{GLS}	MZ_t^{GLS}	MSB^{GLS}	MPT^{GLS}	MZ_α^{GLS}	MZ_t^{GLS}	MSB^{GLS}	MPT^{GLS}
IPX		-0.100	-0.070	0.680	29.130	-6.810	-1.800	0.260	13.410
IPM		-0.520	0.480	0.910	34.250	-5.180	-1.560	0.300	1.740
Priv. Investment		-18.880***	-3.050***	0.160	1.370	-32.460***	-4.010***	0.120	2.880
Priv. Savings		-0.690	-0.370	0.530	18.010	-29.810***	-3.850***	0.120	3.090
Asymptotic	1%	-13.800	-2.580	0.170	1.780	-23.800	-3.420	0.143	4.030
Critical	5%	-8.100	-1.980	0.230	3.170	-17.300	-2.910	0.168	5.480
Values	10%	-5.700	-1.620	0.280	4.450	-14.200	-2.620	0.185	6.670

*Note: A statistic lower than the critical value leads to the rejection of the null hypothesis of the presence of a unit root, *,**,*** indicate rejection of the null hypothesis at 1%, 5%, and 10% levels.*

Table 8
Perron-Rodriguez Unit Root Test

		MZ_{α}^{GLS}	MZ_{t}^{GLS}	MSB_{t}^{GLS}
Priv. Savings		-15.8087	-2.8111	0.1778
Priv. Investment		-15.1211	-2.7471	0.1816
Critical	1%	-27.0000	-3.6600	0.1340
Values	5%	-22.9000	-3.3500	0.1450
	10%	-20.7000	-3.1900	0.1540

Note A statistic lower than the critical value leads to the rejection of the null hypothesis of the presence of a unit root.

Table 9
Cavaliere-Harvey-Leybourne-Taylor Unit Root Test

		MZ_{α}^{GLS}	MZ_{t}^{GLS}	MSB_{t}^{GLS}
Priv. Savings		-9.4060	-2.1690	0.2310
Priv. Investment		-10.8660	-2.3080	0.2120
Critical	1%	-16.2100	-2.8150	0.1730
Values	5%	-15.7100	-2.7100	0.1720
	10%	-23.1700	-3.3930	0.1460

Note: A statistic lower than the critical value leads to the rejection of the null hypothesis of the presence of a unit root.

A.2 Lag Selection Criteria

Table 10
Lag Selection

Selection Criteria			
AIC(n)	HQ(n)	SC(n)	FPE(n)
2	1	1	2

AIC: Akaike Information Criterion; HQ: Hannan-Quinn Information Criterion; SC: Schwarz Information Criterion; FPE: Final Prediction Error.

A.3 Johansen Cointegration Test

Table 11
Johansen Cointegration Test - 2 lags - W/ Intercept

Johansen Cointegration Test - 2 lags				
Test type: trace statistic, without linear trend and constant in cointegration				
Hypothesis	Trace	10%	5%	1%
At least 03	3.60	7.52	9.24	12.97
At least 02	12.42	17.85	19.96	24.60
At least 01	31.74	32.00	34.91	41.07
None	63.23	49.65	53.12	60.16
Test type: eigen max statistic, without linear trend and constant in cointegration				
Hypothesis	Max-eigen	10%	5%	1%
At least 03	3.6	7.52	9.24	12.97
At least 02	8.82	13.75	15.7	20.2
At least 01	19.32	19.77	22.00	26.81
None	31.49	25.56	28.14	33.24

The test considered the IPX, IPM, private savings, and private investment.

Table 12
Johansen Cointegration Test - 2 lags - W/ Trend

Johansen Cointegration Test - 2 lags				
Test type: trace statistic, with linear trend in cointegration				
Hypothesis	Trace	10%	5%	1%
At least 03	4.03	10.49	12.25	16.26
At least 02	22.2	22.76	25.32	30.45
At least 01	47.07	39.06	42.44	48.45
None	79.47	59.14	62.99	70.05
Test type: eigen max statistic, with linear trend in cointegration				
Hypothesis	Max-eigen	10%	5%	1%
At least 03	4.03	10.49	12.25	16.26
At least 02	18.17	16.85	18.96	23.65
At least 01	24.87	23.11	25.54	30.34
None	32.4	29.12	31.46	36.65

The test considered the IPX, IPM, private savings, and private investment.

Table 13

Johansen Cointegration Test - 2 lags - W/ Intercept

Johansen Cointegration Test - 2 lags				
Test type: trace statistic, without linear trend and constant in cointegration				
Hipótesis	Traza	10%	5%	1%
At least 05	2.77	7.52	9.24	12.97
At least 04	11.12	17.85	19.96	24.60
At least 03	26.13	32.00	34.91	41.07
At least 02	49.23	49.65	53.12	60.16
At least 01	75.01	71.86	76.07	84.45
None	111.15	97.18	102.14	111.01
Test type: eigen max statistic, without linear trend and constant in cointegration				
Hypothesis	Max-eigen	10%	5%	1%
At least 05	2.77	7.52	9.24	12.97
At least 04	8.36	13.75	15.67	20.20
At least 03	15.01	19.77	22.00	26.81
At least 02	23.1	25.56	28.14	33.24
At least 01	25.77	31.66	34.40	39.79
None	36.15	37.45	40.30	46.82

The test considered the IPX, IPM, private savings, and private investment.

A.4 VECM: Adjustment Vector & Cointegration Equation

Table 14
Adjustment Vector

Adjustment Vector (α)				
Variable	Estimate	Std. Error	t-value	Pr($\succ\mid t \mid$)
Priv. Savings	-0.122	0.000	-432.41	0.00004
Priv. Investment	-0.168	0.000	-456.36	0.00001
IPX	-0.002	0.001	-222.97	0.00010
IPM	0.000	0.000	55.398	0.00011

Table 15
Cointegration Equation

Cointegration Equation (β)				
Variable	Estimate	Std. Error	t-value	Pr($\succ\mid t \mid$)
Priv. Investment	-2.5936	0.0048	-543.6177	0.0001
IPX	15.9748	0.1337	119.5119	0.0001
IPM	-8.3116	0.2526	-32.9032	0.0001

A.5 Impulse Response Function

The impulse response functions were analyzed using the bootstrap method at 90 confidence. The reference period is quarterly.

Table 16

IPX Shock: Investment & Savings Response

Investment & Savings Response to an IPX Shock		
Period	Investment	Savings
1	-1.011	-0.47
2	-0.16	-0.06
3	0.24	0.04
4	0.41	0.07
5	0.45	0.05
6	0.44	0.03
7	0.41	0.02
8	0.39	0.01
9	0.38	0.005
10	0.38	0.003

Table 17

IPM Shock: Investment & Savings Response

Investment & Savings Response to an IPM Shock		
Period	Investment	Savings
1	-0.091	-0.2666
2	0.4333	-0.1899
3	0.3592	-0.2892
4	0.2438	-0.3657
5	0.1536	-0.4108
6	0.1004	-0.4321
7	0.0748	-0.4410
8	0.0653	-0.4399
9	0.0634	-0.4386
10	0.0665	-0.4375

A.6 Variance Decomposition

Table 18
Investment Variance Decomposition

INVESTMENT VARIANCE DECOMPOSITION				
PERIOD	IPX	IPM	INVESTMENT	SAVINGS
1	27.96%	0.23%	14.78%	57.03%
2	23.48%	4.39%	15.47%	56.66%
3	22.09%	6.46%	17.21%	54.24%
4	23.40%	7.02%	18.47%	51.11%
5	25.39%	6.97%	19.53%	48.12%
6	27.18%	6.76%	20.44%	45.62%
7	28.63%	6.54%	21.27%	43.55%
8	29.82%	6.34%	22.06%	41.78%
9	30.83%	6.16%	22.80%	40.21%
10	31.72%	6.00%	23.50%	38.79%
11	32.53%	5.85%	24.16%	37.46%
12	33.27%	5.72%	24.78%	36.23%
13	33.98%	5.59%	25.36%	35.07%
14	34.63%	5.47%	25.90%	33.99%
15	35.25%	5.36%	26.42%	32.97%
16	35.84%	5.26%	26.90%	32.00%
17	36.39%	5.16%	27.35%	31.09%
18	36.91%	5.07%	27.78%	30.24%
19	37.41%	4.98%	28.19%	29.42%
20	37.87%	4.90%	28.57%	28.65%
21	38.32%	4.82%	28.94%	27.92%
22	38.74%	4.75%	29.28%	27.23%
23	39.14%	4.68%	29.61%	26.57%
24	39.52%	4.61%	29.93%	25.94%
25	39.89%	4.54%	30.23%	25.34%

Table 19
Savings Variance Decomposition

SAVINGS VARIANCE DECOMPOSITION				
PERIOD	IPX	IPM	INVESTMENT	SAVINGS
1	10.55%	3.36%	32.57%	53.52%
2	7.93%	3.72%	43.46%	44.88%
3	6.24%	5.17%	52.05%	36.55%
4	5.20%	7.16%	57.61%	30.04%
5	4.41%	9.09%	61.37%	25.14%
6	3.79%	10.72%	63.99%	21.50%
7	3.31%	12.01%	65.93%	18.75%
8	2.94%	13.01%	67.43%	16.62%
9	2.64%	13.80%	68.64%	14.92%
10	2.39%	14.43%	69.63%	13.54%
11	2.19%	14.95%	70.45%	12.40%
12	2.02%	15.39%	71.16%	11.43%
13	1.88%	15.76%	71.76%	10.61%
14	1.75%	16.08%	72.28%	9.89%
15	1.64%	16.36%	72.73%	9.27%
16	1.54%	16.61%	73.13%	8.72%
17	1.46%	16.83%	73.49%	8.23%
18	1.38%	17.02%	73.80%	7.80%
19	1.31%	17.20%	74.09%	7.40%
20	1.25%	17.36%	74.35%	7.05%
21	1.19%	17.50%	74.58%	6.73%
22	1.14%	17.64%	74.80%	6.43%
23	1.09%	17.76%	74.99%	6.16%
24	1.05%	17.87%	75.17%	5.91%
25	1.01%	17.97%	75.34%	5.68%