External Shocks, Exchange Rate Adjustments, and Income Distribution in Egypt*

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Abstract

This study examines the complex dynamics of the Egyptian economy in response to external shocks and currency devaluation. Using a SAM-based CGE model, the research highlights the economic interactions between production sectors, households, government and the rest of the world. It explores resource competition in markets for production factors and goods, and on macroeconomic constraints such as the government budget, savings and investment, and foreign exchange revenues. Key findings reveal the substantial impact of differential domestic inflation (45%) and the challenges posed by limited foreign exchange inflows (32%) and deteriorating export competitiveness (19%). External shocks, including the COVID-19 pandemic and geopolitical events, have subtle impacts on GDP, employment, household consumption, and inequality. Sectoral analyses show varied effects across export-oriented and non-tradable industries. As Egypt contends with global challenges, the study emphasizes the need for targeted policies that balance export competitiveness, foreign savings, and domestic stability. The findings provide valuable insights for policymakers navigating the complexities of the dynamic global economy.

Keywords: Exchange Rate- External Shocks- Macroeconomics- Egyptian Economy- Computable General Equilibrium Models

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الصدمات الخارجية، تعديلات سعر الصرف، وتوزيع الدخل في مصر

ملخص

تستهدف هذه الدراسة تقدير الديناميكيات المعقدة للاقتصاد المصري في مواجهة الصدمات الخارجية وانخفاض قيمة العملة المحلية. وباستخدام نموذج التوازن العام المستند على مصفوفة الحسابات الاجتماعية SAM-based CGE model، تركز هذه الدراسة على تحليل التشابكات الاقتصادية بين القطاعات الإنتاجية، والقطاع العائلي، والحكومة، والعالم الخارجي، مع الأخذ في الاعتبار المنافسة على الموارد في أسواق عوامل الإنتاج والسلع، وكذلك القيود الاقتصادية الكلية على الموازنة العامة للدولة وعلى كل من الاستثمار والادخار، وعائدات النقد الأجنبي. وتكشف النتائج الرئيسية للدراسة عن وجود تأثير كبير للتضخم المحلي (45%)، والتحديات التي تفرضها محدودية تدفقات النقد الأجنبي (32%)، بالإضافة لتأثير تآكل القدرة التنافسية للصادرات (19%). كما تؤدي الصدمات الخارجية، ناهيك عن تداعيات جائحة كوفيد-19 والأحداث الجيوسياسية، إلى تأثيرات دقيقة على الناتج المحلي الإجمالي والتشغيل واستهلاك الأسر وعدم المساواة في مصر. وتشير التحليلات القطاعية إلى التأثيرات المتباينة على الصناعات الموجهة للتصدير والصناعات غير القابلة للاتجار. وفي ظل التحديات العالمية التي يواجهها الاقتصاد المصري، تؤكد الدراسة على ضرورة وجود سياسات تحقق التوازن بين كل من القدرة التنافسية للصادرات ومعدل الادخار والاستقرار الاقتصادي. وتسهم نتائج هذه الدراسة في تقديم رؤى عملية لصناع السياسات الذين يواجهون تعقيدات الاقتصاد العالمي الديناميكي.

الكلمات المفتاحية: سعر الصرف، الصدمات الخارجية، الاقتصاد الكلي، الاقتصاد المصري، نماذج التوازن العام.

1. Introduction

The Egyptian economy, characterized by a semi-industrialized structure, stands at the crossroads of global uncertainties, posing a formidable challenge to its economic stability. In this context, the study focuses on several dimensions of economic instability: macroeconomic, currency, financial and external. The study captures these aspects of economic instability through various target variables: GDP growth, inflation, exchange rate fluctuations, Balance of Payments indicators and exposure to external shocks. This study delves into the intricate dynamics of Egypt's economic landscape, particularly its response to external shocks and the consequential adjustments in exchange rates. As the nation grapples with significant global events, including the COVID-19 pandemic and geopolitical shifts, along with the impact of currency devaluation, understanding the interplay of these factors on key economic indicators and societal well-being becomes paramount.

The primary research problem addressed revolves around Egypt's resilience in the face of external shocks, with a specific focus on tradability and inter-sectoral linkages. Resilience, in an economic context, refers to the ability of an economy to absorb, recover from, and adapt to adverse external shocks while maintaining or quickly returning to a stable and sustainable growth trajectory. It involves the capacity to minimize the impact of shocks on economic performance, ensure the continuity of essential economic functions, and adapt to changing circumstances in a way that supports long-term economic stability and growth. The study captures resilience through simulation of external shocks. The rapidly changing global economic landscape necessitates an examination of Egypt's capacity to sustain growth and stability, requiring an in-depth analysis of relationships between various economic sectors, consumers, producers, the government, and the global market. The paper aims to decipher how shocks propagate through these channels and influence the equilibrium exchange rate, providing essential insights for devising effective economic policies.

Employing the International Food Policy Research Institute's (IFPRI) Rural Investment and Policy Analysis (RIAPA) Computable General Equilibrium (CGE) model, this study offers a detailed representation of Egypt's economic activities. Tailored to capture the distinctions of the nation's agricultural, industrial, and service sectors, this model illuminates the interdependencies and linkages that define Egypt's economic fabric. By grounding the analysis in a national Social Accounting Matrix (SAM) for 2019, the study establishes a benchmark equilibrium position, enabling an exploration of the intricate relationships that shape Egypt's response to external shocks.

Through an extensive simulation design, the study examines the potential impacts of external shocks and currency devaluation on crucial economic indicators such as GDP, employment, household consumption, and inequality. This research contributes not only by summarizing key insights but also by acknowledging the study's limitations and proposing avenues for future research and model refinement. It emphasizes understanding the broader implications of the findings for economic resilience and adaptive strategies. In navigating the challenges of a dynamic global economy, this structured exploration seeks to offer practical insights for policymakers and researchers alike.

1. Exchange Rate Policy in Egypt: Evolution, Reasons, and Effects of Past Devaluation Episodes

During the last two decades, the Egyptian pound (EGP) experienced major episodes of depreciation, the first of which was in 2003 when the price for US dollars (USD) increased to EGP 6.86 (from EGP 3.85). The second took place in 2016 when the EGP/USD exchange rate jumped from EGP 9 pounds to EGP 19. In March 2022, the Egyptian pound started a new round of depreciation, declining against the USD from EGP 16 to more than EGP 18. In late October 2022, there was a new round of depreciation to EGP 24 per USD, and again in January 2023, the Central Bank of Egypt (CBE) allowed the value of the pound to decline for the third time, reaching more than EGP 30 against the USD.

1.1. Exchange rate policy until 2003

Towards the end of the 1990s there were several events that affected the foreign exchange market. Most notably, the financial crisis in Southeast Asian countries (1997), and the decline in global oil prices. This led to pressure on foreign exchange reserves, and increased expectations of devaluation, and thus increased demand for the USD, leading to a continued decline in international reserves and the emergence of a parallel market for foreign exchange.

This prompted the CBE to devalue the Egyptian pound in January 2003, while maintaining the fixed exchange rate regime. The nominal exchange rate moved from EGP 3.85 to 6.86 against the USD. However, the long duration of these circumstances necessitated a decision to allow the exchange rate to float. This move aimed to enable the implementation of an autonomous monetary policy capable of managing the challenging economic conditions and alleviating the strain on foreign reserves.

Despite the announcement of the exchange rate float, the measures taken were closer to the system of managed float, and the exchange rate gradually stabilized. As a result of this devaluation, exports of goods and services increased in real terms from $16 billion in 2001, to $24 billion in 2004 and $29 billion in 2005. The annual real growth rate of exports increased almost five-fold—from 4.97 percent in 2002 to 25.32 in 2004. In addition, the share of exports in GDP rose from 17.48 percent to around 30 percent in 2005, leading to an improvement in the trade balance deficit, which declined from 4.35 percent in 2002 to only 1.36 percent in 2005. The current account surplus also witnessed a remarkable increase from 0.73 percent to 4.98 percent in 2004. This can be explained by the fact that devaluation makes imports more expensive, encouraging domestic production to replace imported goods. Therefore, this can reduce the import bill, improving the trade balance. The government may also have implemented policies to

support export sectors, attract foreign investment, and enhance economic stability. This multifaceted impact underscores the broader economic adjustments following the devaluation.

1.2. Exchange rate policy in 2016

The January 25, 2011, upheavals significantly impacted the Egyptian economy, but the exchange rate remained relatively stable around EGP 5.93 per USD during that year. However, by Q3 2016, the exchange rate weakened to EGP 8.8 per USD, primarily due to a decline in tourism revenues and real GDP (Maher, Zhao, and Tang 2022).

Starting from 2011, the current account deficit increased five-fold from $5.5 billion to around $20.9 billion in 2016, representing approximately 6.2 percent of GDP. This was attributed to the sharp fall in export revenue, which dropped by around 11 percent in 2014 and by another 15 percent in 2016. Exports of goods and services fell from $49 billion in 2013 to only $34.3 billion in 2016—a loss of more than $15 billion in real terms over 3 years. Imports of goods and services also declined by around 0.59 percent in 2014 and then by 2.2 percent in 2016, contributing to the widening of the trade deficit, which increased from 6.34 percent in 2013 to around 10 percent of GDP in 2016.

These circumstances led to devaluation of the Egyptian pound against the USD in the first half of 2017, reaching EGP 18.5. Subsequently, inflation rose, exceeding 33 percent in July 2017. As a result, Egypt adopted a contractionary monetary policy, raising the CBE policy rate, and adjusting the operational structure of monetary policy and increasing the unremunerated reserve requirement. With those monetary conditions stabilizing in the years that followed, and the exchange rate settled around EGP 15.9 to the USD by end of December 2019 (Osman 2018). Inflation also decreased significantly, dropping from 32.9 percent in July 2017 to 3.6 percent in November 2019. Foreign exchange reserves reached $45.1 billion, covering about 8.2 months of commodity imports in September 2019, compared to about $15.9 billion, covering 2.9 months of commodity imports in November 2014 (Elsherif 2016). This stabilization refers to achieving more stable inflation rates, controlled through contractionary monetary policies, and a more stable exchange rate of the Egyptian pound against the USD.

1.3. Exchange rate policy in 2022

The COVID-19 pandemic has had multifaceted impacts on the Egyptian economy, driven by disruptions in key sectors like tourism, trade, and remittances. The government has, therefore, had to cope with increasing fiscal pressures, inflation and unemployment while managing the public health crisis. No sooner had the Egyptian economy started to recover from the Covid-19 pandemic in 2021/2022 than the Ukraine war erupted,

causing serious economic damage, because of high reliance on food imports such as wheat, corn and sunflower oil. As a result of these import dependencies, Egypt experienced a major surge in food prices. In addition, Egypt witnessed a massive capital outflow, with large losses in reserves. Rising international cereal prices, international political uncertainty, increasing world interest rates, poor performance of Egypt's exports, and the bulge in debt payments provoked a flight of hot money and doubts about Egypt's ability to service its debts.Hence, in October 2022, the authorities decided to use the exchange rate instrument once again, devaluing the Egyptian pound dramatically against the USD on October 27, 2022, in the context of Egyptian government's attempts to secure a three-billion-dollar loan from the International Monetary Fund (IMF, 2023).

We can consider this approach a "managed floatation", where the Central Bank of Egypt intervenes by selling foreign exchange reserves when demand for foreign currency increases, and buying when supply rises. This strategy helps keep the exchange rate stable within a certain time frame. However, using foreign exchange reserves to stabilize the currency without implementing a comprehensive policy package creates uncertainty. This uncertainty arises because it may signal that underlying economic issues, such as inflationary pressures, fiscal deficits, or structural imbalances, are not being adequately addressed.

To tackle the currency challenge, Egypt took measures to enhance foreign exchange liquidity and stabilize the Egyptian pound. In particular, the CBE occasionally intervenes in the market to manage exchange rate fluctuations and mitigate excessive volatility. On the other hand, to confront currency challenges and promote economic stability, Egypt implemented a combination of monetary policies and structural reforms. The CBE has raised interest rates and increased reserve requirements to curb inflation and stabilize the pound, while also adopting an inflation-targeting framework and conducting open market operations to manage liquidity. Structural measures include regulatory reforms to improve the business environment, significant investments in infrastructure and human capital development, and sector-specific enhancements in agriculture and manufacturing. Trade facilitation and policies to attract foreign direct investment (FDI) complement these efforts. Together, these strategies aim to create a resilient economy capable of sustaining growth and withstanding external shocks.

The black-market exchange rates exacerbate the Egyptian government's challenges, as the growing disparity between official and unofficial rates fuels speculation. This speculation arises because economic agents lack confidence in the sustainability of the current policy measures. Consequently, this situation leads to

heightened volatility and uncertainty, undermining investor confidence and hindering economic recovery.

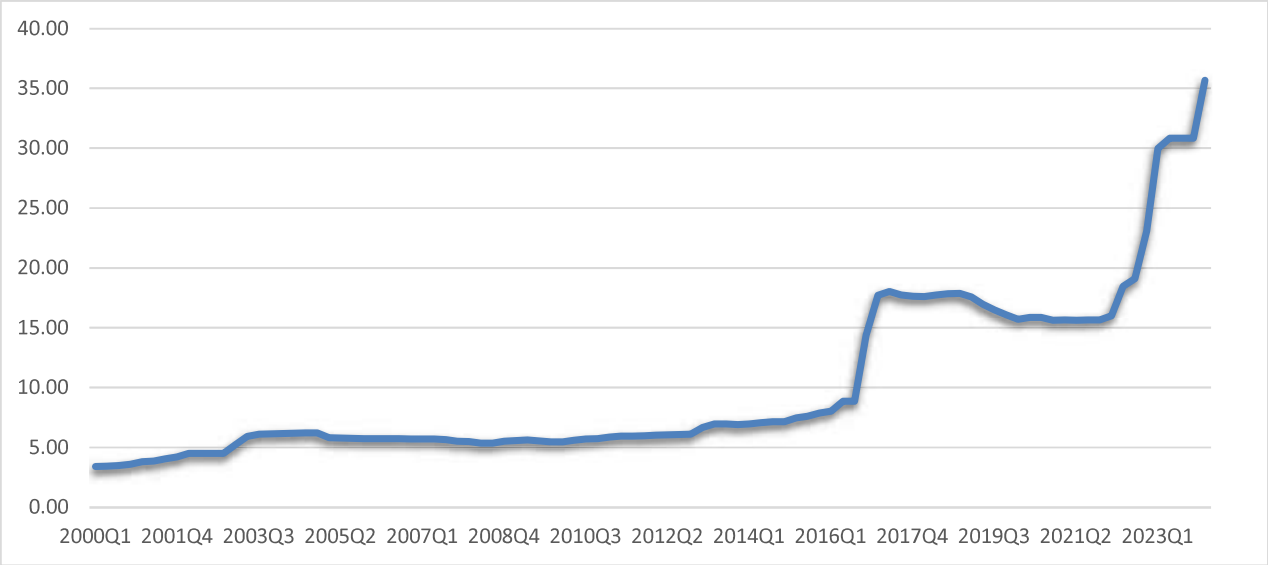

Figure (1): Nominal Exchange Rate Domestic Currency per US Dollar, Period Average

Source: International Monetary Fund, International Financial Statistics (IFS).

1.4. Pros and cons of flexible exchange rate

The advantages of floatation largely depend on the strength of a country's economy and the targets it aims to achieve. There is an opportunity in the devaluation of the EGP against the USD and other hard currencies with regard to the export sector, the tourism sector, and remittances.

In terms of exports, the devaluation of the EGP makes exported Egyptian commodities cheaper, thus more competitive vis-à-vis similar commodities from other countries. In terms of tourism, devaluing the pound will make Egypt a cheaper and thus a more attractive tourist destination, boosting tourism and injecting foreign currency into the economy. The same applies to remittances, which will increase in value with a devalued pound, implying that more money will arrive from Egyptians living in countries with stronger currency.

In addition, such a decision would also limit the import of luxury goods, reduce the travel and spending of Egyptians abroad, pushing people to buy local products and create more jobs locally.

It is claimed that a devaluation alone provides only temporary relief and does not instill confidence in investors. For enduring impact, it needs to be integrated into a

comprehensive policy package designed to enhance the economy's competitiveness in both real and financial sectors. Long-term sustainability depends on improving total factor productivity. This strategy will help restore market liquidity, increase foreign cash flows, rebuild investor confidence, resolve the foreign currency shortage crisis, and eliminate the long-standing subsidy burden.

On the negative side, adopting a floating policy as the USD appreciates against the local currency will lead to larger budget deficits as foreign debt servicing becomes costlier. This negative impact could be mitigated through various channels. First, economic policies should aim to enhance the competitiveness of production by fostering the supply side of the economy to provide more tradable goods targeted toward the export market. Second, fiscal imbalances should be better addressed, with the government targeting a reduction in the fiscal deficit. Additionally, monetary policy plays an important role in controlling further inflationary expectations (Hemming and Kochhar, 1990).

Another challenge concerns the growth rates of dollar-oriented industries. The discrepancy between the exchange rate of the pound before and after flotation can lead to significant changes in growth rates for sectors operating in the local market. These industries generate income in dollars, which, when converted to local currency, results in substantial increases in revenue growth. This situation can create disparities in income distribution and asset valuation. Without public policy measures for social protection, these changes can lead to adverse distributional effects. However, these are not distortions in macroeconomic outcomes or growth. Instead, the focus should be on reducing the budget deficit and temporarily limiting aggregate domestic demand until competitive industries and activities can stimulate the economy's recovery. This approach ensures that the economy stabilizes and grows sustainably in the long term.

As the CBE seeks to mitigate exchange rate fluctuations, maintaining a robust level of reserves becomes essential. However, addressing Egypt's enduring trade deficit requires a more strategic approach that prioritizes enhancing productivity growth and competitiveness. Instead of relying solely on import substitution programs and export-oriented policies, which can be costly and may lead to lower productivity, the focus should be on implementing policies that stimulate productivity growth while safeguarding vulnerable segments of the population. By prioritizing measures aimed at boosting productivity and competitiveness, Egypt can effectively tackle its balance of payments challenges in a sustainable manner.

Egypt has experienced a chronic deficit in both foreign trade and current account balances (Figure 2). The economy is vulnerable to external shocks because of its reliance

on volatile revenue sources, including tourism, the Suez Canal, and foreign remittances, in addition to insufficient productivity growth. This vulnerability has been manifested, inter alia, by three types of external shocks: a terms-of-trade shock, an export shock, and a foreign savings shock.

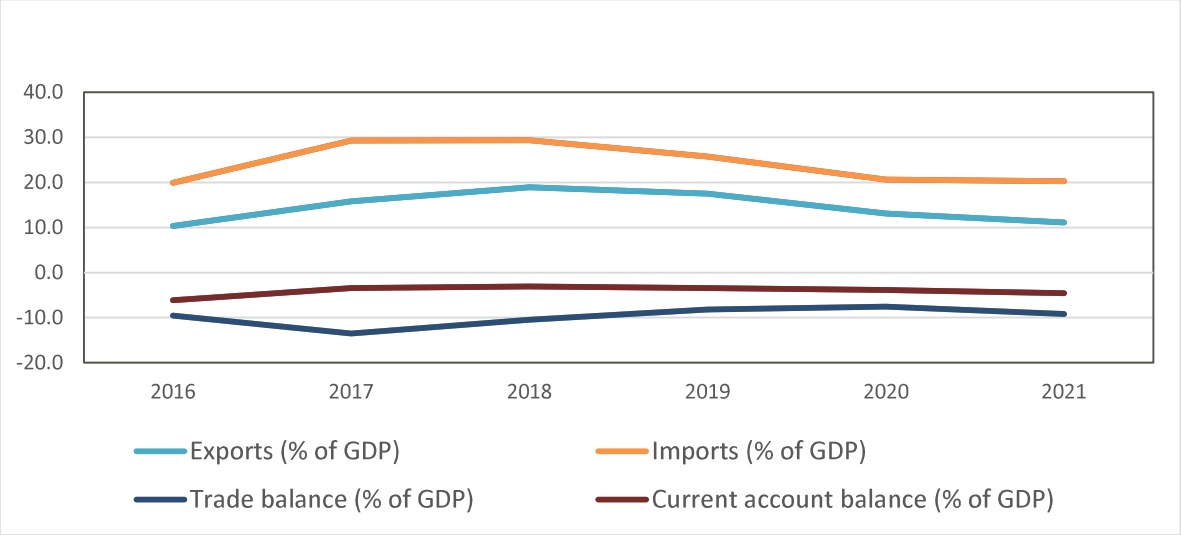

Figure (2): Foreign Trade and Current Account Balance, 2016-21 (% of GDP)

Source: www.cbe.org.eg/en/economic-research/time-series

2. Causes and Trends of Disequilibrium

Macroeconomic disequilibrium occurs when an economy is out of balance due to external shocks or internal policy distortions. This often manifests as unsustainable budget and trade deficits, exacerbated by overly lax monetary policies, making the economy vulnerable to external shocks. Fiscal imbalances, resulting from persistent budget deficits due to excessive spending or insufficient revenue, lead to increased public debt, inflation, crowding out of private investment, economic uncertainty, and reduced fiscal space. Addressing these issues requires sound fiscal policies, controlled expenditure, enhanced revenue, structural reforms, and effective debt management. Without these measures, there is limited capacity to manage shocks, potentially leading to further economic instability. On the one hand, external shocks might include massive and sudden capital outflows, natural disasters, and a terms-of-trade shock. On the other hand, an internal economic distortion might occur due to a structural bias towards favouring a specific sector in the economy. In addition, imbalances might occur because of the mismanagement of fiscal and monetary policies such as excessively flexible fiscal policy (e.g., a decrease in taxes or increase in government spending). All these sources of imbalances pose pressures on both the country's external balance of payments and the

level of domestic prices (Izquierdo et al., 2001). In this case, the actual exchange rate might deviate from its desired path, also leading to the erosion of foreign reserves. To prevent this loss, the government often opts to impose restrictions on foreign exchange transactions. However, the root causes of imbalances are not solved, and hence the problem is prolonged, and the situation might exacerbate. A disequilibrium is marked by significant shortages of foreign currency that are often associated with a balance of payments crisis. Therefore, governments usually aim to implement a structural adjustment program that is composed of a stabilization phase, followed by an economic reform phase. The stabilization phase usually entails a sizable devaluation of the domestic currency vis-à-vis the foreign currency (Edwards and Van Wijnbergen 1989).

Hence, devaluations or exchange rate adjustments are frequently used as a method of macroeconomic adjustment (Edwards and Van Wijnbergen 1989; Grekou 2019), through their influence on relative prices (Collier and Joshi 1989). However, these tools alone are not sufficient for comprehensive macroeconomic adjustment. Fiscal and trade policies, as well as a robust regulatory and institutional framework, are equally, if not more, important. Therefore, for devaluation to be effective, it must be accompanied by policies that slow down domestic aggregate demand growth, particularly through fiscal and monetary measures. Without these complementary policies, the impact of the devaluation will quickly dissipate, returning the economy to its original state of imbalance, as evidenced by Egypt's economic challenges over the past twenty years.

There are multiple theoretical explanations for the relationship between the balance of payments and exchange rates, that include mainly the elasticity approach, the absorption approach, and the other hypothesis known as the twin-deficit hypothesis. According to the elasticity approach, a country's current account can benefit from a real exchange rate depreciation since imports become more expensive while exports become less expensive and more competitive. However, the impact on the trade balance depends on two effects: the volume effect versus the value impact. When a currency depreciates, more products are exported and fewer are imported, which might lead to an improvement in the trade balance, only if the volume effect is larger than the value effect. In other words, the increase in import prices is offset by an increase in the quantity of exported goods (Amaral and Breitenbach, 2021).

According to the absorption approach of the balance of payments, a currency depreciation only benefits the current account if production increases more than the purchase of goods (Alexander, 1952; Amaral and Breitenbach, 2021). In this approach, there are two ways to affect the current account, either by reducing spending or by switching spending. Expenditure switching entails a change in spending from imported

to domestic products. Therefore, the success of a devaluation depends on its capacity to change or reduce spending, and whether there are underutilized resources that can help generate more real income and more output. If the elasticities are high enough, the first scenario will occur. By influencing relative prices, a devaluation might have an impact on the real exchange rate via the expenditure-switching channel. However, this assumes fairly efficient domestic markets with few distortions and a level playing field between the various agents operating in the economy. Again, productivity growth and competitiveness with appropriate social protection. A devaluation that raises prices and changes consumer spending could lead to an increase in the total amount of production across the economy (Edwards and Van Wijnbergen, 1989).

Nevertheless, it is reasonable to wonder whether reducing budget deficits will accelerate the process of containing external imbalances. This is relevant to the twin-deficits hypothesis, which asserts that an economy with a trade deficit also has a budget imbalance (Bluedorn and Leigh, 2011). If increased public spending or reduced taxes raise national income and, as a result, imports, the current account deficit may also result from the budget deficit (Helmy, 2018). Additionally, according to the current account targeting hypothesis, the external and government deficits have an inverse unidirectional connection (Afonso and Coelho, 2021).

2.1. Trade balance

Egypt's economy suffers from both internal and external sources of macroeconomic imbalances. By examining the sectoral composition of GDP, services accounted for around 52 percent of GDP in 2021, indicating that the Egyptian economy is mostly biased towards services. Compared to similar economies, such as those in the Middle East and North Africa (MENA) region, the service sector's share of GDP can vary, often ranging between 40 to 60 percent. While a strong service sector is not inherently negative, an overreliance on services at the expense of industrial and agricultural sectors can lead to vulnerabilities, particularly if the service sector is less competitive or less resilient to external shocks. From 2014 through 2021, agriculture's share of Egypt's GDP remained constant at about 11 percent. During the same period, the manufacturing sector's contribution to GDP decreased from around 40 percent to 30 percent due to several obstacles that limited its competitiveness. These obstacles include outdated infrastructure, complex regulatory frameworks, limited access to affordable financing, and a skills gap in the labor force. High energy costs, protectionist trade policies, and political and economic instability further exacerbate these challenges. Additionally, the slow adoption of modern technologies and insufficient investment in research and development hinder productivity and innovation. Therefore, the trade

deficit increased more than four times from 2004/2005 to 2021/2022, as imports grew faster than exports (Figure 3). This is due to the nature of Egyptian exports being mostly low-value manufactured products or raw materials, thus affecting revenue from exports. Furthermore, the import bill was substantially affected as Egypt, like all other economies, imports a diversity of items, including petroleum, wheat, machinery, and electronics, which have become more expensive in recent years because of factors such as the global economic crisis and rising oil costs. The increase in production costs brought on by the devaluation of the pound in 2016 was a notable factor in the underwhelming performance of non-oil exports. However, the intended gains from the exchange rate depreciation were quickly eroded by macroeconomic policies that did not appropriately manage domestic aggregate demand, compounded by structural hindrances to competitiveness. It is not solely the exchange rate but a panoply of obstacles that hinder productivity growth. The exchange rate depreciation is a symptom of deeper issues such as poor productivity growth and lack of competitive ability. Significant increases in import costs, widespread wage hikes, and high inflation rates further exacerbated these challenges, preventing exporters from capitalizing on potential gains in price competitiveness (BNP Paribas 2019). Addressing these underlying productivity and competitiveness issues is crucial for sustainable economic improvement.

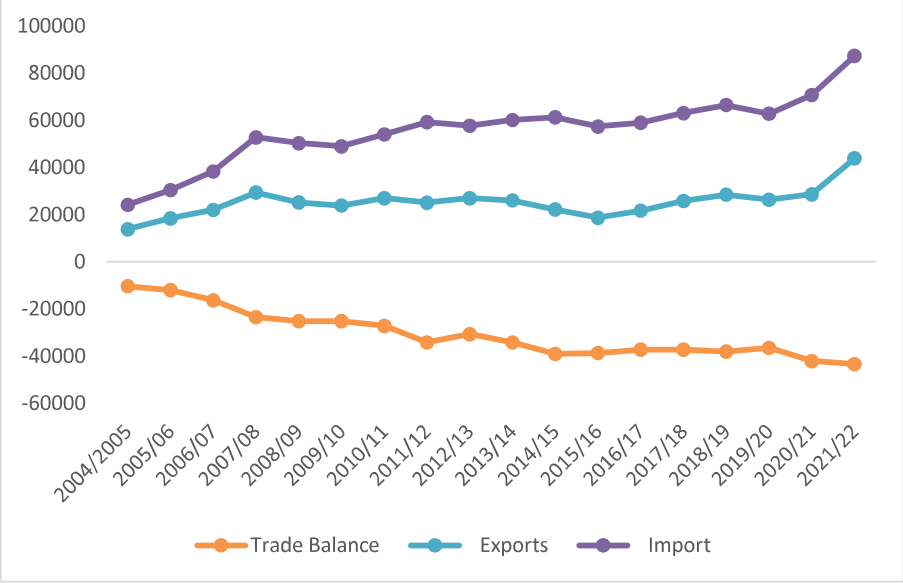

Figure (3): Trade Balance, 2004/05–2021/22 (USD mn)

Source: www.cbe.org.eg/en/economic-research/time-series

2.2. Current account

Egypt's economy is also characterized by persistent current account deficits (Dissou and Nafie, 2021; Figure 4), which necessitate the continuous import of capital to finance these deficits. If the majority of this capital comes in the form of debt, the economy is at risk of recurring debt crises, particularly if the economy's growth rate does not exceed the interest rate on the accumulated debt. Persistent current account deficits can arise from various factors, including a structural imbalance between exports and imports, and the reliance on volatile export service earnings, as mentioned above. Hence, there is a need to rely on FDI financing as well as debt flows to cover the financing gap, especially in the context of insufficient domestic savings. The Covid-19 pandemic and the Russia-Ukraine war have caused several economic challenges for all countries, including Egypt. Furthermore, the Egyptian economy is finding it increasingly difficult to attract foreign direct investment and enhance market competitiveness not only due to worldwide economic stagnation caused by successive crises but also because international and domestic investors have little confidence in the business environment and macroeconomic policies. While global economic conditions play a role, Egypt's attractiveness as an enabling environment for investment remains a significant issue.

The current account balance was in surplus from 2004/05 to 2007/08 before falling into deficit from 2008/09 to 2021/22 due to the chronic trade imbalance that overtook the service and transfer surplus. Although the service balance and transfers have a positive effect on the current account (via remittances, tourism receipts, and the Suez Canal), the investment income balance and trade balance have had a more negative impact.

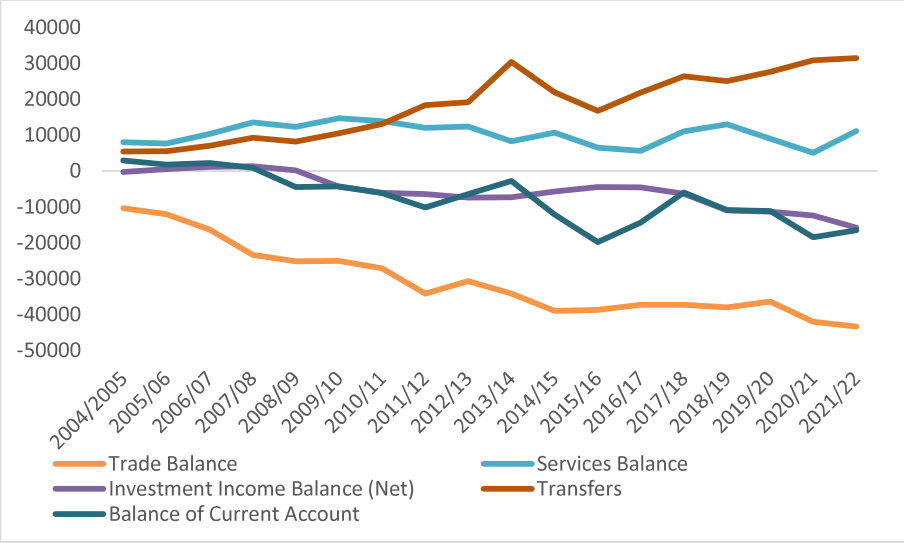

Figure (4): Current Account Balance, 2004/05–2021/22 (USD mn)

3. Literature Review

(Shokry and Bouaddi, 2017) investigate whether the devaluation induces a contractionary or expansionary effect on economic sectors in Egypt, by exploring the effect of changes in the exchange rate on sectoral production. Real effective exchange rate (REER) shows negative elasticities for most subsectors, indicating that devaluation is contractionary for Egypt's economy in the short run. The private sector in Egypt is generally more responsive to REER changes compared to the state-owned sector. However, state-owned sub sectors that contribute significantly to GDP, such as manufacturing, mining, and petroleum products, also show high responsiveness. This suggests that while the private sector should be supported during devaluation, attention should also be directed to the state-owned sector by implementing measures like tax cuts or increased subsidies, and these are essentially policy interventions to change relative prices. Egypt's sub sectors do not seem to align with conventional economic theories regarding factors affecting production, such as import penetration and export orientation. Even in sectors where exports surpass imports, the impact of devaluation appears negative in Egypt. This suggests that conventional strategies like shifting expenditures and relying on tariffs and imports may not yield the expected results. Unique features of the Egyptian economy, such as low competitiveness, high production costs, and limited substitution capacity between imports and domestic goods, likely contribute to this phenomenon. Moreover, structural issues like regulatory barriers and inadequate infrastructure could further impede the positive effects of devaluation. "Deeper analysis" would entail a thorough examination of each subsector, considering factors such as supply chain dynamics, market conditions, and product differentiation. This approach would provide insights into specific challenges and opportunities within each sector, enabling more targeted and effective policy recommendations.

(Alazzawi and Hlasny, 2019) focus on analysing the disparities in cost-of-living changes after the large-scale devaluation that occurred in 2016 in Egypt. This paper investigates how exchange rate fluctuations in the Egyptian pound are passed through to prices of various commodity groups, and the implications of currency devaluations for households' cost of living. The study also checks if households in different regions and from different income levels experience different rates of cost-of-living changes because of the devaluations, and the expected effect on inequality and poverty. The main findings show that the pass-through effect of devaluation is highest and most significant for highly tradable goods such as food, alcohol, apparel, and equipment. However, it is lowest or even negative for domestically produced, non-tradable goods such as communication services, cultural services, medical services, education, utilities, and

restaurants and hotels. After factoring out the impact of devaluation, it becomes apparent that most of the price increases are devaluation-induced. The lowest income quintiles were the hardest hit by these price increases.

(Elbagory, 2017) analyses the effect of currency devaluation on the Egyptian economy, by assessing the various fluctuations in the exchange rate as well as measuring the effects of devaluation on the Egyptian economy. While external shocks often trigger devaluation, overreliance on this strategy can destabilize markets and hinder investment. Despite emphasizing exchange rate stability, this perspective overlooks Egypt's long-standing depreciation trends, indicating deeper structural issues. Unlike countries like Thailand and South Korea, Egypt's trajectory underscores the need for broader economic strategies focused on addressing underlying weaknesses and promoting productivity growth and competitiveness. An alternative approach necessitates addressing underlying economic weaknesses and fostering productivity growth and competitiveness. Merely maintaining exchange rate stability without addressing structural deficiencies may deplete foreign exchange reserves and lead to a crisis. Thus, a comprehensive strategy encompassing fiscal and monetary reforms, alongside measures to enable productivity growth, competitiveness coupled with wise fiscal and monetary policy.

Finally, there are a couple of studies that have used CGE models to assess the impact of currency devaluation in Egypt. (Elbadawi and Soto, 2014) examine the macroeconomic effects of exchange rate devaluation in Egypt using a CGE model. The analysis focuses on the short- and medium-term impacts on key economic indicators such as GDP, inflation, trade balance, and sectoral outputs. It finds that devaluation can have both positive and negative effects, depending on the structural characteristics of the economy and accompanying policy measures. (Abu-Ismail and Kheir-El-Din, 2005) use a CGE model to investigate the impacts of exchange rate policy, including devaluation, on economic growth in Egypt. The study explores how devaluation affects different sectors of the economy, income distribution, and overall economic welfare. The findings suggest that devaluation can lead to improvements in export competitiveness, but also highlight the importance of considering inflationary pressures and the need for supportive fiscal and monetary policies.

Sherman Robinson and Hans Lofgren have conducted extensive research using CGE models to analyze various economic issues in Egypt, including the impacts of devaluation. (Robinson, Lofgren et al. 1999) does not focus solely on devaluation, but utilizes a CGE model to explore the broader impacts of macroeconomic policies on poverty and income distribution in Egypt. The model can be adapted to study the effects of exchange rate changes, including devaluation, on different household groups.

(Lofgren and El-Said, 2001) uses a CGE model to assess the impacts of structural adjustment policies, including exchange rate adjustments, on the Egyptian economy. It provides insights into how devaluation, as part of a broader reform package, affects poverty and income distribution. (Lofgren and Robinson, 1999) investigates the potential impacts of food subsidy reforms using a CGE model. While the primary focus is on subsidies, the model incorporates exchange rate dynamics, which can be used to simulate the effects of devaluation on food prices, household welfare, and government budgets. Finally, (Lofgren, 2000) utilizes a CGE model to analyze the macroeconomic and microeconomic effects of various shocks, including potential exchange rate devaluations. It examines the consequences for different sectors, household groups, and overall economic performance.

These studies illustrate the usefulness of CGE models to analyze the complex and multifaceted impacts of exchange rate devaluation on the Egyptian economy. They provide insights into the potential benefits and challenges associated with such policy measures, helping policymakers to design more effective economic strategies.

4. External Shocks and Exchange Rate Adjustment

4.1 Egypt General Equilibrium Model

Because the focus is on exchange rate pass-through, structural adjustment, and income distribution the multi-sectoral, general equilibrium model emphasizes a detailed representation of domestic agricultural, industrial, and service production activities and their linkages between each other[1] and with consumers, the government, and the rest of the world on factor and product markets (see Figure 5). Thirty-seven sectors are distinguished: twelve agricultural sectors, twenty-one industrial sectors and four services sectors. In agriculture, a sectoral distinction is made between eight types of crops and three types of livestock and one other agricultural sector comprising fishing and forestry. Other primary-producing sectors are crude oil and natural gas production and mining. Besides mining sectors, the model distinguishes between seven agro-processing sectors with strong backward linkages to agriculture, and nine other manufacturing sectors with either strong intersectoral linkages to mining sectors or intra-sectoral linkages within other manufacturing. Finally, there are two utilities—electricity and water—and construction with strong backward linkages to natural gas and petroleum products or other manufacturing. Many of the agricultural sectors as well as utilities and construction have very low export-output shares and could be regarded as non-tradables (see Table 2).

[1] See Table 2 for the sectoral classification in Egypt's CGE model.

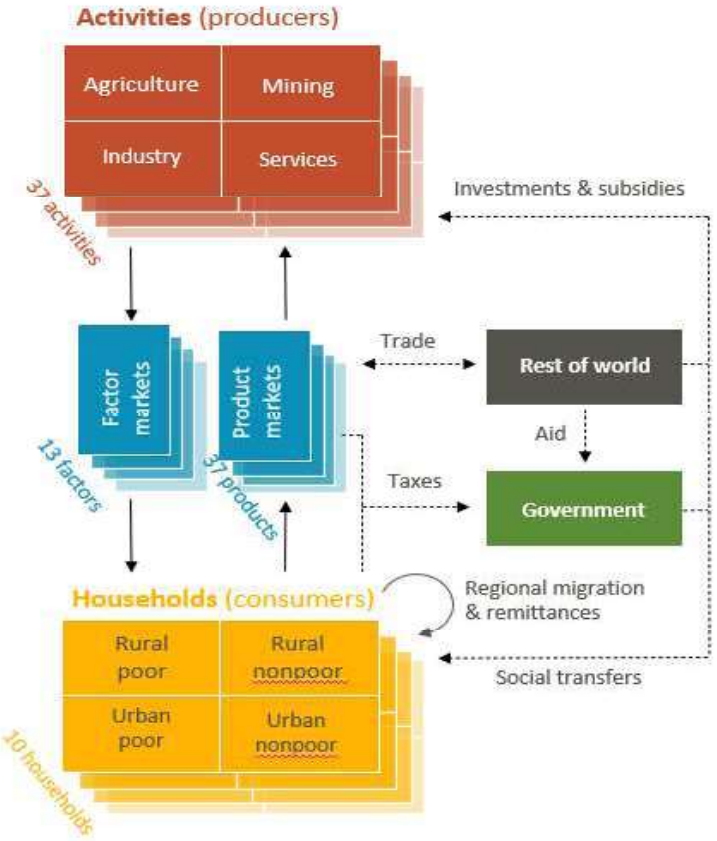

Figure (5): Trade-focused RIAPA CGE Model

Source: Egypt CGE model.

The model is based on a national social accounting matrix (SAM) for 2019 (Serag et al. 2021)[2] that integrates national income, input-output, balance-of-payments current accounts and household survey information into a comprehensive and consistent dataset. It is assumed to represent the initial (benchmark) equilibrium position of the Egyptian economy and provides numerical values to several parameters of the analytical model (see the following section).

The analytical model used belongs to a class of policy planning models developed by Dervis, de Melo, and Robinson (1982), which, in turn, have their origin in Johansen's (1960) pioneering work on the Norwegian economy. One distinguishing characteristic of these models is the fairly firm rooting in microeconomic theory: Producers minimize costs subject to certain technological constraints and prices, while consumers maximize

[2] The SAM has been constructed by CAPMAS (Central Agency for Public Mobilization and Statistics) in collaboration with IFPRI's Egypt Strategy Support Programme in Cairo.

utility subject to a budget constraint. Another trait is the detailed attention devoted to income and expenditure flows; unlike input-output tables, SAMs provide the structural backbone of these models.[3] The core equations of the model used are summarized in Table 1, and its essential features are as follows:[4]

Domestic consumers have constant-elasticity-of-substitution (CES) utility functions over imports and domestically produced goods. Assuming that they seek to minimize the cost of acquiring a given amount of an Armington (1969) composite good, the demands for domestically produced goods and imperfect imported substitutes become derived demands. This leads to the import and domestic prices diverging, something which is crucial to the results derived below.

On the export side, domestic producers are assumed to maximize their revenue at given prices for domestic and foreign supply and are subject to transformation possibilities. This, too, has an impact on domestic to international price differences.

Capital and agricultural land are assumed to be fixed and sector-specific in the short-to medium run. There are eight labor groups, differentiated by regional affiliation (rural, urban) and education (uneducated, primary, secondary, and tertiary) and all mobile across sectors within each group. This means that workers in each group receive the same wage in every sector, although that wage may, and generally will, differ between sectors.

Since this study focuses on determinants of the equilibrium exchange rate, the balance of payments' current account is assumed to be exogenous, while the "equilibrium" exchange rate is determined endogenously. Both private savings rates and the level of real government consumption (provision of public goods) are assumed to be fixed in the short to medium run, while investment and government savings (budget deficit) adjust to reach macroeconomic equilibrium and public budget balance.

The nominal exchange rate is determined endogenously. The model focuses entirely on the real sector with money regarded as a 'veil' along the traditional classical line. This means that all real variables depend only on relative prices, leaving us to choose a numeraire for the system to determine the absolute price level. Our choice of a

[3] Several CGE models have been developed and are widely used to analyze the economic impact of policy changes, external shocks, and other economic phenomena in Egypt. A few examples are Breisinger et al. (2020) on impacts of COVID-19, Hendy and Zaki (2013) on trade policy and economic reforms, Helmy et al. (2019) on food subsidies and poverty, Breisinger et al. (2019) on energy subsidies and economic growth, and Al-Raffai et al (2015) on green energy and development.

[4] For a detailed description of the model see Lofgren et al (2002).

constant CPI is motivated by the Egyptian authorities' emphasis on an accommodating monetary policy.

Table (1): Core Equations of the Egypt CGE Model

Price Block	
Import price	$PM_i = pwm_i(1 + tm_i)R$
Export price	$PE_i = pwe_i(1 + te_i)R$
Consumer price	$(1 - tq_i)PQ_i \cdot Q_i = PD_iD_i + PM_iM_i$
Consumer price index	$\text{CPI} = \sum_i \quad PQ_i \cdot cwts$
Producer price	$PX_i \cdot X_i = PD_iD_i + PE_iE_i$
Value-added price	$PA_i(1 - ta_i)QA_i = PVA_iQVA_i + PINT_iQINT_i$
Production and Trade Block	
CES production function	$QA_i = \alpha(\Sigma_i F_i^{-\rho_i})^{1/(1+\rho)}$
Factor demand	$WF_f wfdist_{f,i} = PVA_i(1\text{-}tva_i)QVA_i \,/\Sigma_f \delta_{f,i} QF_{f,i}^{\rho})^{1/(1+\rho)}$
Intermediate demand	$QINT_{j,i} = ica_{j,i}QINTA_i$
Composite supply	$QX_i = a_i^t\left[\delta_i^t E^{\delta} + (1 - \delta_i^t)D^{\delta}\right]^{1/\rho}$
Export supply	$E_i = D_i\left[\frac{(1-\delta)}{\delta}\frac{PE_i}{PD_i}\right]^{\sigma t}$ $\qquad \sigma t = \frac{1}{\delta - 1}$
Composite demand	$Q_i = a_i^q\left[\delta_i^q M^{-\delta} + (1 - \delta_i^q)D^{-\delta}\right]^{-1/\rho}$
Import demand	$M_i = D_i\left[\frac{\delta}{(1-\delta)}\frac{PD_i}{PM_i}\right]^{\sigma q}$ $\qquad \sigma q = \frac{1}{1+\rho}$
Institution Block	
Domestic Factor income	$YF_f = \Sigma_i WF_{f,i}QF_{f,i}$
Institutions factor income	$YIF_{s,f} = shif_{s,f}\{(1 - tf_f)YF_f - trnsfr_{row,f}R\}$
Private institutions total income	$YI_s = \Sigma_f YIF_{s,f} + \Sigma s_f TRII_{s,s} + trnsfr_{s,gov} \cdot CPI + trnsfr_{s,row}R$
Private redistribution	$TRII_{s,s} = shii_{s,s}(1 - MPS_s)(1 - TINS_s)YI_s$
Household consumption expenditures	$EH_h = (1\text{-}\Sigma_s shii_{s,h})(1 - MPS_h)(1 - TINS_h)YI_h$
Household commodity demand	$PQ_iQH_{i,h} = PQ_i\gamma_{i,h} + \beta_{i,h}(EH_h - \Sigma_i PQ_i\gamma_{i,h})$
Investment demand	$QINV_i = IADJ \cdot \; qbarinv_i$
Government demand	$QG_i = GADJ \cdot \; qbarg_i$
Government revenues	$\text{YG} = \Sigma_s TINS_s YI_s + \Sigma_f tf_f YF_f + \Sigma_i tva_i PVA_i QVA_i + \Sigma_i ta_i PA_i QA_i +$ $\Sigma_i tm_i pwm_i QM_i R + \Sigma_i te_i pwe_i QE_i R + \; \Sigma_i tq_i PQ_i QQ_i + \Sigma_f YIF_{gov,f} +$ $+ trnsfr_{gov,row}\, R$
Government recurrent expenditures	$\text{EG} = \Sigma_i PQ_i QG_i + \; \Sigma_s trnsfr_{s,gov} \cdot CPI$
System constraints	
Factor market equilibrium	$\Sigma_i QF_{f,i} = \; QFS_f$

Commodity market equilibrium $QQ_i = \Sigma_j QINT_{i,j} + \Sigma_h QH_{i,h} + QG_i + QINV_i + qdst_i + QT_i$

BoP current account equilibrium $\Sigma_i pwm_i QM_i + \Sigma_f trnsfr_{row,f} = \Sigma_i pwe_i QE_i + \Sigma_s trnsfr_{s,row} + FSAV$

Government budget YG = EG + GSAV

Explanation of sets and variables used in the equations

Sets

i, j	Sectors, commodities
f	Factors
s	Institutions (households, enterprises, government, rest of world)

Endogenous variables		Exogenous variables and parameters	
PM_i	domestic price of imports	$pwm_i pwe_i$	world price of imports world price of exports
R	exchange rate (E£/US$)	$tm_i te_i tq_i$	import tariff
$PE_i PQ_i PD_i$	domestic price of exports	ta_i	export tax
CPI	price of composite goods	cwts$_i$	sales tax
Q_i	price of domestic products	α	activity tax
	producer price	ρ	consumer price index weights
QA_i	net price or unit value added	$wfdist_{f,i}$	efficiency parameter
D_i	unit intermediate input cost	tva_i	trade substitution parameter
	consumer price index	δ	wage distribution parameter
M_i	composite demand	$ica_{j,i}$	value-added tax
E_i	sectoral production	σt	distribution parameter
$QVA_i QINT_i$	demand for domestic good import demand	σq	input-output coefficient
$QF_{f,i}$	export supply	$shif_{s,f}$	export transformation elasticity
	real value added		import substitution elasticity
WF_f	intermediate demand	$trnsfr_{row,f}$	institutional factor income shares
$WF_{f,i}$	quantity of factor f in sector i	$trnsfr_{s,gov}$	transfer from factor f to RoW
	average factor wage	$trnsfr_{s,row}$	transfer from gov to institution s transfer from institution s to RoW
$QINTA_i$	wage for factor f in sector i	$shii_{s,s}$	inter-institutional share parameter
$YIF_{s,f}$	total sectoral intermediate demand	$\gamma_{i,h}$	household subsistence parameter
	factor income f of institution s	$\beta_{i,h}$	household budget shares
YF_f	total factor income	$qbarinv_i$	exogenous investment demand
YI_s	income of (dom. non-gov) institutions		
$TRII_{s,s}$	domestic inter-institutional transfers		
	savings rates of private institutions		
MPS_s	direct tax rates of private institutions		
$TINS_s$	household expenditures		
EH_h	investment demand		
	investment scaling factor		
	quantity of government consumption		

$QINV_i$	government demand scaling factor	$qbarg_i$	exogenous government demand
$IADJ$	government revenue government recurrent expenditures	$trnsfr_{gov,row}$	transfers from RoW to gov
QG_i	factor supply	$qdst_i$	stock changes
$GADJ$	government savings (budget balance)		
YG			
EG			
QFS_f			
GSAV			

4.2 Structural Characteristics of the Egyptian Economy

Table 2 provides a summary of the most important sectoral features of the economy together with the crucial elasticities for determining the results of policy simulations. Columns (1) and (3) describe the structure of production and value added across sectors. The structure of gross outputs reveals a typical composition of output found in a semi-industrial country where agriculture and services still provide more than 50 percent of gross domestic production. Within the manufacturing sector, traditional non-durable food and basic consumer goods dominate together with oil-based processing industries. The importance of intermediate inputs for each sector is indicated by the sectoral value-added output shares in column (2). High value-added ratios in the agricultural and mining sectors indicate small backward linkages. Contrarily, the manufacturing sectors exhibit the lowest value-added ratios suggesting high backward linkages. Column (3) indicates the sectoral distribution of value added. As can be seen, more than 50 percent of total value added is generated in the trade & transport, other private services, and the public sector.

The next three columns provide information about each sector's trade orientation. Column (4) indicates that 16 out of the 32 tradables-producing sectors export more than 10 percent of their output, with equipment and hotels & restaurants being the most export-oriented sectors in the economy. These export ratios are quite high and reflect a country that is a top tourism destination. Moreover, there is substantial academic and scientific evidence supporting the notion that Egypt has pursued an outward-oriented development strategy, especially from the 1990s onward (see, e.g., Ahmed and Ghani (2007), Abedini and Péridy (2008), Ikram (2018), World Bank (2018), and IMF (2018)). On the import side, a typical picture emerges when one considers both the share of imports in domestic absorption (which indicates the degree of import 'orientation'; column 5) and the share of imported intermediate inputs in total intermediate inputs

(which indicates the degree of import 'dependence'; column 6). Food crops, mining and the manufacturing sectors are the most import-oriented sectors, and all sectors are highly import-dependent. Natural gas, utilities and hotels & restaurants are the only non-traded sectors that face no import competition, yet between 9 and 19 percent of sectoral inputs are imported.

The last three columns give the crucial elasticities for determining the results of policy simulations generated by the model. Because production technology for sectoral value added is modelled by two-level CES production functions, the share observations obtained in the benchmark equilibrium data set provide us with a set of labour demand and output supply elasticities.[5] Given this technology specification, price elasticities of supply are the highest in labour-intensive sectors with a large share of labour value added in total value added. Column (7) indicates the share of final demand in sectoral absorption, and therefore gives an approximation of the price elasticity of demand. Thus, composite good price elasticities of demand are absolutely highest for sectors with close proximity to final demand. The foreign trade elasticities given in the next column roughly capture the extent of product differentiation due to differences in quality and degree of product homogeneity. Thus, sectors with a high share of intermediate demand and investment demand are seen to be the least homogeneous products with limited substitutability. On the other hand, agricultural products along with the more traditional non-durable consumer goods are close substitutes for imports. Fats & oils, and petroleum products and fertilizer consist mainly of synthetic varieties and are less substitutable. Finally, the income elasticities of demand for households in Column (10) reflect the degree of necessity of the goods. Here, the percentage of spending on agricultural primaries and food products decreases less than income if devaluation leads to losses of real income.

[5] Partial sectoral price elasticities of supply are defined as $s \equiv fLK$, where f is the elasticity of substitution between (mobile) labor and bundle of (immobile) capital and land and θ's are the factor shares for labor and other factors; sectoral s have been revised to take account of sectoral differences in f.

Table (2): Structure of the Egyptian Economy in the BASE Solution[a]

	PRDshr (1)	VA-OUTshr (2)	VAshr (3)	EXP-OUTshr (4)	IMP-DEMshr (5)	Vm/Vshr (6)	FNshr (7)	ε^S (8)	σ^{ARM} (9)	η (10)
Maize	0.64	87.5	1.0	0.1	29.3	4.7	2.0	0.7	0.7	0.1
Rice	0.3	82.0	0.4	n.a.	0.1	4.9	43.5	0.4	5.1	0.9
Wheat and barley	0.24	64.7	0.3	n.a.	39.5	6.8	61.2	0.4	0.6	0.1
Other cereals	0.11	79.2	0.2	2.9	1.0	4.3	5.2	0.3	1.3	0.1
Vegetables	1.35	49.3	1.2	5.5	0.0	3.9	83.1	0.9	1.9	0.6
Fruits and nuts	1.19	86.5	1.8	18.6	7.0	7.7	76.7	0.8	1.9	0.9
Other crops	1.1	68.4	1.3	15.8	36.1	6.5	33.5	0.9	3.3	1.1
Cattle & raw milk	2.09	92.1	3.4	0.0	1.1	7.2	58.0	0.4	2.0	0.9
Poultry	1.55	42.2	1.2	0.0	0.3	17.2	86.4	0.5	1.3	1.2
Other livestock	0.32	82.1	0.5	1.9	0.6	1.4	37.0	0.4	0.7	2.0
Forestry & fishing	0.91	74.1	1.2	0.3	1.0	8.8	87.1	0.2	1.3	0.5
Crude oil	3.46	85.5	5.3	10.3	10.5	11.0	8.3	0.1	5.2	1.0
Natural gas	1.94	91.7	3.2	13.2	n.a.	9.4	51.6	0.0	17.2	1.0
Other mining	1.23	67.7	1.5	34.1	30.7	21.3	25.9	0.5	0.9	1.0
Meat processing	0.28	24.1	0.1	1.7	42.8	2.2	59.5	0.3	3.9	2.0
Fish & seafood proc	0.03	16.5	0.0	17.4	66.1	2.2	38.0	0.2	4.4	0.5
Dairy	0.93	19.7	0.3	6.1	7.9	6.9	94.8	0.3	3.3	0.5
Fruit & vegetable proc	0.41	35.0	0.3	30.5	5.6	5.6	54.2	0.2	3.7	0.6
Fats and oils	0.7	20.7	0.3	5.7	22.2	25.8	84.4	0.2	0.7	0.6
Grain milling	0.44	22.1	0.2	9.3	16.9	26.3	64.4	0.3	2.6	0.1
Other foods	4.23	33.5	2.5	4.7	6.3	19.3	88.5	0.3	2.0	1.1
Textiles & clothing	2.56	23.4	1.1	22.0	22.1	20.5	65.1	0.7	3.8	0.8
Wood & paper produc	0.71	27.0	0.3	14.7	36.6	24.2	56.0	0.2	3.0	1.8
Petroleum products	7.08	33.0	4.2	12.8	13.7	11.2	53.1	0.0	0.7	1.8
Fertilizer	0.73	21.6	0.3	33.6	5.5	4.2	29.3	0.2	0.5	1.8
Chemicals	6.48	33.6	3.9	12.3	22.3	19.2	52.6	0.2	3.3	1.8
Machinery	1.02	20.8	0.4	1.6	42.7	17.5	37.4	0.3	4.4	1.8
Equipment	0.84	19.3	0.3	44.6	66.1	22.3	92.5	0.2	4.1	1.8
Vehicles	0.13	20.7	0.1	10.9	73.2	27.2	94.7	0.6	4.3	1.8
Other manufacturing	6.06	38.6	4.2	9.8	17.3	19.2	23.7	0.2	3.8	1.8
Utilities	3.42	40.3	2.5	0.3	n.a.	9.3	58.4	0.4	2.8	1.5
Construction	6.9	44.2	5.4	1.7	1.2	17.5	93.2	0.5	0.9	1.0
Trade & transport	13.5	84.0	20.1	12.8	12.8	13.9	40.1	0.5	0.9	1.0
Acc & food services	4.24	39.6	3.0	39.7	n.a.	18.6	98.7	0.3	0.9	1.0
Private services	13.41	69.3	16.5	3.0	10.6	11.7	55.2	0.6	0.9	1.0
Public services	9.46	71.4	12.0	2.0	1.9	14.5	92.3	1.5	0.9	1.0
TOTAL	100.0	56.3	100.0	9.7	13.7					
Total agriculture	9.8		12.5	4.9	10.9					
Total non-agriculture	90.2		87.5	10.3	14.0					

[a]PRODshr= Sectoral composition of gross domestic output; VA-OUTshr= Sectoral value added output share; Vashr=Sectoral distribution of value adde EXP-OUTshr=exports as a percentage of output; IMP-DEMshr=imports as percentage of absorption; Vm/Vshr=share of imported intermediate inputs i total intermediate inputs; FNshr=final demand as share of absorption; ε^S=price elasticity of output supply; σ^{ARM}=trade substitution elasticity; η=income elasticity of demand.
n.a. not applicable

Source: Calculated from Egypt 2019 SAM.

4.3. Simulation design

As shown by Dervis, de Melo, and Robinson (1982, pp. 332-341), the emergence of a foreign exchange crisis can be analyzed by looking at what happens to the underlying "equilibrium" exchange rate over the period considered. Changes in the equilibrium exchange rate ê can be decomposed into changes due purely to real forces $(\hat{k} - \hat{l})$, such as differential rates of technical progress between tradables and no tradables, changes in tastes, differential rates of factor accumulation, and so on, domestically $(\hat{k})$ and abroad $(\hat{l})$, and changes due to differential inflation, home $(\widehat{PD})$ *and abroad* $(\widehat{PW})$, caused by differences in domestic and foreign supplies and demands for money, i.e.,

$$\hat{e} = (\hat{k} - \hat{l}) + \left(\widehat{PD} - \widehat{PW}\right)$$

Changes in the exchange rate reflect both real and monetary phenomena. The general equilibrium model described above determines changes in the equilibrium exchange rate that can be traced back to real phenomena ($\hat{e} = \hat{k}$) endogenously. Events in the rest of the world that determine $\hat{l}$ and $\widehat{PW}$, and domestic inflation $\widehat{PD}$ are treated as exogenous. In the following scenarios, the effects of changes in $\hat{k}$ that resulted from three types of shocks are analyzed first:

- The first is a terms-of-trade shock, i.e. an increase in import and export prices for wheat (+30%), maize and oilseeds (+20%), crude oil, natural gas, petroleum, and fertilizer (+60%)[6] — labeled TOTshock —, which resulted from the reduction of world-wide supply during the COVID-19 pandemic and following the Russian war against Ukraine.

The second is an export shock, i.e. a 25% reduction of export to domestic supply ratios for wheat, maize, oilseeds, crude oil, natural gas, petroleum, and fertilizer[7] — labelled EXPshock —, resulting from a loss of product competitiveness on world markets.

- The third shock is a foreign-savings shock, i.e., a 50% reduction of net foreign capital inflows[8] — labelled FSAVshock — resulting from massive capital outflows that occurred in 2022 and led to severe foreign currency shortages.

Then, a fourth scenario — called DEVAL — combines all three real shocks with a 29.9 percent inflation differential to determine the overall change in the equilibrium exchange rate.

- DEVAL: TOTshock + EXPshock + FSAVshock + 29.9 percent increase in domestic prices

Finally, a fifth scenario — called BASIC — reflecting the historical run over the period 2020-23, keeps the exchange rate fixed despite external shocks, and serves as a benchmark for assessing the quantitative impact of shocks and devaluation.

- BASIC: TOTshock + EXPshock + FSAVshock + fixed exchange rate

[6] In the Egypt CGE model, this is implemented by increasing world market prices for import and exports, i.e., pwm_i and pwe_i in Table 1. Source: Abay et al. 2022.

[7] Implemented as a reduction of the EXP-OUTshr in Table 2.

[8] Implemented as a reduction of FSAV in Table 1.

4.4 Simulation results

Selected macroeconomic indicators

Table 3 below shows simulation results for National Accounts indicators, exchange rates and prices, and current account and trade deficits in the upper, middle, and lower part, respectively. Assuming that the recent 40% devaluation of EGP reflects the adjustment of the equilibrium exchange rate that equates demand and supply of foreign exchange, the change of the equilibrium exchange rate can be decomposed into

- Terms-of-trade shock: 1.8/40 = 4.5%
- Export shock: 7.6/40 = 19.0%
- Foreign savings shock: 12.8/40 = 32.0%
- Differential inflation: 100—4.5—19.0—32.0 = 44.5%

Differential domestic inflation is the single most important cause for the change in the equilibrium value of the exchange rate, yet it explains only 45 percent of the total change. The lack of foreign exchange inflows and the loss of export competitiveness explain another 32 and 19 percent, respectively.

The contribution of the terms-of-trade shock induced by the Covid pandemic and Russia's-war against Ukraine is lowest because rising world market prices for maize, wheat, oilseeds, crude oil, natural gas, petroleum, and fertilizer affect both imports (negatively) and exports (positively) in Egypt. Since the total export share of these goods exceeds their total import share, Egypt faces a positive terms-of-trade shock of 3.9 percent. Yet, Egypt is generally more import-dependent than export-oriented for most of the affected commodities, with the worsening of the trade balance requiring a nominal devaluation of 1.8 percent and import substitution of 5.9 percent and a reduction of real exports by 12.1 percent.

The loss of export competitiveness in simulation EXP shock leads to increasing trade and current account deficits of 0.3 and 0.7 percent of GDP, respectively, and a stronger devaluation of the equilibrium exchange rate by 7.6 percent, which puts adjustment pressure on imports and investment demand, because demand for machinery, equipment, and vehicles is both strongly import oriented (with a large import-demand share) and import dependent (with a large share of imported goods in intermediate demand).

The lack of foreign exchange or foreign investment, both FDI and portfolio investment, in simulation FSAV shock is the second most important cause for the devaluation of the Egyptian pound. Lower capital inflows (and or higher capital

outflows) directly reduce domestic absorption by 1.7 percent with the brunt of adjustment falling on investment (-10.3 percent). Since part of the income from abroad is used to buy local goods, domestic prices fall by 2.2 percent. Moreover, lower capital inflows lead to a real devaluation of 15.4 percent, which affects real imports more strongly (-14.2 percent) while reducing adjustment pressure on exports (-8.6 percent).

The final 2 columns in Table 3 contrast the results of a combined shock plus devaluation scenario (DEVAL) with a "historical" scenario (BASIC) that keeps the exchange rate fixed despite negative external shocks. Overall, the results show that a 40 percent increase in the equilibrium exchange rate leads to a reduction of the trade and current account deficits by 1.8 and 2.1 percent of GDP, respectively, a 14.6 percent real devaluation and a 1.5 and 0.5 percent reduction of domestic absorption and household real consumption, respectively, with the brunt of adjustment falling on investment. By contrast, keeping the exchange rate fixed and allowing massive borrowing from abroad increase domestic absorption and household consumption by 2.8 and 2.0 percent. However, higher absorption comes at the cost of increasing trade and current account deficits of 1.6 and 1.7 percent, as observed in the past.

Table (3): Macroeconomic Impact (% change for non-BASE)

	BASE*	TOT shock	EXP shock	FSAV shock	DEVAL	BASIC
Absorption	5,439.4	0.8	0.4	-1.7	-1.5	2.8
Consumption	4,048.0	0.6	0.6	0.1	-0.5	2.0
Investment	957.9	2.1	-0.4	-10.3	-6.4	7.3
Exports	843.3	-12.1	-12.1	-8.6	-7.8	-16.6
Imports	1,300.8	-5.9	-7.9	-14.2	-11.5	-2.3
Real exchange rate	91.3	9.4	8.5	15.4	14.6	7.0
Nominal exchange rate	100.0	1.8	7.6	12.8	40.0	fix
World export price	100.0	10.9	fix	fix	10.9	10.9
World import price	100.0	6.7	fix	fix	6.7	6.7
World price	100.0	8.4	fix	fix	8.4	8.4
Domestic price	109.6	0.9	-0.8	-2.2	32.4	1.3
Consumer price	100.0	fix	fix	fix	32.6	fix
Terms-of-trade	100.0	3.9	fix	fix	3.9	3.9
C/A deficit/GDP	4.5	0.1	0.3	-1.9	-2.1	1.7
Trade deficit/GDP	9.9	0.1	0.7	-1.3	-1.8	1.6

*Billions of EGP for National Accounts aggregates, indices for exchange rates and prices, and shares of GDP at market prices for deficits

Source: Egypt CGE model.

Sectoral GDP

National GDP and employment are not affected by any of the shocks and devaluation since we assume full employment of all factors in the short to medium run. Real income gains in agriculture, mining and manufacturing are generally offset by real income losses in utilities and construction, and vice versa for terms-of-trade shock (Figure 6). Sectoral GDP gains and losses are largest in the case of lower capital inflows and devaluation. Lower capital inflows induce lower demand for investment goods, affecting construction, which produces almost exclusively non-tradable investment goods. On the other hand, other capital goods producing sectors, such as machinery, vehicles, and equipment benefit from their export orientation and lower input costs. If real shocks are accompanied by nominal devaluation, the resulting real appreciation also leads to a redistribution of real income from non-tradable construction and utilities towards tradable agriculture and mining as well as tradable manufacturing sectors, where import substitution increases income.

Regarding the agri-food system, GDP and employment are less affected. Moreover, modest gains in GDP (except for TOT shock) are observed in primary agriculture, while food processing slightly declines. Hence, devaluation benefits export-oriented mining and capital goods industry, import-oriented agriculture and trade-oriented food and consumer goods.

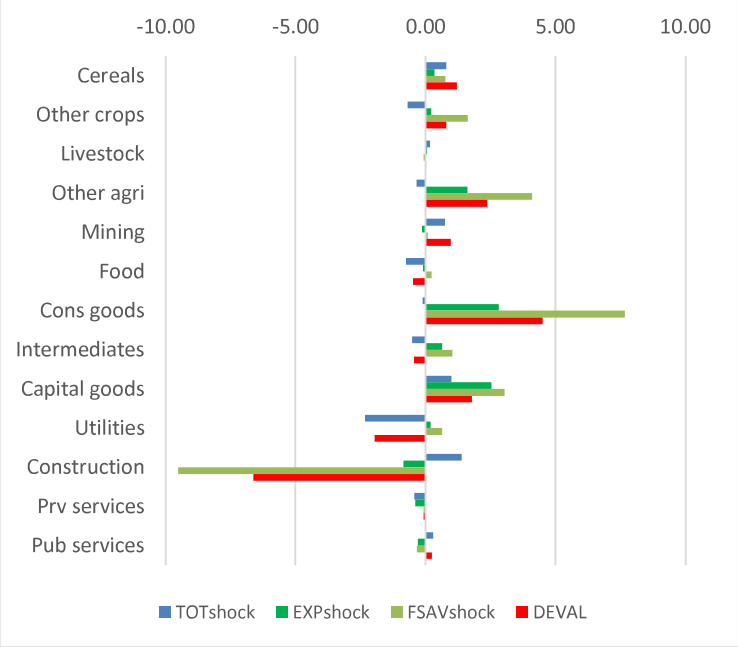

Figure (6): Sectoral Real GDP (% change)

Source: Egypt CGE model.

Sectoral employment

National employment is not affected by any of the shocks and devaluation since all factors are assumed to be fully employed over the short to medium run. Moreover, capital used in agriculture, livestock, mining, and other industry and service sectors as well as land used in crop production are assumed to be immobile across sectors, while all labor types are mobile. As a result, individual sectors can only expand by hiring labor from other sectors. And any relocation of labor will lead to a contraction of other sectors, with the change in employment generally exceeding the change in sectoral GDP.

- Changes in employment exceed GDP gains and losses, particularly in capital-intensive mining and intermediates production and food processing in the case of TOTshock.
- Devaluation creates employment in tradable producing sectors while non-tradable construction and utilities (water and electricity) release labor.
- Food processing, being both more import than export-oriented and strongly import-dependent and relatively labor-intensive, also releases large amounts of labor.
- Mining benefits from devaluation and strongly increases employment but from a low initial level.
- Labor-intensive non-tradable construction must bear the brunt of adjustment regarding job losses.

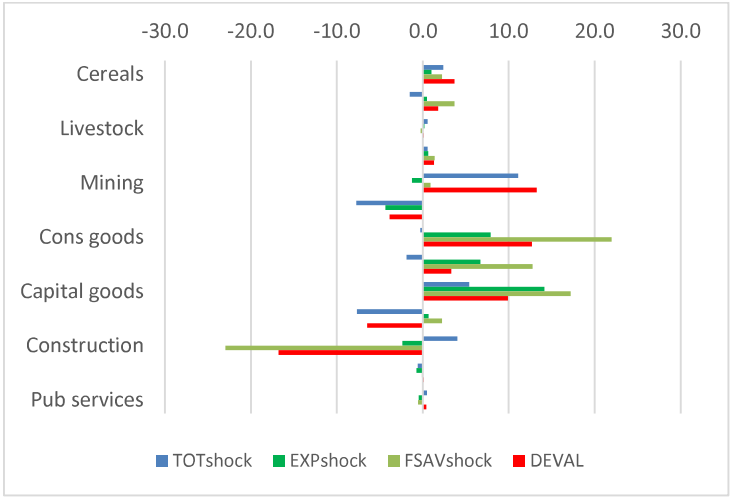

Figure (7): Sectoral Employment (% change)

Source: Egypt CGE model.

Household consumption

Figure 8 shows percentage changes of household real consumption for the devaluation-cum- shocks (DEVAL) and fixed-exchange-rate (BASIC) scenarios together with results for the three external-shock scenarios. National figures on household consumption are equal to those in Table 3, i.e., increasing and decreasing by 2 and 0.5 percent in the historical run and the devaluation scenario, respectively. Household welfare generally rises in rural and urban areas and for poor and nonpoor households[9] in all external shock scenarios and the historical run at the expense of worsening external conditions, but declines in the devaluation scenario with improving external conditions. The exception is urban households, which are negatively affected by lower foreign capital inflows. These households earn a large part of their income in the construction sector, which is contracting strongly because of lower investment demand. All other households benefit from all external shocks, by falling prices and/or rising factor incomes.

The importance of shocks differs across population groups as follows:

- Rural and non-poor households are benefiting more than urban and poor households from export demand and foreign savings shocks.
- The terms-of-trade shock has a larger positive impact on urban and non-poor households' welfare than on rural and poor households.

The devaluation of the Egyptian pound causes welfare losses for all households, with losses being larger for rural than for urban households and larger for poor than non-poor households. Poor households bear the brunt of exchange rate adjustment. Although poor households benefit more than urban households from nominal and real devaluation, these households are more strongly affected by rising domestic prices for agricultural goods, food items and other simple consumer goods and services.

[9] Poor households include the two lower income quintiles in rural and urban regions. Non-poor households include the three higher quintiles.

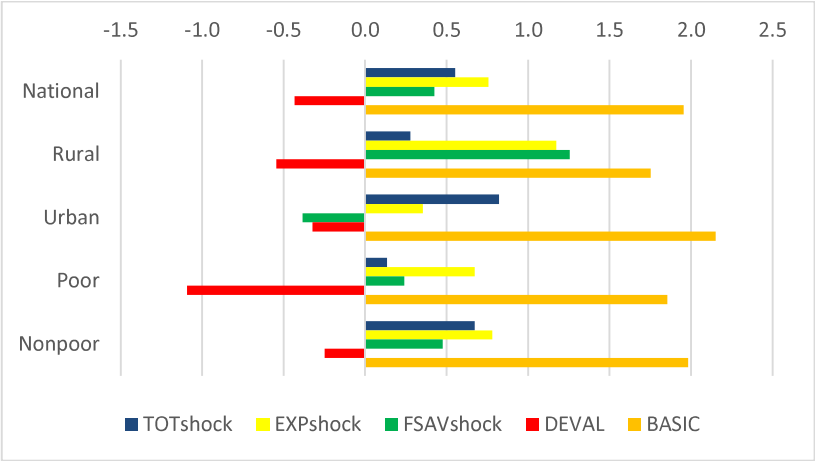

Figure (8): Household Real Consumption (% change)

Source: Egypt CGE model.

Inequality

In terms of inequality, Figure 9 demonstrates the regressive impact of shocks and devaluation, with welfare losses varying across income quintiles. Compared to the historical run, which had involved slightly lower and higher than 2 percent welfare gains for income quintiles 1-4 and income quintile 5, respectively, all households experienced welfare losses by the 40 percent devaluation of the Egyptian pound. Welfare losses range from 1.5 percent for the poorest quintile to slightly less than 0 percent for the richest quintile. The richest household group that benefited most from massive borrowing, terms-of-trade changes, export restrictions and domestic inflation, is the least affected by devaluation, and vice versa for the poorest household group. Overall, inequality is rising with the emergence and the management of the foreign exchange crisis.

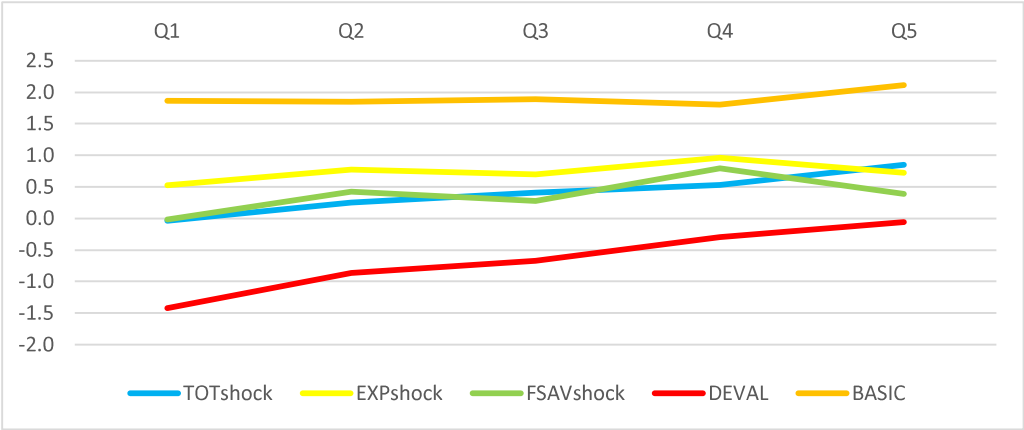

Figure (9): Household Consumption by Quintiles (% change)

Source: Egypt's CGE model.

Conclusion

The simulation results and the subsequent sectoral analyses shed light on the intricate dynamics of the Egyptian economy under various external shocks and devaluation scenarios. Key observations include the significant role played by domestic inflation, accounting for 45% of the total change in the equilibrium exchange rate. The dearth of foreign exchange inflows and the erosion of export competitiveness contribute 32% and 19%, respectively, emphasizing the multifaceted nature of the challenges faced.

The terms-of-trade shock induced by global events, such as the Covid-19 pandemic and Russia's war against Ukraine, has a comparatively lower impact due to its dual effect on imports and exports. Notably, the positive terms-of-trade shock of 3.9% is insufficient to counterbalance Egypt's overall import dependence, necessitating a nominal devaluation of 1.8%, import substitution of 5.9%, and a reduction in real exports by 12.1%.

The loss of export competitiveness, as simulated in the EXPshock scenario, leads to escalating trade and current account deficits, alongside a more pronounced devaluation of 7.6%. This situation amplifies adjustment pressures on imports and investment demand, particularly in machinery, equipment, and vehicles, which are both import-oriented and import-dependent.

The lack of foreign exchange and foreign investment emerges as the second most influential factor driving the devaluation of the Egyptian pound. Lower capital inflows result in a direct reduction of domestic absorption by 1.7%, with the most significant impact on investment (-10.3%). Real devaluation of 15.4% affects real imports more strongly (-14.2%), while alleviating adjustment pressures on exports (-8.6%).

Comparing the combined shock plus devaluation scenario (DEVAL) with the fixed-exchange-rate scenario (BASIC), it becomes evident that a 40% increase in the equilibrium exchange rate reduces trade and current account deficits by 1.8% and 2.1% of GDP, respectively. The accompanying 14.6% real devaluation results in a 1.5% reduction of domestic absorption and a 0.5% reduction in household real consumption, primarily impacting investment. Conversely, keeping the exchange rate fixed and allowing massive borrowing from abroad increases domestic absorption and household consumption but at the cost of widening trade and current account deficits.

Sectoral analyses reveal nuanced impacts on GDP and employment, with gains and losses distributed across different sectors. The agri-food system, for instance, experiences varying effects, with export-oriented mining and capital goods industries

benefiting from devaluation, while import-oriented agriculture and trade-oriented food and consumer goods face challenges.

Household consumption patterns show complex dynamics, with rural and non-poor households benefiting more from export demand and foreign savings shocks. The terms-of-trade shock has a more positive impact on urban and non-poor households compared to rural and poor households. However, the devaluation of the Egyptian pound results in welfare losses for all households, with rural and poor households bearing the brunt of the adjustment cost.

As Egypt grapples with the challenges posed by global events, formulating a flexible economic framework requires a comprehensive approach that balances export competitiveness, foreign savings, and domestic stability. Sector-specific responses to shocks underscore the need for targeted policies, especially for export-oriented and non-tradable industries. Policies should be precise to meet the specific needs of different sectors and income groups.

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