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Effect of Exchange Rate Movements on Inflation in Sub-Saharan Africa

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ABSTRACT: This paper provides new evidence on the exchange rate passthrough to domestic inflation in Sub-Saharan Africa (SSA) using both bilateral US dollar exchange rate and the nominal effective exchange rate (NEER), and monthly data. We find that depreciations cause sizable increases in domestic inflation. The passthrough in SSA is higher than in other regions and its magnitude depends on the exchange rate regime, type of exchange rate (bilateral versus NEER), natural resource endowment and domestic market competitiveness. The passthrough is found to be disproportionately larger and more persistent for large depreciation shocks, and for exchange rate changes that are more persistent. We also find evidence of asymmetry, with passthrough eight times stronger during depreciations than appreciations. Additional findings suggest that improved monetary policy effectiveness is an important driver of our observed declining estimates of exchange rate passthrough over time, supporting the long-standing view that strengthening monetary policy frameworks and credibility helps mitigate the impact of depreciations on inflation.

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Authors' Email Addresses:	lkemoe2@imf.org, hmighri@imf.org, squayyum@imf.org; mmbohoumama@imf.org

WORKING PAPERS

Effect of Exchange Rate Movements on Inflation in Sub-Saharan Africa

Prepared by Laurent Kemoe, Moustapha Mbohou, Hamza Mighri, and Saad Quayyum[1]

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1. Introduction and Literature Review

This paper focuses on estimating the exchange rate passthrough to inflation in sub-Saharan Africa. It investigates how large and persistent the exchange rate passthrough to inflation is for the region across different exchange rate regimes and country characteristics such as resource endowment, competition in domestic market and monetary policy effectiveness. It estimates these pass-throughs for changes in the exchange rate against the US dollar, which is the dominant currency for trade invoicing, as well as the nominal effective exchange rate (NEER). It captures a rich set of dynamics of exchange rate passthrough to inflation using monthly data and controlling for several drivers of inflation including a proxy for monthly output gap. It also tests whether there are asymmetries and nonlinearities in passthrough rate, and documents how the exchange rate passthrough has evolved over time. Last, it discusses policy implications for the region.

The literature on the exchange rate passthrough is extensive and has attracted the interest of economic researchers for decades, as evidenced by seminal papers by Dornbusch (1987), Taylor (2000), Campa and Goldberg (2005), Goldberg and Campa (2010), Gopinath (2015) and Gopinath and others (2020). The reasons for such enthusiasm in the literature are numerous. Exchange rates can have profound effects on domestic prices and resource allocation within a country. They are an integral part of macroeconomic policy makers' toolkit and often serve as an anchor for monetary policy in developing countries. Changes in exchange rates can help countries adjust to macroeconomic shocks, such as changes in the terms of trade, external financing, and demand conditions. At times, they reflect macroeconomic imbalances from excessive fiscal spending or loose monetary policy. Hence, understanding how changes in the exchange rate affects inflation is important for policy makers, particularly central bankers who need to determine the monetary policy stance and decide whether to intervene in the foreign exchange market. This literature has evolved considerably since its inception, to cover issues related to the level of passthrough, its evolution over time, drivers of such dynamics, its cyclicality, asymmetries, and nonlinearities.

However, studies looking into these issues in the Sub-Saharan African (SSA) context remain sparce. To our knowledge, Razafimahefa (2012) is the only paper that analyzes the exchange rate passthrough and its determinants for all SSA countries. He shows that the exchange rate passthrough in the region is incomplete, and more pronounced following depreciations and devaluations than in episodes of exchange rate appreciation—with the latter having almost no impact on domestic prices—due to downward rigidity in prices. He also finds a lower passthrough in countries with flexible exchange rate regimes compared to fixed exchange rate regimes, suggesting that in the latter group of countries, economic agents perceive exchange rate changes as permanent and, therefore, are keener to update prices due to the permanent change in production costs. Finally, he documents the decline in the exchange rate passthrough in SSA since the mid-1990s which could be attributed to significant improvements in its economic and political determinants.

Several other papers have studied the exchange rate passthrough in individual African countries or have used samples that include limited numbers of African countries. Among the former group, South Africa is the country on which most of the studies are conducted (Jooste and Jhavery, 2014; Kabundi and Mbelu, 2018; and Kabundi and Mlachila, 2019), and there is a consensus that in this country: (1) exchange rate movements are passed through to import prices completely and rapidly (first stage passthrough) but importers only partially

pass these costs on to final consumers (second stage passthrough); (2) exchange rate passthrough has decreased substantially since the adoption of the inflation targeting framework, indicating a better anchoring of inflation expectations and improved monetary policy credibility.

A few other studies cover a subset SSA countries—with their number ranging from 2 to 12, less than one-third of the countries in the region (see, e.g., Choudhri and Hakura 2006; Akofio-Sowah 2009; Frankel and others 2012; Ozkan and Erden 2015; and Ha and others 2019). The main conclusions from these studies are as follows: (1) the exchange rate passthrough to domestic prices show in developing economies has steadily declined from the late 1990s to the late 2000s and remained relatively stable thereafter. However, the exchange rate passthrough remains higher on average in these countries compared to advanced economies; (2) flexible exchange rate regimes, low inflation environments and monetary policy credibility (often following the adoption of an inflation targeting regime) play a key role in lowering the passthrough of exchange rate fluctuations to domestic prices; and (3) other country macroeconomic and geographical characteristics (such as their income levels, distance relative to trade partners, tariffs, wages, level of competitiveness etc.) are non-negligible determinants on the exchange rate passthrough to inflation.

Our paper contributes to the existing literature in several ways. First, we focus on SSA and include almost all countries in the region, while most papers in the literature only include a subset of countries. As stated above, one exception is Razafimahefa (2012). We depart from this paper by not only investigating the impact of changes in the NEER, but also focusing on the bilateral exchange rate against the US dollar. This is motivated by: (1) the recent literature on dominant currency pricing (see e.g., Gopinath, 2015; Gopinath and others 2022) according to which the US dollar is by far the main currency of invoice for trade worldwide; and (2) recent findings by IMF (2023a) suggesting that 84 percent of exports from and 67 percent of imports into the median SSA country in 2022 were priced in US dollars. We also document the role of monetary policy effectiveness in greater detail, given the consensus found in the literature that it plays an important role in the dynamics of exchange rate passthrough. Second, we use local projection methods (Jordà, 2005) which allow the generation of dynamic and state-dependent cumulative response functions to exchange rate movements that are robust to misspecification (see Caselli and Roitman, 2019; Carrière-Swallow and others 2021). Moreover, we use monthly data for our estimations which, combined with cumulative impulse responses allows us to deepen the analysis of the exchange rate passthrough by looking into the speed of passthrough to consumer prices. This has an important policy advantage as it allows policy makers to evaluate their reaction time while facing sudden or imminent exchange rate fluctuations. Third, we study the heterogeneity of passthrough estimates among different country groups, distinguishing between exchange rate regimes, natural resource endowment, competition in domestic markets and the degree of monetary policy effectiveness. Fourth, we study a broader set of nonlinearities in passthrough estimates by looking separately into episodes of persistent versus temporary depreciations, and the effect of large depreciations.

Overall, this paper sheds new light on the complexities of exchange rate passthrough in SSA, offering important and novel insights for policymakers. First, our analysis shows that SSA economies display a high exchange rate passthrough to inflation, but these passthrough are lower than previously estimated (Razafimahefa, 2012). Second, we find that changes in both NEER and bilateral exchange rate against the US dollar are important drivers of inflation but their impact depending on country characteristics. The exchange

rate passthrough in the region surpasses that observed in other regions on average, in line with previous findings in the literature (Ozkan and Erden 2015; Ha and others 2019; Aisen and others 2021). A one percentage point increase in the rate of depreciation against the US dollar leads, on average, to an increase in inflation of 0.22 percentage point in a year, compared to 0.15 in emerging Asia and 0.18 in Latin America. Third, larger depreciations are associated with larger and more persistent passthrough. Fourth, the exchange rate passthrough to inflation is asymmetric in the region. During episodes of depreciation, the passthrough to consumer prices is estimated to be eight times stronger than during episodes of appreciation. This suggests inflationary pressures may not come down as quickly when local currencies strengthen against hard currencies. Fifth, we corroborate that exchange rate passthrough has been falling in the region.

Finally, we explore a rich set of country characteristics that affects exchange rate passthrough. The estimated passthrough using the bilateral exchange rate against the US dollar shows that countries with non-pegged regimes display a higher passthrough compared to countries with a conventional peg regime, while the estimates based on the NEER show that the cumulative response of inflation to an exchange rate depreciation is higher in countries with a conventional peg regime compared to countries with non-pegged regimes. While trade is priced mainly in US dollar for most countries in SSA, the picture is significantly different for countries in pegged regimes where trade is mostly invoiced in the currency of the peg, explaining the limited passthrough of bilateral exchange rate against the US dollar in those countries compared to countries with non-conventional peg regimes.

Furthermore, our empirical findings suggest that monetary policy remains a crucial and effective tool in limiting exchange rate passthrough to inflation in SSA. We show that passthrough effects are weaker in countries with more effective monetary policy, and central bank independence is an important explanatory factor for the observed declining trend of exchange rate passthrough over the last decade in SSA. The degree of market competition, as well as inflation and exchange rate volatilities are other important factor explaining this observed trend, underscoring the importance for policymakers to limit economic uncertainty.

The rest of the paper is organized as follows. Section 2 presents the empirical methodology and provides a brief description of the data used in the analysis. Section 3 presents the baseline results, discusses differences in passthrough estimates across different country groups, and documents asymmetries and nonlinearities in the effect of currency movements on inflation. Section 4 discusses the implications for monetary policy in SSA countries and closes with some concluding remarks.

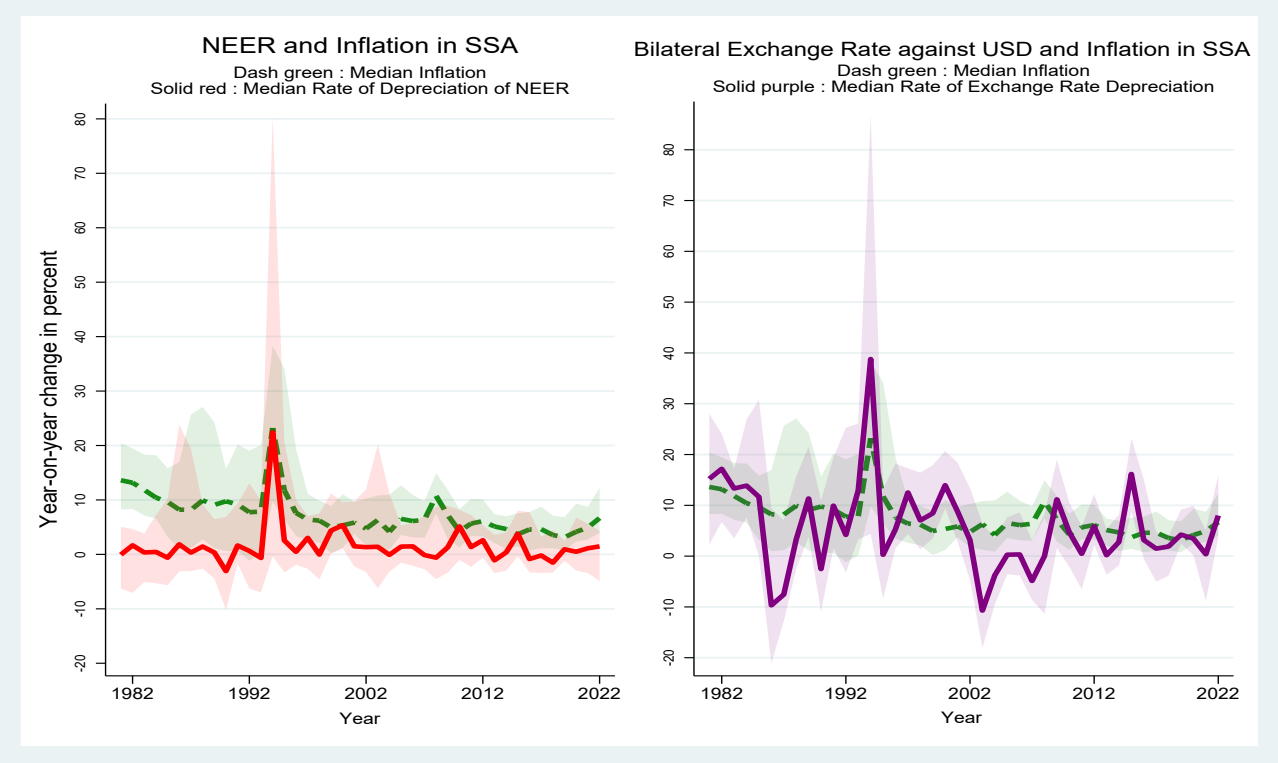
2. Empirical Strategy and Data

One of the motivations for this paper is the strong co-movement between changes in exchange rates and changes in consumer prices. As depicted in Figure 1, episodes of nominal exchange rate depreciations tend to coincide with episodes of higher inflation, suggesting that in SSA, the exchange rate passthrough to inflation might be high.

We use local projection methods (Jordà, 2005) to robustly estimate the impact of exchange rate variations on inflation. This approach has the advantage of being flexible, as it easily allows to account for possible nonlinear or state-dependent effects, which is challenging for traditional vector autoregressive models (Auerbach and

Gorodnichenko, 2013; and Nakamura and Steinsson, 2018). It is flexible enough to robustly control for endogeneity issues, especially when the shock variable—here the exchange rate—is not necessarily exogeneous. Local projection methods have been widely used in the literature to estimate state-dependent impulse responses. For instance, Caselli and Roitman (2019) use them to explore different dimensions of nonlinearities and asymmetries in the transmission of exchange rate variations to prices and find significant evidence of nonlinearities—related to both the size and duration of exchange rate depreciation, as well as the monetary policy regime—in exchange rate passthrough estimates in emerging market economies. Bordon and others (2016) use local projection methods to estimate the impact of labor and product market reforms on growth and employment rate accounting for the business cycle and monetary policy stance. Carrière-Swallow and others (2023) use this technique to document the nonlinear impact of shocks to global shipping cost on domestic prices for a large panel of countries.

Figure 1: Nominal exchange rate depreciations and inflation dynamic in Sub-Saharan Africa (1982-2022)



Source: Authors' calculations
Note: The shaded areas represent the interquartile range. NEER refers to the nominal effective exchange rate.

This method allows us to generate the dynamic cumulative response of domestic prices to exchange rate movements, while controlling for traditional drivers of inflation, cyclical conditions, and time-invariant factors. Various specifications help determine whether the impact of exchange rate changes on inflation depends on country characteristics, the exchange rate regime, and the rate, direction, and size of these changes. Our baseline specification follows Gopinath (2015), Caselli and Roitman (2019), Carrière-Swallow and others (2023), and Obstfeld and Zhou (2022):

$$P_{i,t+h} - P_{i,t-1} = \mu_i^h + \sum_{j=1}^{l} \gamma_j^h \, \Delta P_{i,t-j} + \beta^h \, \Delta ER_{i,t} + \sum_{j=0}^{l} \theta_j^h \, X_{i,t-j} + \varepsilon_{i,t}^h \qquad (1)$$

Where h is the response horizon in months, $P_{i,t}$ is the natural logarithm of the consumer price index (CPI) in country i and month t; ΔER is the year-over-year log change in the nominal exchange rate—we report estimation results using both the bilateral nominal exchange rate against the US dollar and the NEER; μ_i^h is a vector of country fixed effects; β^h traces the impact of exchange rate movements on prices h months after the shock;[1] [2] and γ_j^h measures the persistence of changes in the CPI. X is a set of control variables including traditional external and drivers of domestic prices in SSA countries. In our applications external drivers include the annual percent change in international oil, fertilizer, and food prices, and global shipping costs proxied by the Baltic Dry Index. Country specific drivers include local demand conditions proxied by the cyclical component of the night lights indicator of economic activity and a climate-related events variable to capture local supply shocks like droughts, floods and insect infestations that are common in SSA countries. The number of lags *(l)* has been chosen to be equal to twelve, which helps control for additive seasonal effects that may exist in the price series. To control for both serial correlation and cross-sectional dependence in error terms, we estimate equation (1) for each horizon $h = \{0,1, \dots, 24\}$ using Dricoll-Kraay standard errors.

In estimating equation (1), we use monthly data from multiple sources spanning 2013m1-2022m7[3]. Exchange rates series are collected from the IMF's *International Financial Statistics*; CPI data, international oil, fertilizer, food prices, and the Baltic Dry Index are collected from *Haver Analytics*; the cyclical component of the night lights indicator of economic activity and the indicator of climate-related events are derived using updated data from Hu and Yao (2019) and the international disasters database (*EM-DAT*), respectively.[4]

3. Results

3.1. Baseline Results

Estimation results for the baseline model are presented on the left panel of Figure 2 which, for a given horizon h, shows the h-month-ahead cumulative percent change in the CPI level attributable to a 1 percent change in the rate of depreciation (solid lines), along with the 95 percent confidence band (shaded areas). The results based on the NEER and the bilateral exchange rate vis-à-vis the US dollar are statistically similar, except for the first two months where results based on the latter measure are not statistically different from zero. The exchange rate passthrough to inflation 12 months after the initial shock is around 0.25 when using the NEER and 0.22 when using bilateral exchange rates; the passthrough reaches 0.37 and 0.31, respectively, after two years. These results suggest that on average in the region, a one percentage point (ppt) increase in the rate of

[1] β^h captures the impact of a percent change in the nominal exchange rate on the growth rate of the CPI between t and $t+h$ (cumulative effect). When $h = 12$, this corresponds to the impact on annual inflation as traditionally defined.

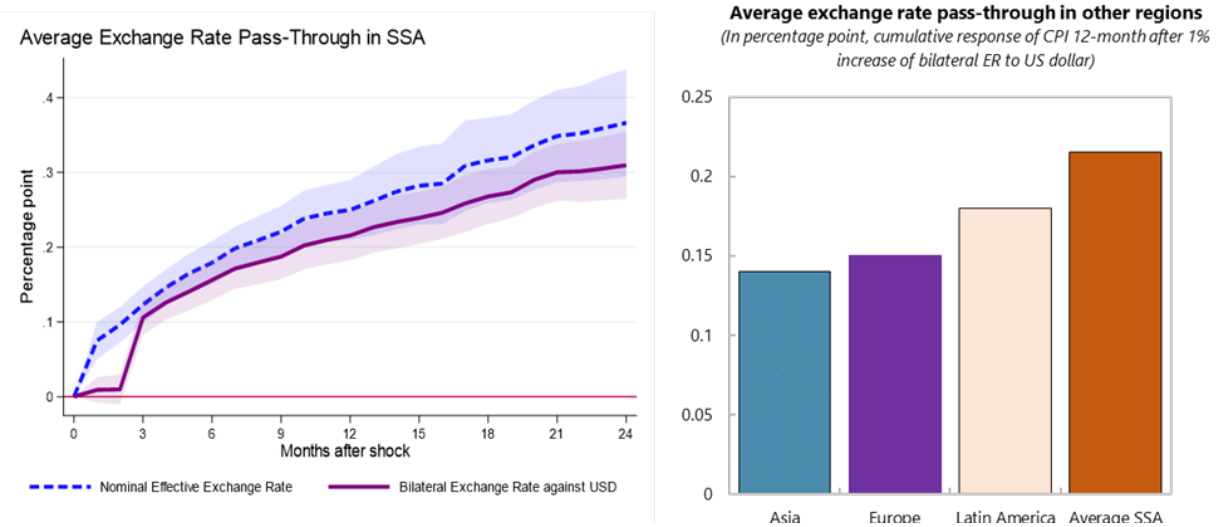
[2] It worth mentioning that given the pervasiveness of price controls in SSA—limiting the transmission of exchange rate movements to prices—the estimates of exchange rate passthrough in this paper could be interpreted as lower bounds.

[3] Night lights indicator data is only available starting from 2013m1, hence the choice of the sample start date. In Section 3.4 below (where we study the evolution of exchange rate pass-through over time), the sample begins in 2002m1 and the night light indicator is dropped for earlier years. Country-years considered outliers (e.g., hyperinflation episodes and excessive exchange rate volatility in some countries) for each indicator are excluded from the sample.

[4] The cyclical component of the night lights indicator of economic activity was extracted using a HP filter and the indicator of climate-related events is a dummy variable which captures all natural disasters and adverse climate events that affect food supply and or have damage effect on the production base (drought, storm, flood, extreme temperature, etc.).

depreciation of the nominal exchange rate against the dollar (NEER) leads to an increase in inflation by 0.22 (0.25) ppt after one year, and an increase in prices by 0.31 (0.37) percent after two years. These results are in line with the general findings in the empirical literature that suggest a higher exchange rate passthrough to inflation in emerging and developing economies (EMDEs) when compared to advanced economies (AEs, Figure 2, right panel)[5]. Various reasons are usually put forward in the empirical literature to explain this stylized fact. For instance, inflation expectations tend to be less anchored in EMDEs compared to AEs, making prices more susceptible to higher and prolonged reactions to exchange rate movements. Additionally, the low level of competition in domestic markets in EMDEs means that firms in these economies generally have greater pricing power; as a result, they can swiftly pass exchange rate depreciations through to domestic prices (Razafimahefa, 2012; Caselli and Roitman, 2019). We test these hypotheses in the following sections by looking at heterogeneities, nonlinearities, and asymmetries in the exchange rate passthrough among SSA countries.

Figure 2: Average estimates of exchange rate passthrough in Sub-Saharan Africa



Sources: Authors calculations; Carriere-Swallow and others (2023)
Note: The lines on the chart on the left represent the cumulative impacts of a one percent increase (depreciation) in local currency/USD (solid purple) and in nominal effective exchange rate (dash blue) on consumer prices. The shaded areas (blue and purple) represent the 95 percent confidence band. On the chart on the right, the bars illustrate the percent change in CPI one year after a one percent increase (depreciation) in the bilateral exchange rate to the US dollar (local

3.2. Heterogeneity Analyses: Key Characteristics Affecting the Passthrough

Average estimates of exchange rate passthrough may mask significant variations among countries. The size of exchange rate passthrough in SSA may vary across countries depending on their characteristics. These could include the exchange rate regime (Campa and Goldberg, 2005), the degree of monetary policy effectiveness (Gagnon and Irhig 2004; Razafimahefa 2012; Carrière-Swallow and others 2016,; Caselli and Roitman 2019),

[5] Caselli and Roitman (2019) find an exchange rate pass-through to prices of around 0.22 and 0.25 after 12 and 24 months respectively, using a sample of 28 emerging market economies. Carrière-Swallow and others (2023) recently found much lower pass-through for emerging markets in Asia and Latin America, respectively at 0.15 and 0.18 after twelve months.

the level of competition in domestic markets (Devereux and others 2015), the share of trade invoiced in foreign currencies, the import content of domestically produced goods (Carrière-Swallow and others 2016; Casa and others 2017; Gopinath 2015; Obstfeld and Zhou 2022), and the degree of participation in global value chains (Georgiadis and others 2017). We focus on three of these characteristics for which data is available for most SSA countries (namely the exchange rate regimes, the degree of monetary policy effectiveness, and the level of competition in the domestic product market), in addition to the natural resource status which we suspect might play an important role in the SSA context given many countries' foreign exchange reserve are from natural resource exports.

A. Exchange Rate Regime

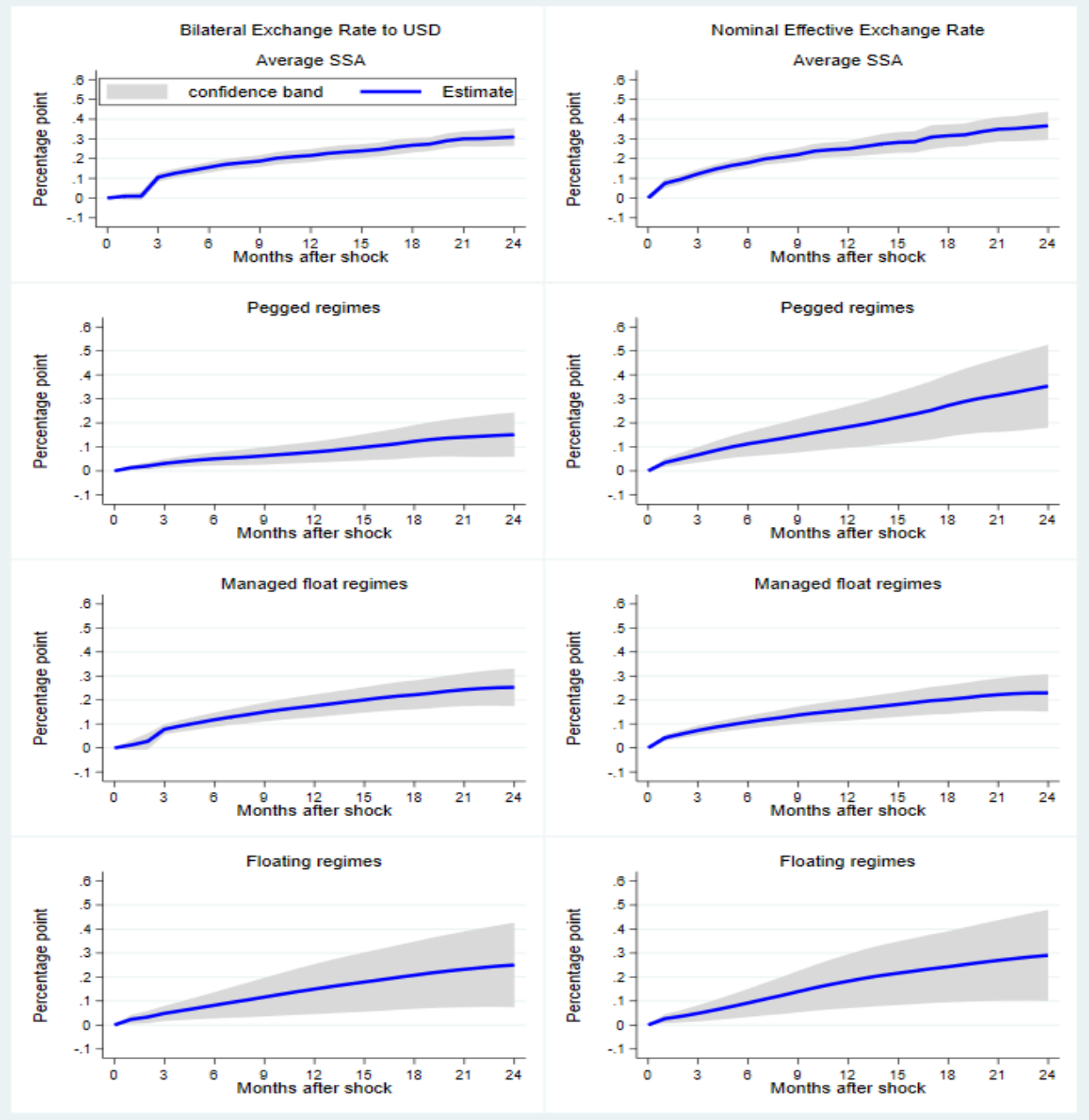
The literature suggests that countries' exchange rate arrangements play an important role in the degree of exchange rate passthrough to inflation (Akofio-Sowah 2009; Razafimahefa 2012; Ha and others 2019). For example, by pegging its currency to a country with low inflation a central bank may better anchor inflation expectations among the public, limiting the impact of exchange rate fluctuations on domestic prices. This section seeks to identify how that plays out in the SSA context. It goes beyond previous studies on the region in two important respects. First, it uses more comprehensive monthly data comprising all SSA countries from 1980-2022. Second, it classifies exchange rate regimes in a more disaggregated manner than the traditional dichotomy between fixed and floating exchange rates. We use the de facto classification of exchange rate regimes as published by the IMF in its 2022 *Annual Report on Exchange Arrangements and Exchange Restrictions*, and we group countries into three categories : (i) Pegged regimes: countries with conventional pegs both on de jure and de facto basis; (ii) Managed float: countries with crawling pegs, craw-like arrangements and other managed arrangements; and (iii) Floating regimes: countries with flexible exchange rate regimes.[6] The effect of the exchange rate regime on the passthrough is captured by re-estimating a version of model (1) that is augmented with dummy variables reflecting the above categories.

Our results based on the bilateral exchange rate against the US dollar (Figure 3, left panel) show that countries with managed floats or with floating regimes display a higher exchange rate passthrough to inflation compared to countries with conventional pegs. On average, a one ppt increase in the rate of depreciation against the US dollar leads to an increase in inflation of 0.20 ppt in countries with managed float regimes and 0.15 ppt in those with floating regimes, twelve months after the shock, compared to less than 0.08 ppt in pegged countries. However, the estimates based on the NEER (Figure 3, right panel) show that the cumulative response of inflation to an exchange rate depreciation after one year is higher in countries with pegged regimes (0.19) compared to countries with non-pegged regimes (0.16 for countries with managed float regimes and 0.18 for countries with float regimes). The difference between pegged and non-pegged regimes is even more striking when considering the passthrough at a two-year horizon. The cumulative exchange rate passthrough to consumer prices after two years in countries with pegged regimes is more than 0.35, which is significantly higher than countries with managed float regimes (0.23) and countries with float regimes (0.29). Our results based on NEER are broadly consistent with those of Razafimahefa (2012) who find that the exchange rate

[6] See Annex Table 1 for a list of countries in each of the three categories. All countries with conventional pegs in our sample are pegged to either the euro or the South African rand and hence their currencies experience fluctuation against the US dollar.

passthrough is higher in countries with pegged regimes than in their non-pegged counterparts, possibly because economic agents in the former group perceive exchange rate changes as permanent and are more inclined to transfer those changes to domestic prices due to permanent changes in production costs.

Figure 3: Cross country heterogeneity of exchange rate passthrough in SSA – Exchange rate regimes



Sources: Authors' estimates

Note: For each chart, the shaded area represents the 95 percent confidence band. In addition to the whole sample, this figure also shows results for 3 subgroups of SSA countries grouped by exchange rate regimes. See annex table 1 for the list of SSA countries grouped by exchange rate regimes ("Floating", Managed Float", and "Pegged"), using IMF de facto classification (2022).

The limited passthrough of bilateral exchange rate against the US dollar in countries with pegged regimes could be attributed to the fact that a relatively smaller portion of their imports are invoiced in US dollars. Indeed, while trade is priced mainly in US dollar trade for most countries in SSA, the picture is significantly different for countries in pegged regimes where trade is mostly invoiced in the currency of the peg.[7] For instance, around 72 percent of trade in the West African Economic and Monetary Union is invoiced in euros (Boz et al., 2020). As a result, changes in the US dollar have a weaker impact on import prices and consumer prices than changes in the NEER.

B. Monetary Policy Effectiveness

To investigate how the effectiveness of monetary policy affects the exchange rate passthrough in the SSA context, we estimate a version of equation (1) where the response of inflation to variations in exchange rates depends on the degree of monetary policy effectiveness captured by a dummy variable which takes a value of one when monetary policy is considered "effective" and zero otherwise:

$$P_{i,t+h} - P_{i,t-1} = \mu_i^h + \sum_{j=1}^{l} \gamma_j^h \, \Delta P_{i,t-1} + \beta^h \, \Delta ER_{i,t} + \delta_h \Delta ER_{i,t} \times dummy_{i,t} + \varphi_h dummy_{i,t} + \sum_{j=0}^{l} \theta_j^h \, X_{i,t-j} + \varepsilon_{i,t}^h \qquad (2)$$

Following Carrière-Swallow and others (2023), we use central bank's track record at delivering price stability as a proxy of monetary policy effectiveness. We use the median of inflation rate in the 2000s to split the sample into "high" and "low" past inflation bins[8].

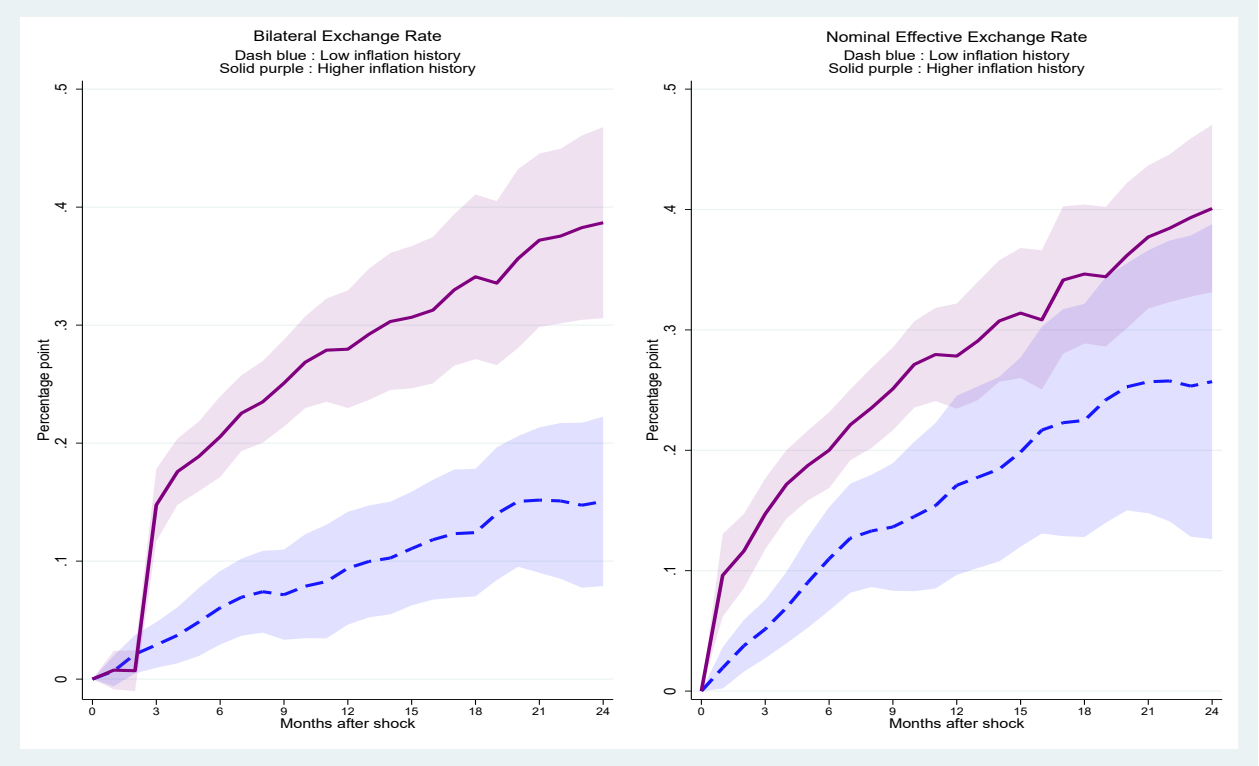
As is evident in Figure 4, the effectiveness of monetary policy plays an important role in limiting exchange rate passthrough. The estimated exchange rate passthrough tends to be significantly higher in SSA countries with historically high inflation, compared to countries with a good track record of low inflation. The difference of exchange rate passthrough between countries with a history of high inflation and those with low past inflation—which is starker when considering the shock on bilateral exchange rate to US dollar—could reflect a limited second-round or indirect effect of exchange rate variations on inflation in countries with effective monetary policy. Exchange rate movements can impact inflation through two main channels: the direct channels related to the imported consumption and cost channels, and the indirect channel. First round or direct effects occur when exchange rate changes directly affect the prices of imported goods, which in turn impact domestic CPI through two ways: the change in prices of final imported goods or the cost of production changes as higher prices of imported intermediate inputs create additional cost pressures for producers, creating pressure to

[7] IMF (2023) finds that for the median Sub-Saharan African country, 84 percent of exports and 67 percent of imports in 2022 were priced in US dollars.

[8] As a robustness check, we conduct an alternative estimation in which we employ the median of inflation across the entire sample as a threshold for defining inflation regimes for countries and time periods. We estimate equation (2) wherein the dummy is assigned a value 1 when inflation is higher than the median ("high inflation episode"), and zero otherwise ("low inflation episode"). The results (see Annex Figure 2) validate the initial findings – the exchange rate pass-through tends to be higher during episodes of high inflation.

charge higher prices to domestic consumers.[9] Second-round effects occur when the exchange rate depreciation affects assets prices and alter inflation expectations leading to more broad-based and entrenched inflation, which can be significant in countries with poor track records of low inflation and weak monetary policy credibility.

Figure 4: Exchange rate passthrough to inflation and monetary policy effectiveness in SSA



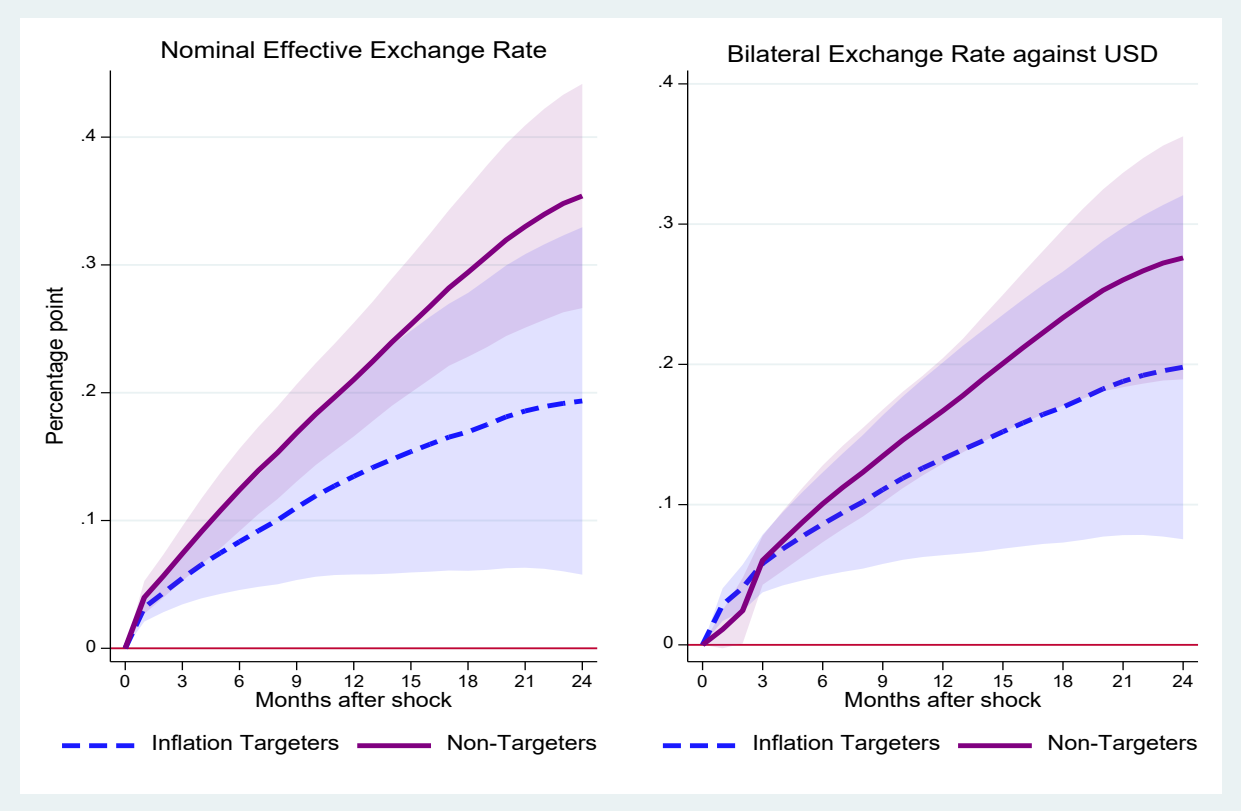
Sources: Authors' estimates
Note: The shaded areas represent the interquartile range.

The ability of monetary policy to be effective in delivering low and stable inflation depends to a large extent on the policy framework that governs the central bank response to inflation shocks. To further check whether monetary policy effectiveness matters for the exchange rate passthrough, we now focus on the policy framework that governs monetary policy response. We use inflation targeting as an alternative proxy of the strength of monetary policy framework. Empirical evidence on the performance of inflation targeting is broadly supportive of the effectiveness of the framework in delivering low inflation, anchoring inflation expectations, and lowering inflation volatility. For example, Gagnon and Ihrig (2004) find that central banks' increased focus on inflation control within inflation targeting frameworks played a significant role in the declining exchange rate passthrough in developed countries. They suggest that when the central bank has established credibility in combating inflation and its goals are transparent, individuals are less likely to transfer cost increases caused by currency depreciation. Recent empirical research on developing countries confirms that countries with an inflation targeting regime experience significantly lower exchange rate passthrough to inflation than those with

[9] There is a consensus in the literature that the first round passthrough is complete, regardless of the degree of monetary policy effectiveness.

other monetary policy frameworks (Jooste and Jhavery, 2014; Ozkan and Erden, 2015; Kabundi and Mbelu, 2018; Caselli and Roitman, 2019). Our results (Figure 5) show little evidence of a difference in exchange rate passthrough estimates between inflation targeting and non-targeting regimes in SSA.[10] One possible explanation for this inconclusive result could be the nascent stage of inflation targeting regimes in SSA countries, except for South Africa where recent empirical evidence shows that the adoption of an inflation targeting framework played a crucial role in lowering the passthrough of exchange to domestic prices (see Jooste and Jhavery, 2014; and Kabundi and Mbelu, 2018).

Figure 5: Exchange rate passthrough to inflation in SSA – Inflation targeting regimes vs. non-inflation targeting regime



Sources: Authors' estimates
Note: The shaded areas represent the interquartile range.

C. Level of Competition in the Domestic Products Market

Competition among firms is generally deemed an essential driving force of market economies, as it ensures an efficient allocation of resources, generates firm dynamics that boost innovation and productivity growth. In contrast, the lack of competition among firms has significant potential costs, hurting the poor through higher prices of essential items and undermining growth and the ability of the economy to absorb shocks. Market power can also determine how much of the exchange rate changes producers and importers pass on to

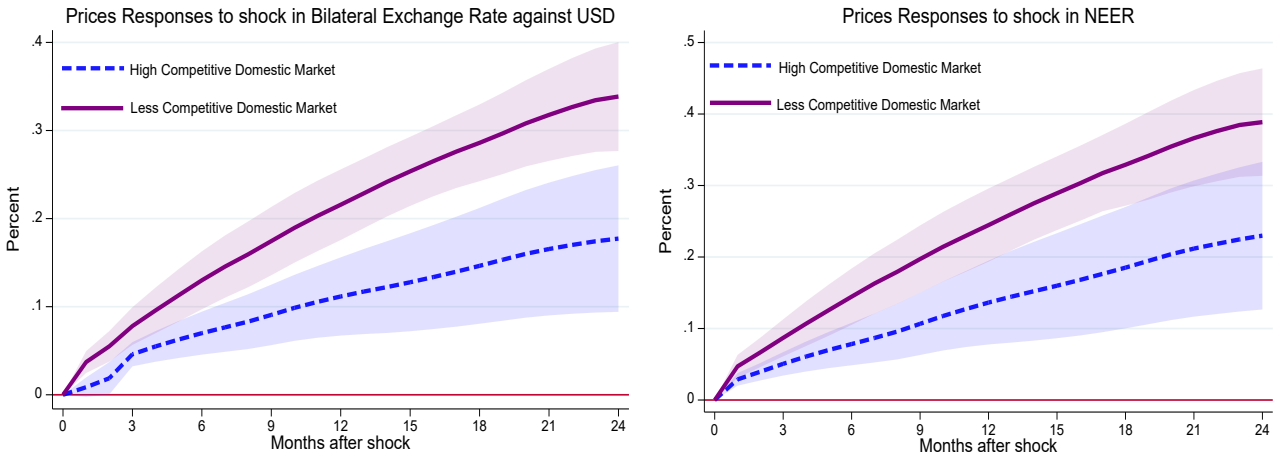
[10] Countries with IT regimes in SSA include South Africa, Ghana, Kenya, Malawi, Mauritius, Mozambique, Seychelles, Uganda, and Zambia. To investigate how the inflation targeting regime affects the exchange rate pass-through in the SSA context, we estimate a variant of equation (1) augmented with a dummy variable which takes a value of one when the country's central bank follows IT regime and zero otherwise.

consumers. In fact, markets with low levels of competition are generally characterized by the dominance of a few firms, which often have high market power and are less productive.

Cherif and others (2020) find, using both country-level indicators and some firm-level indicators, that competition in SSA countries remains low relative to the rest of the world, with more than 70 percent of the countries in the region falling in the bottom half of countries globally in terms of domestic and foreign competition indicators. The structurally low level of competition in the domestic products market in low income and emerging market countries has also been cited as one of the main determinants of the high exchange rate passthrough to inflation relative to advanced economies (Razafimahefa 2012; Ha and others 2019; Carrière-Swallow and others 2021). Cherif and others (2020) also show that there are important heterogeneities across country groups in the region, with oil exporters having lower level of domestic market competition relative to other country groups.

Against this background, this section aims to assess how the exchange rate passthrough to inflation varies across countries depending on their level of domestic market competition. Following Cherif and others (2020), we use the Bertelsmann-Stiftung Transformation Index (BTI), focusing on countries' scores on the subcomponent "*Organization of the Market and Competition*,", which range between 0 (lowest level of competition) and 10 (highest level of competition). We split our countries in two groups, those with high competition, if the country's average BTI score over the period 2006-2022 is above the median score for the entire sample, and those with low levels of domestic competition when the average BTI score is below that median. To investigate how competition in the domestic market affects the exchange rate passthrough in the SSA context, we estimate a state-dependent version of equation (1) where the response of inflation to variations in exchange rates depends on the level of domestic market competition captured by the dummy variable constructed as described above.

Figure 6: Exchange rate passthrough and the level of competition in the domestic products market



Sources: Authors' estimates

Note: The shaded areas represent the interquartile range.

We find that the size of the passthrough in the region also depends on the level of competition in the domestic market (Figure 6). The exchange rate passthrough appears to be higher when there is less competition in the domestic products market. This broadly reflects the fact that low level of competition in SSA countries is generally related to the market dominance of a few firms, which are often less productive. Because of their mark-up power or because they lack efficiency to absorb some temporary cost-push shocks stemming from

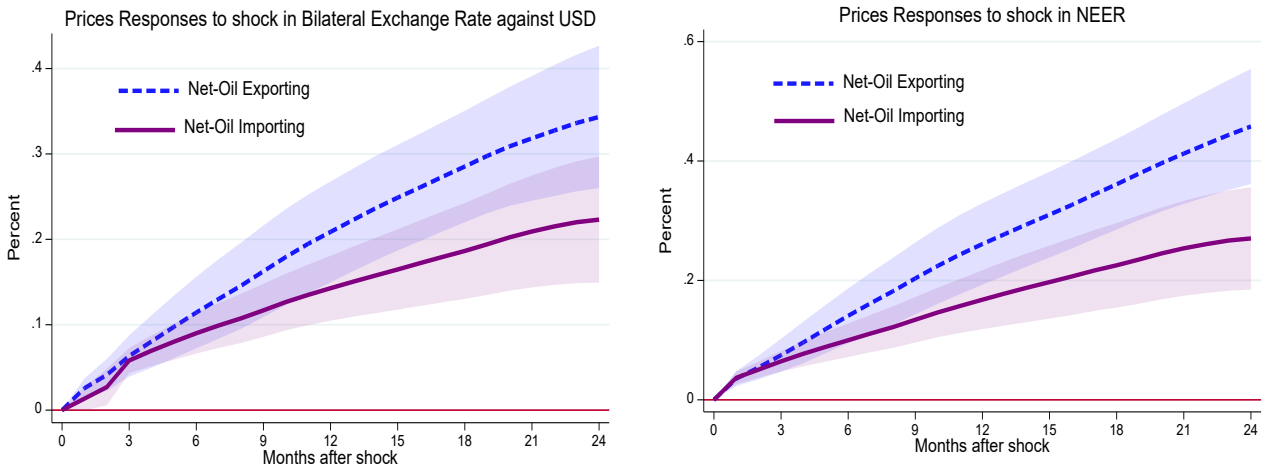
exchange rate variations, firms in less competitive markets in SSA may tend to rapidly pass exchange rate movements to consumer prices. These results are robust to the change in the market competition index. We find similar results in the first few months following the shock, using an alternative indicator of domestic market competition: the Global Competition Index (see Annex Figure 3).

D. Natural Resource Status

The degree of reliance of natural resources revenues is a potential economic structural characteristic that could drive the heterogeneity of exchange rate passthrough across countries. Resource boom is often associated with exchange rate overvaluation which can crowd out production from other tradable sectors. This can, in turn, make countries more reliant on imported goods in their consumption basket which can affect passthrough. Natural resource dependence is also associated with weaker institutions, which can undermine a country's ability to manage macroeconomic shocks. We test the hypothesis by estimating a state-dependent version of equation (1) where the response of inflation to variations in exchange rates depends on the natural resource status of a country, captured by a dummy variable taking the value 1 if the country is a net oil exporter and zero otherwise.

Our results show some evidence of a higher and more persistent passthrough in oil-exporting countries relative to other country groups. As a robustness check, we also use a dummy variable that distinguishes between resource-intensive countries rather than just net oil exporters; our results remain virtually unchanged (see Annex Figure 4). These results may reflect the fact that non-resource-intensive countries generally have more competition-prone market structures than oil exporters which are less diversified Cherif and others (2020). Another intuition is that for oil-exporting countries, a depreciation of the local currency may have a net positive impact on nominal revenue in local currency, which in turn may contribute to sustain the domestic demand and further increase inflationary pressures.

Figure 7: Exchange rate passthrough and natural resource status



Sources: Authors' estimates
Note: The shaded areas represent the interquartile range.

3.3. Nonlinearity and Asymmetries

The literature on the exchange rate passthrough highlights the presence of nonlinearities and asymmetries, meaning that prices may respond differently to large changes in the exchange rate, and depreciations may

generate an asymmetric reaction relative to appreciations (Pollard and Coughlin 2004; Bussière 2013; Frankel and others 2012; Caselli and Roitman 2019). Many studies showed, for emerging markets and developed economies, that the exchange rate passthrough to inflation is more pronounced following a depreciation than following an appreciation. On SSA countries, Razafimahefa (2012) found that domestic prices respond more intensively to a depreciation of the local currency than to an appreciation which was found to have almost no impact on domestic prices.

We investigate two sources of nonlinearity of exchange rate passthrough to inflation. First, we examine whether high depreciation rates have more than proportional impacts on inflation than moderate changes. Given that exchange rates are generally quite volatile, we push the nonlinearity analysis further by testing whether the impact of an exchange rate depreciation on inflation could vary depending on whether the depreciation episode is considered as "persistent" (i.e., long-lived) or "temporary" (i.e., shorter-lived).[11]

A. Magnitude of Depreciations

Historical data show that except for some countries like Angola, DRC, Zambia, Ghana and Mozambique, exchange rates depreciations above 20 percent are quite infrequent across SSA countries (see Annex Figure 1). We consider this threshold in calibrating what could be considered on average as an episode of high exchange rate depreciation for most SSA countries. In our estimations, we consider one threshold to characterize realistic episodes of high depreciation: when the monthly year-on-year percent change in the exchange rate is larger than 10.

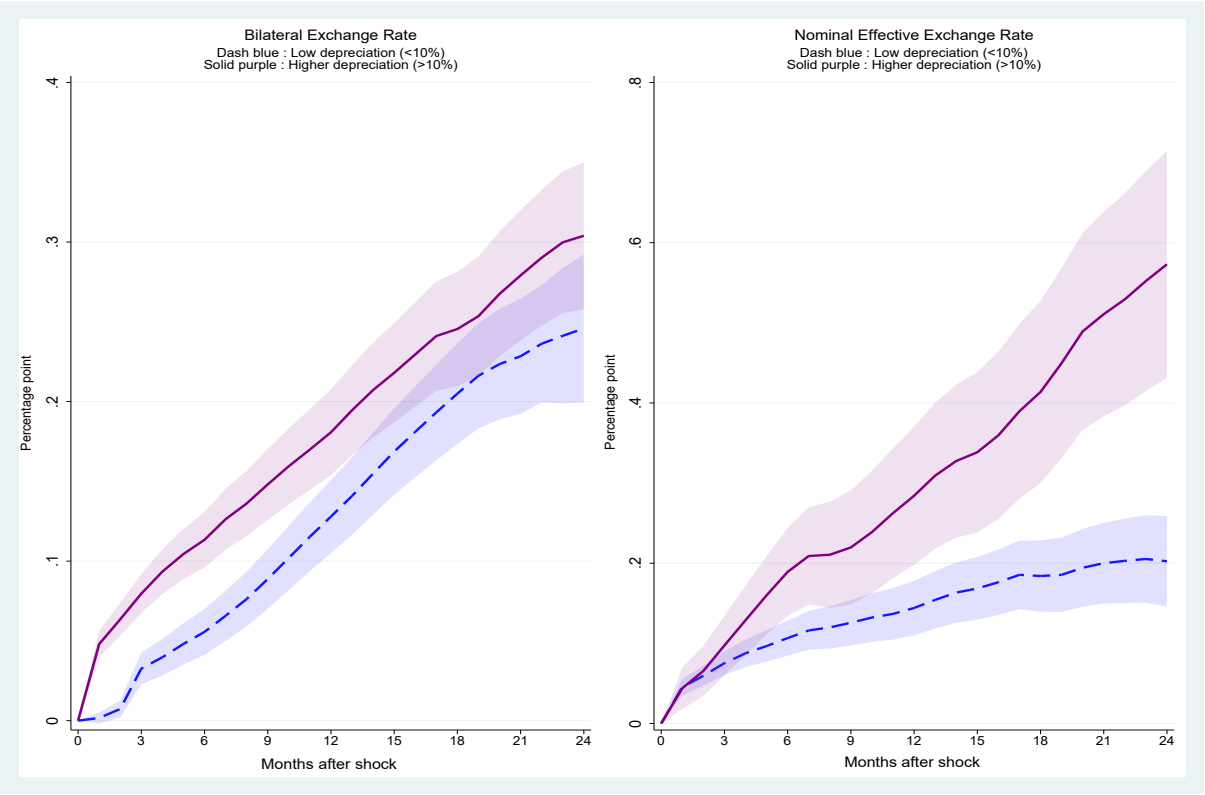
Based on this threshold, we construct the dummy variable ($high\_d_{i,t}$) capturing episodes of high depreciations and estimate the following equation:

$$P_{i,t+h} - P_{i,t-1} = \mu_i^h + \sum_{j=1}^{l} \gamma_j^h \, \Delta P_{i,t-j} + \beta^h \, \Delta ER_{i,t} + \delta_h \Delta ER_{i,t} \times high\_d_{i,t} + \varphi_h high\_d_{i,t} + \sum_{j=0}^{l} \theta_j^h \, X_{i,t-j} + \varepsilon_{i,t}^h \qquad (3)$$

Estimation results (Figure 8) show evidence of nonlinearity in the impact of exchange rate depreciation on inflation in SSA countries. The size of the depreciation matters. Results based on the NEER show that when depreciations are modest, the increase in inflation occurs mostly in the first year after the shock. However, at higher levels of depreciation, the percentage increase in inflation is not only disproportionately larger in the first year, but it continues to be high well into the second year after the shock. Results based on the bilateral exchange rate against the US dollar also show that the exchange rate passthrough to inflation during the first year following the shock is faster and higher during high depreciation episodes. Given their disproportionate impact on inflation, large depreciations of exchange rates could be associated with considerable risks of inflation de-anchoring in SSA, especially in countries where inflation is already high and central bank credibility is weak.

[11] Razafimahefa (2012) uses the temporary vs. permanent/persistent nature of exchange rate fluctuations to justify higher estimates of exchange rate past-through in pegged regimes relative to non-pegged ones. As presented above, our analyses show that the exchange rate pass-through is lower in pegged regimes compared to non-pegged ones.

Figure 8: Exchange rate passthrough to inflation during episodes of high depreciation

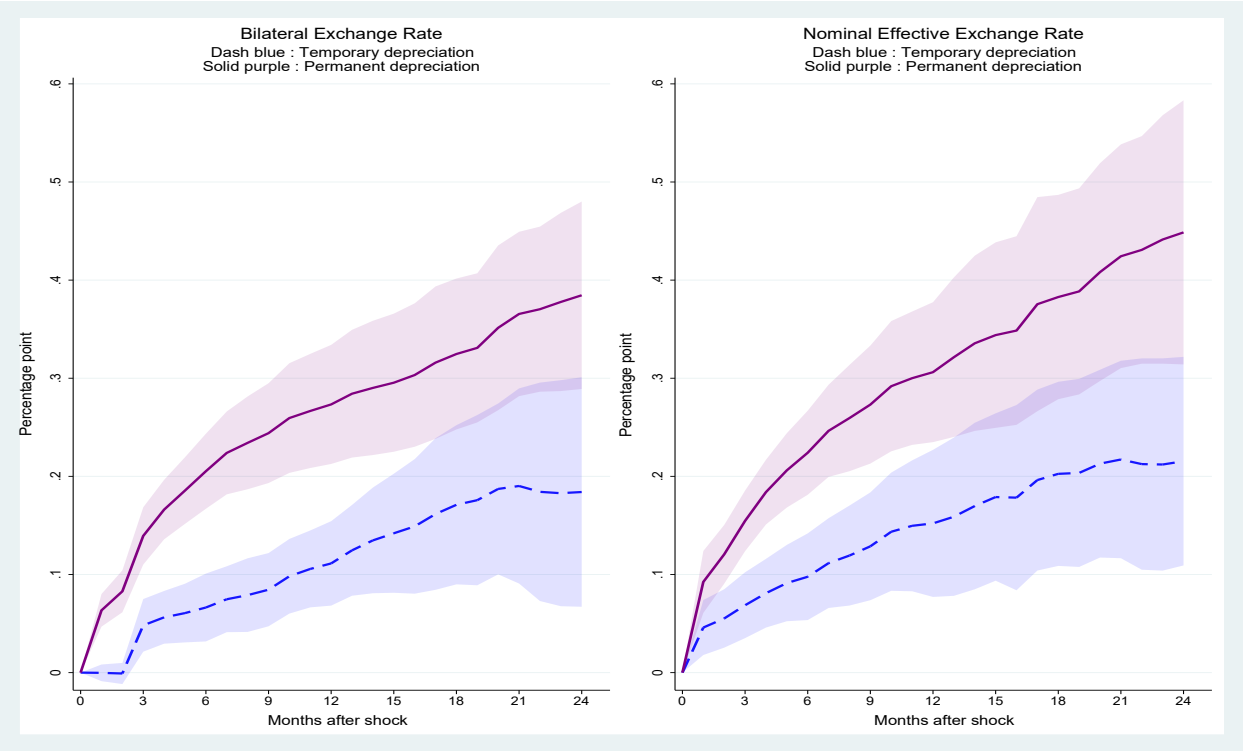


Sources: Authors' estimates
Note: The shaded areas represent the interquartile range.

B. Persistence of Depreciation Shocks

The literature suggests that nonlinearities in passthrough estimates could also be related to the persistence of the exchange rate shocks, meaning that prices may respond differently to prolonged depreciations of exchange rate compared to more temporary ones. To test this hypothesis, we construct a dummy variable that capture the persistence of episodes of exchange rate depreciation. We define a persistent episode as one where the exchange rate depreciates by more than 10 percent for more than three consecutive months. We estimate a version of equation (3) where the dummy variable is substituted by the one capturing persistent episodes of depreciation. We find that persistent episodes of exchange rate depreciation tend to have disproportionately larger impact on inflation (Figure 9). Importers and firms may tend to rapidly transmit movements in exchange rate to prices when they perceive those movements as long-lasting.

Figure 9: Average exchange rate passthrough in SSA – Permanent vs. temporary episodes of depreciation



Sources: Authors' estimates
Note: The shaded areas represent the interquartile range.

C. Depreciations vs. Appreciations

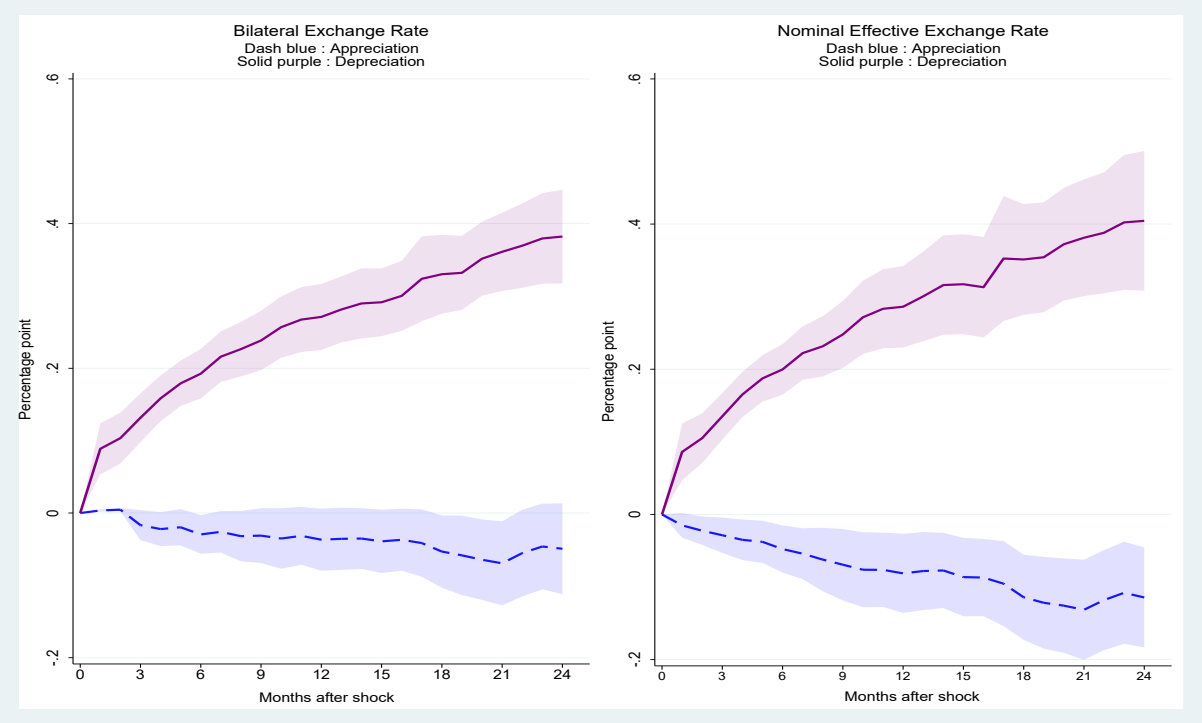
The literature on pricing-to-market and mark-up models originally assumed that prices change symmetrically with exchange rate variations. But, in practice firms and importers generally have a stronger incentive to pass on a depreciation to prices than an appreciation.[12] To test the asymmetry between appreciation and depreciation we construct a dummy variable ($typshock\_d_{i,t}$) which captures the sign of an exchange rate shock: 1 if it is a depreciation and 0 otherwise. We estimate a version of equation (3) with the new dummy variable capturing the type of exchange rate shock. We find that the exchange rate passthrough to inflation is asymmetric in SSA countries (Figure 10). During episodes of depreciation, the passthrough is estimated to be about eight times stronger—in absolute terms—than during periods of appreciation, suggesting that prices may not come down quickly when the local currencies strengthen after period of depreciation.

The degree of competitiveness of product markets is generally one key factor used in the literature to explain the asymmetry in the exchange rate passthrough to inflation. In general, due to their higher market power, dominant firms operating in a less competitive environment have less incentive to reduce margins and hence passthrough nominal appreciations (Bussière, 2007). Therefore, they tend to adjust their prices more during a depreciation than during an appreciation. Existing evidence shows that in many developing countries, markets

[12] Whether exchange rate variations are absorbed or passed on to prices has an impact on firms' mark-ups. An appreciation reduces the price of imported inputs while a depreciation increases these prices. Therefore, keeping the final price constant after an appreciation has a positive effect on the seller's mark-up, while doing the same after a depreciation reduces it.

are often characterized by anticompetitive practices and structures (Autor and others 2017; De Loecker and Eeckhout 2018; IMF 2019). This is particularly the case in SSA countries where monopolies, especially state-owned, are widely prevalent and single operators hold large market shares in key sectors in many countries (Cherif and others 2020). Using country-level and firm-level data for 39 SSA countries, Cherif and others (2020) show that market competition in the region remains generally low compared to the rest of the world, with more than 70 percent of the countries in SSA falling in the bottom half of countries globally in terms of domestic and foreign competition. They also find, using firm-level data, that firms' profitability and markups are generally higher in SSA compared to other emerging market economies, confirming the low degree of competitiveness of product market in the region.

Figure 10: Asymmetries in exchange rate passthrough to inflation - Depreciation vs. Appreciation



Sources: Authors' estimates
Note: The shaded areas represent the interquartile range.

3.4. Declining Exchange Rate Passthrough over Time

To examine the evolution of the exchange rate passthrough over time, we estimate the degree of exchange rate passthrough country by country using equation (1) over rolling samples of 10 years, starting in 2002. Our results show that the exchange rate passthrough to consumer prices has, in general, decreased across the region. The median passthrough to inflation in SSA based on the NEER has fallen to 0.16 in 2022 from 0.25 in 2012. This trend is confirmed when using the bilateral exchange rate against the US dollar, with the median passthrough falling to 0.10 in 2022 from 0.16 in 2012.

However, the pace of this decrease has been irregular over time, and there are significant heterogeneities among different groups of countries (Figure 11). The decline is particularly noticeable in countries with conventional pegs, where the median passthrough relative to the NEER has more than halved over the last decade, dropping from 0.35 in 2012 to 0.13 in 2022. In countries with a floating regime, the median passthrough has also fallen to almost half of its 2012 level. Meanwhile, the median passthrough to consumer prices in countries with a managed float also decreased over the last decade, but by a lesser extent, going from a median of 0.25 in 2013 to 0.19 in 2022.

Figure 11: Exchange rate passthrough over time in Sub-Saharan Africa – NEER (2012-2022)

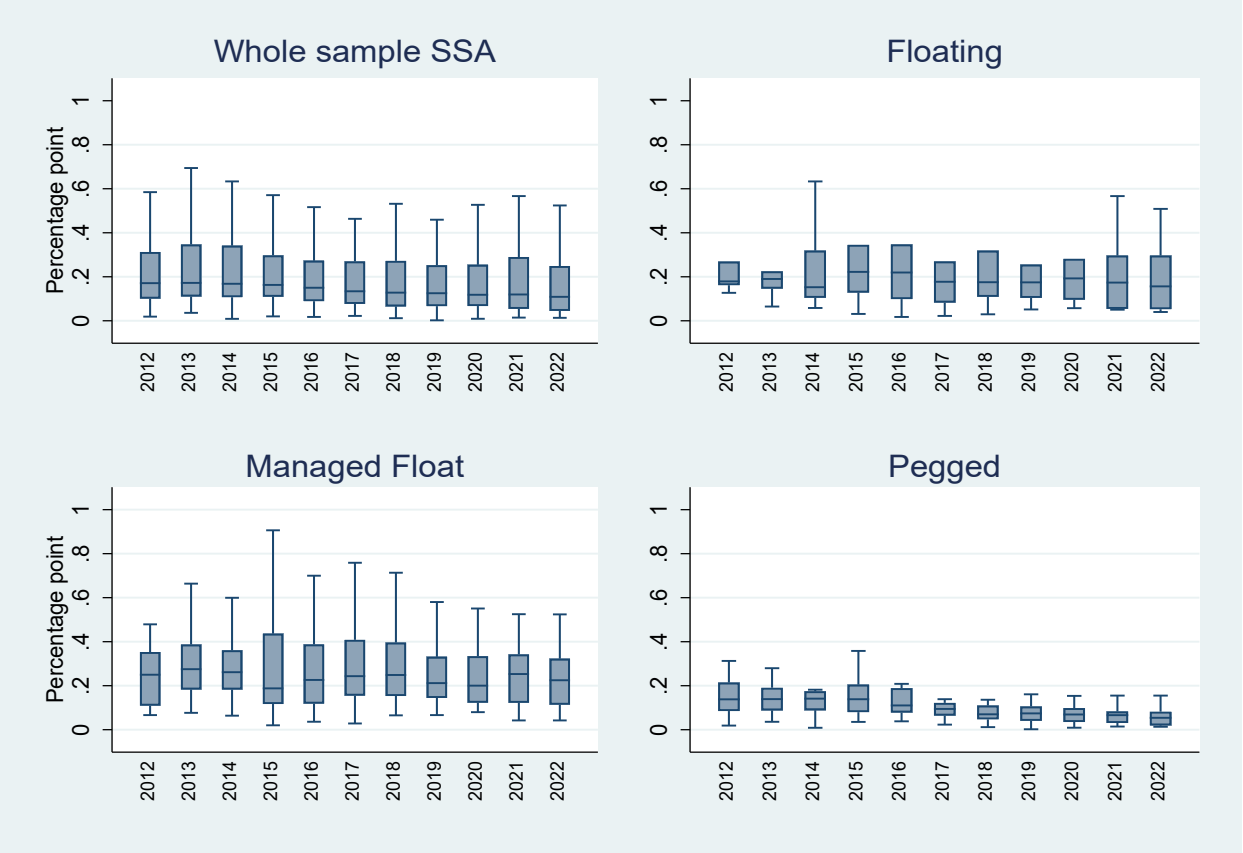
Sources: Authors' estimates

Note: In addition to the whole sample, this figure also shows results for 3 subgroups of SSA countries grouped by exchange rate regimes. See annex table 1 for the list of SSA countries grouped by exchange rate regimes ("Floating", Managed Float", and "Pegged"), using IMF de facto classification (2022). Each bar represents the entire distribution of countries' ERPT estimates, the whiskers represent the interquartile range, while the line within each whisker is the median ERPT.

We have shown that exchange rate passthrough varies significantly across countries in the region and has consistently declined over time. Now we explore the factors behind the heterogeneity across countries and the downward trend of exchange rate passthrough in SSA. To do so, we conduct a regression analysis, using the full set of country- and time-specific passthrough estimates (i.e., annual estimates by country spanning 2012 to 2022), on several potential determinants that have been identified in the literature. These determinants include

average inflation, inflation volatility, average level of exchange rate fluctuations, exchange rate volatility,[13] monetary policy credibility proxied by the index of central bank credibility of Romelli (2022), the level of competition in the domestic products market, proxied by the BTI score, energy subsidies in percent of GDP, and the import content of consumption, proxied by the ratio of imports on total final consumption.

Figure 12: Exchange rate passthrough over time in Sub-Saharan Africa – Bilateral exchange rate against the US dollar (2012-2022)



Sources: Authors' estimates

Note: In addition to the whole sample, this figure also shows results for 3 subgroups of SSA countries grouped by exchange rate regimes. See annex table 1 for the list of SSA countries grouped by exchange rate regimes ("Floating", Managed Float", and "Pegged"), using IMF de facto classification (2022). Each bar represents the entire distribution of countries' ERPT estimates, the whiskers represent the interquartile range, while the line within each whisker is the median ERPT.

To account for the gradual variation of exchange rate passthrough over time, we include a lagged dependent variable in the model. This is a potential source of endogeneity problem due to the correlation between this lagged term and the time-invariant effect. To deal with this issue, we follow the Anderson and Hsiao (1981) approach by estimating the first difference of the model with panel instrumental variables techniques using lagged values of the endogenous variable as instrument.

[13] Average inflation, average exchange rate depreciation, inflation volatility and exchange rate volatility are calculated over rolling samples of 10 years, using monthly data starting in 2002. The volatility is defined as the coefficient of variation (ratio of standard deviation to mean) of the variable of interest during the time span considered.

$$ERPT_{it} = \alpha_i + \gamma_t + \delta ERPT_{it-1} + \beta_j X_{it} + \varepsilon_{it} \quad (4)$$

Where X is the vector of the potential determinants of exchange rate passthrough listed above, and β_j is the vector of coefficients associated to each of the determinants. α and μ are the vectors of country and time fixed effects.

Table 1 presents the results of the regressions for different specifications of equation (4) (with and without the lagged dependent variable). Our results show that the exchange rate passthrough increases with the level of inflation as well as the size of exchange rate depreciation. Higher inflation and exchange rate volatilities are also found to increase the exchange rate passthrough, generalizing the findings of van der Westhuizen and others (2023, for the former) and Miyajima (2020, for the latter) to the whole SSA region. The coefficients associated with the domestic market competition index are all negative and statistically significant. An improvement in the level of competition in the domestic market tends to reduce the size of exchange rate passthrough to consumer prices. These results confirm the state-dependent and nonlinearity analysis done previously, where we find that the exchange rate passthrough tends to be higher in countries with historically high inflation, and during episodes of higher depreciations of exchange rate, while countries with higher levels of domestic market competition tend to experience lower exchange rate passthrough.

The results also show that the central bank independence index is negatively and significantly associated to the exchange rate passthrough. An increase of 0.1 in the central bank independence index is associated with a drop in the estimated passthrough of 0.1–0.15.[14] This result is in line with previous findings in the literature (Taylor 2000; Gagnon and Ihrig 2004; Choudri and Hakura 2006; Miskin and Schmidt-Hebbel 2007; Carrière-Swallow and others 2016) which show that credible monetary policy frameworks, based on strong institutional frameworks that allow central banks to fulfill their mandate independently of fiscal considerations and political pressures and which support well-anchored inflation expectations, can play a key role in stabilizing inflation following large currency depreciations. For example, Carrière-Swallow and others (2016) find that an increase of one unit in central bank independence index can lead to a drop of exchange rate passthrough of about 0.08 in Latin American countries.

4. Robustness Check

The analysis so far is agnostic about the drivers of exchange rate movements and implicitly assumes that exchange rate shocks are exogeneous from inflation dynamics. In practice, this may not be the case, as exchange rate movements may be driven by domestic fundamentals including inflation dynamics (Dornbush, 1976; Clarida and Gali, 1994; Eichenbaum and Evans, 1995). Moreover, exchange rate movements may result from domestic demand shocks that also affect inflation. This is for example the case when an expansionary monetary policy shock leads to both an increase of inflation and a depreciation of the nominal exchange rate. This would bias our estimates toward a higher exchange rate passthrough particular during episodes of high inflation. To address the potential endogeneity of exchange rate shocks, we amend the local projection

[14] The Romelli (2022)'s central bank independence index takes values between 0 and 1. An increase of 0.1 in this index can also be interpreted as an increase of one unit.

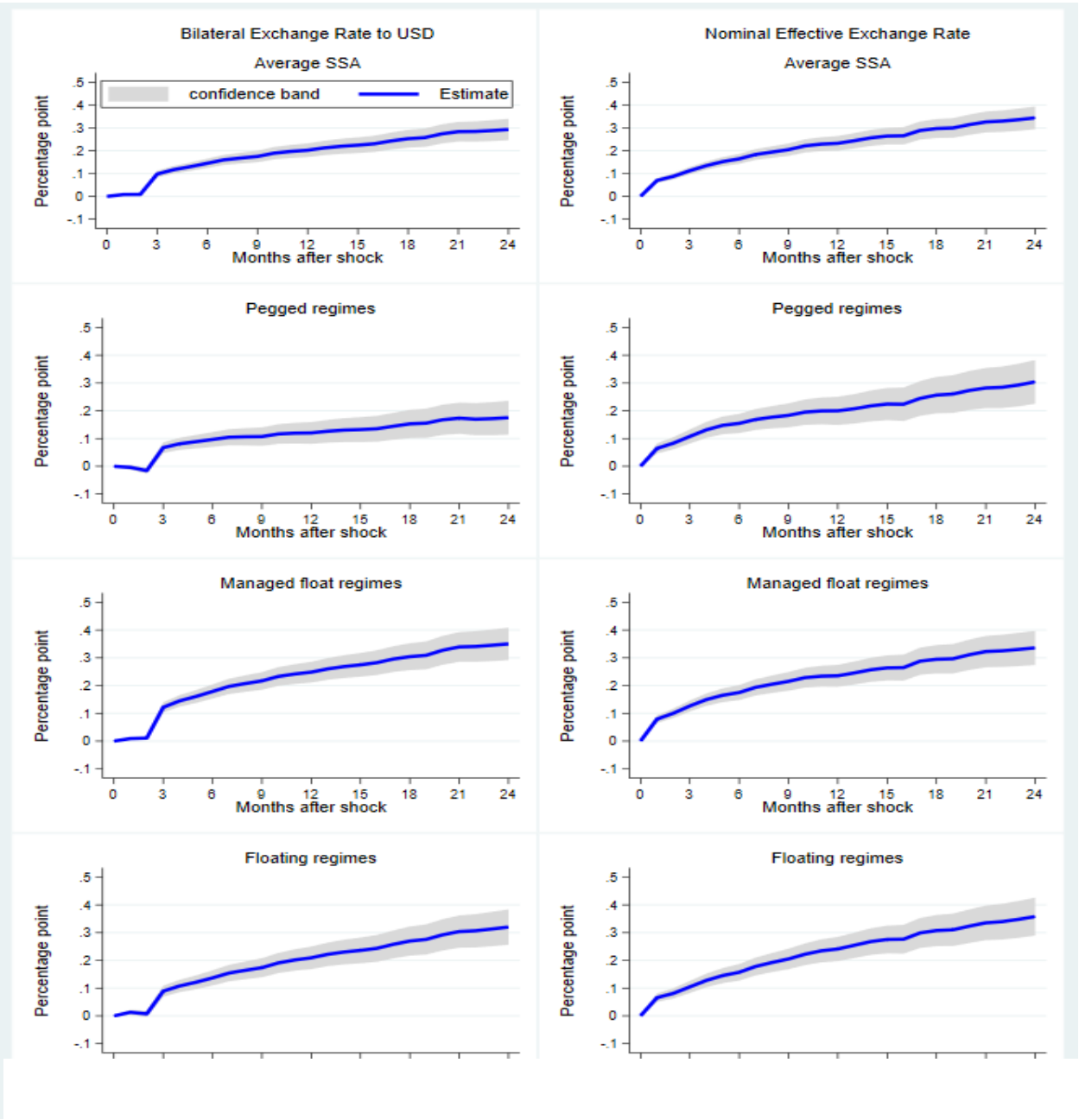
framework to combine it with instrumental variable techniques. Following the literature on the spillovers from US monetary policy to emerging markets (see for instance Rey 2016; Li and others 2020; and Miranda-Agrippino and Rey 2020), we exploit the exogeneity of US monetary policy shocks from the EMs' perspective. We therefore instrument the bilateral exchange rate to the US dollar by the US monetary policy shocks. We use US monetary policy shock from Nakamura and Steinsson (2018). For the estimation with the NEER, we use the IMF global financial conditions index as instrument. Figure 13 shows that the estimates of the exchange rate passthrough from an instrumental variable approach are consistent with the results obtained from the baseline analysis.

Table 1: Determinants of Exchange Rate Passthrough Estimation Results

	Nominal Effective Exchange Rate				Bilateral Exchange Rate against the US dollar			
	OLS	OLS	IV	IV	OLS	OLS	IV	IV
Import share	0.00539	0.0174	0.0717**	0.0751**	0.0366	0.0410	0.0382	0.0595
	(0.0537)	(0.0556)	(0.0257)	(0.0276)	(0.0817)	(0.0886)	(0.0402)	(0.0392)
Energy subsidies	-0.000732	-0.00158	-0.00274**	-0.00266**	-0.00145	-0.000702	-0.00134	-0.00166
	(0.00306)	(0.00316)	(0.000855)	(0.000926)	(0.00467)	(0.00503)	(0.00128)	(0.00132)
Market competition	-0.0140*	-0.0457**	-0.0338**	-0.0319**	-0.0349**	-0.0198*	-0.0312**	-0.0513**
	(0.00311)	(0.00356)	(0.00419)	(0.00522)	(0.00474)	(0.00567)	(0.00713)	(0.00822)
Average inflation	0.0103*	0.0129*	0.0148**	0.0155**	0.0119**	0.0144	0.0442**	0.0633**
	(0.00544)	(0.00636)	(0.00255)	(0.00308)	(0.00113)	(0.0133)	(0.00453)	(0.00515)
Inflation volatility	0.0206**	0.0188*	0.0356**	0.0227**	0.0536***	0.0563***	0.0169*	0.0413**
	(0.00774)	(0.00820)	(0.00340)	(0.00442)	(0.0118)	(0.0131)	(0.00803)	(0.00767)
Average depreciation	0.0180***	0.0175***	0.0390***	0.0152**	0.0192***	0.0208***	0.0635***	0.0108**
	(0.00278)	(0.00297)	(0.00157)	(0.00172)	(0.00423)	(0.00473)	(0.00255)	(0.00245)
Exchange rate volatility	0.00685**	0.00666**	-0.00146	0.00189	0.00340	-0.00419	0.000162	-0.00302
	(0.00206)	(0.00224)	(0.00110)	(0.00142)	(0.00313)	(0.00356)	(0.00208)	(0.00218)
Central bank independence		-5.347**		-1.106**		-6.034*		-1.117**
		(1.908)		(0.0596)		(3.008)		(0.0870)
ERPT (-1)			0.755***	0.718***			1.078***	0.791***
			(0.0528)	(0.0613)			(0.0957)	(0.0642)
_cons	0.308	3.713**	0.0428	-0.0139	0.448	-3.229	0.00440	-0.00189
	(0.181)	(1.202)	(0.0367)	(0.0651)	(0.276)	(1.914)	(0.0650)	(0.102)
adj. R^2	0.402	0.470	0.519	0.528	0.340	0.375	0.478	0.515
Fixed Effects	Yes	Yes			Yes	Yes		
Number of obs.	330	183	261	182	334	183	265	183

Standard errors in parentheses* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. "IV" columns show results of the estimation using instrumental variables method where ERPT(-1) is instrumented with ERPT(-2), while "OLS" columns show results of the simple OLS panel models.

Figure 13: Exchange rate passthrough to inflation in SSA – Instrumental Variable Estimate



Sources: Authors' estimates

Note: For each chart, the shaded area represents the 95 percent confidence band. In addition to the whole sample, this figure also shows results for 3 subgroups of SSA countries grouped by exchange rate regimes. See annex table 1 for the list of SSA countries grouped by exchange rate regimes ("Floating", Managed Float", and "Pegged"), using IMF de facto classification (2022). The slide lines on the chart on the left represent the impact of a one percent increase (depreciation) in local currency/USD (solid purple) and in nominal effective exchange rate (dash blue) on a percent change in consumer prices. The shaded areas (blue and purple) represent the 95 percent confidence band. On the chart on the right, the bars illustrate the percent change in CPI inflation one year after a one percent increase (depreciation) in the bilateral exchange rate to the U.S. dollar (local currency/USD). The estimates of exchange rate pass-through for Emerging Markets in Asia, Europe, and Latin America are from Carriere-Swallow et al. (2023).

5. Policy Considerations and Conclusion

Exchange rates play an important role in inflation dynamics in SSA, which helps to understand the fear of floating among policy makers. Large exchange rate depreciations are associated with high passthrough and can increase the risk of inflation de-anchoring. Policy makers should hence guard against this risk with prudent policies. Macroeconomic policies that can create significant exchange rate pressures such as monetization of fiscal deficits or fiscal policies that fuel external imbalances can have significant inflationary costs through the exchange rate channel.

The effectiveness of monetary policy is important in reducing exchange rate passthrough. We showed that exchange rate passthrough to inflation is more muted in countries where inflation has been kept under check historically. This suggests improving monetary policy frameworks, and proactive role of central banks in combating inflation can help reduce the exchange rate passthrough. Inflationary impulses from large depreciations can be persistent, and hence may require central banks maintaining a tight monetary policy stance for a sustained period. In countries, where monetary policy framework and transmissions are weak or foreign exchange markets are shallow, significant risk of inflation de-anchoring from large exchange rate depreciations can justify foreign exchange interventions by the central banks provided they have sufficient reserve and the shocks are temporary in nature or due to financial risk-off episodes (see IMF, 2022). However, such actions should carefully consider the costs involved including on credibility of the monetary policy framework and functioning of the foreign exchange market. IMF (2023b) provides guidance on how foreign exchange intervention should be used.

The estimated asymmetries in the exchange rate passthrough can inform policy makers' assessment of inflation expectations during periods of exchange rate volatility. The results suggests that prospects of inflation coming down when exchange rate is appreciating is more muted than the possibility of inflation increasing when exchange rate is depreciating. This suggests that central banks may need to take a proactive role in anchoring inflation during episodes of significant currency volatility.

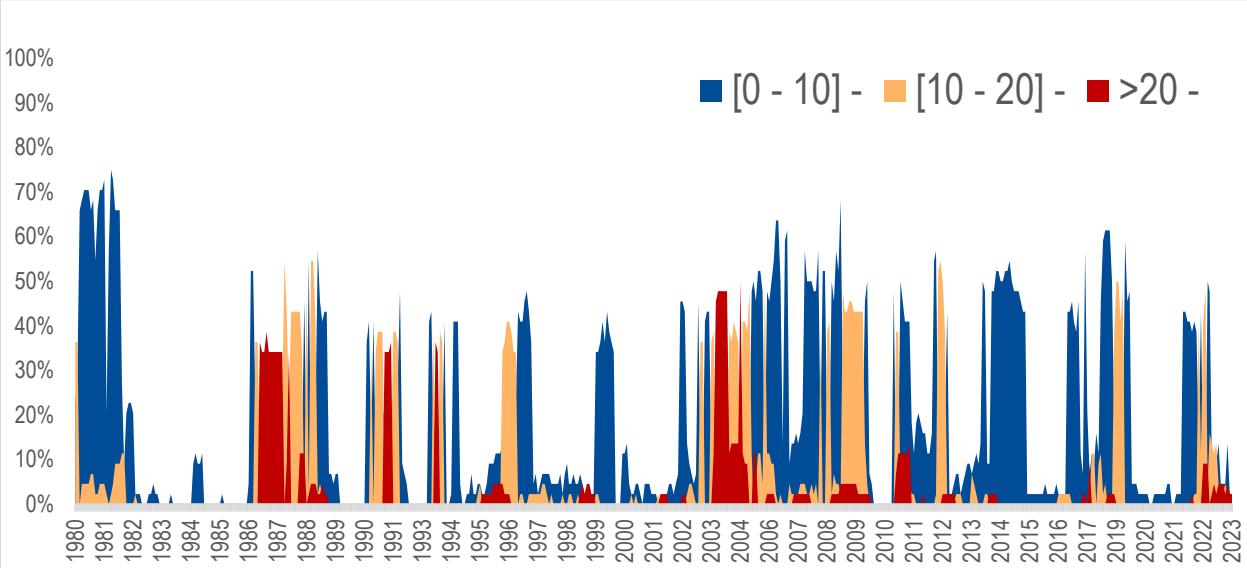
Our analysis suggests that changes in the nominal exchange rate against the US dollar—the key currency of trade invoicing—are an important source of inflation in addition to changes in the NEER, particularly in countries with non-pegged exchange rate regimes. There can be episodes where NEER and bilateral exchange rate against the US dollar move in different directions, as was the case for many countries in sub-Saharan Africa in 2022. During this period, many countries in the region saw their NEER appreciate while their bilateral exchange rate weakened against the US dollar. Central banks hence need to monitor movements of both types of exchange rates to gauge inflation risks.

We also find that higher levels of competition in domestic and more diversified economies, particularly countries that do not export oil, tend to have lower exchange rate passthrough. This suggests structural policies that promote competition in domestic market and greater diversification may help lower the exchange rate passthrough in the region.

Annexes

Annex Figure 1: Frequency of episodes of high exchange rate depreciations in SSA countries

(*1981-2022, share of SSA countries in percent, bilateral exchange rate against US dollar*)

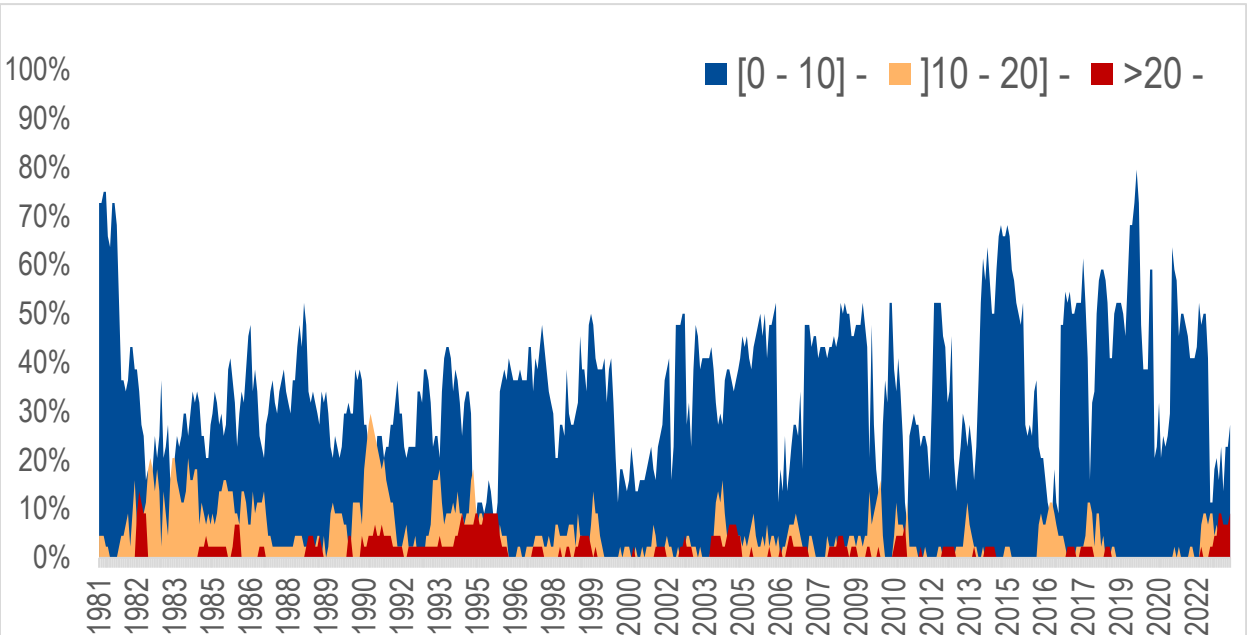


Sources: Authors' calculations

Note: the depreciation calculations use year-on-year changes on monthly data.

Annex Figure 2: Frequency of episodes of high exchange rate depreciations in SSA countries

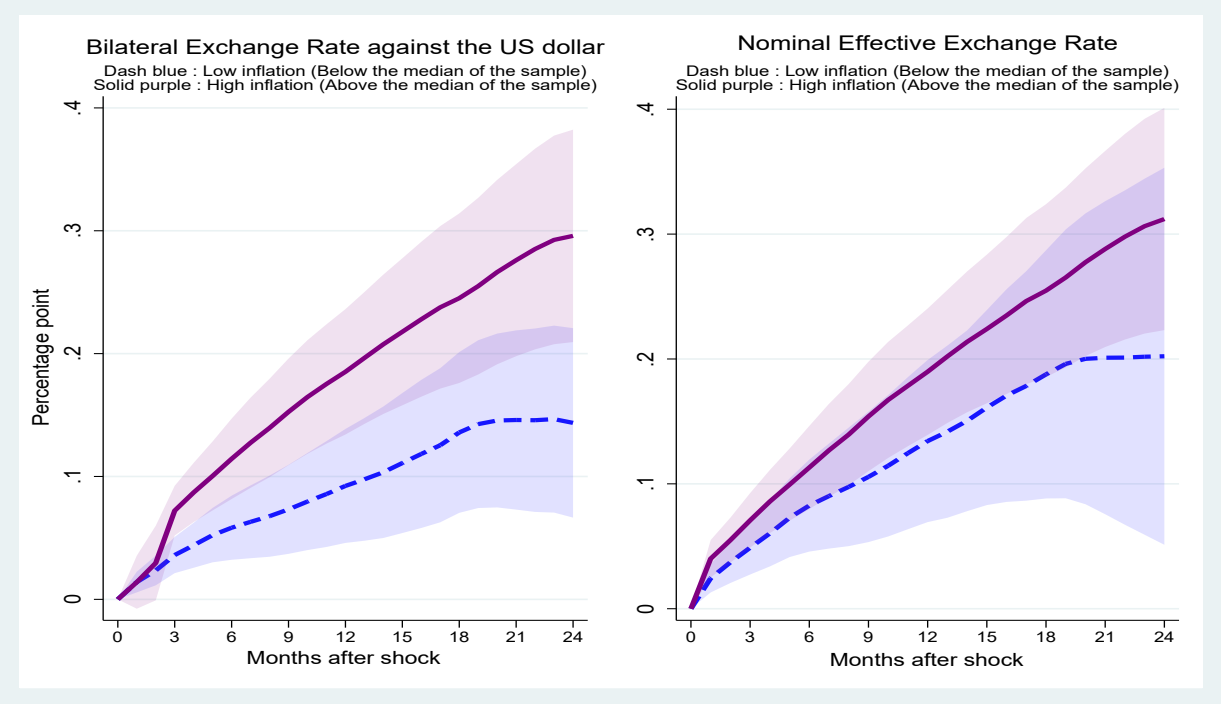
(*1981-2022, share of SSA countries in percent, NEER*)



Sources: Authors' calculations

Note: the depreciation calculations use year-on-year changes on monthly data.

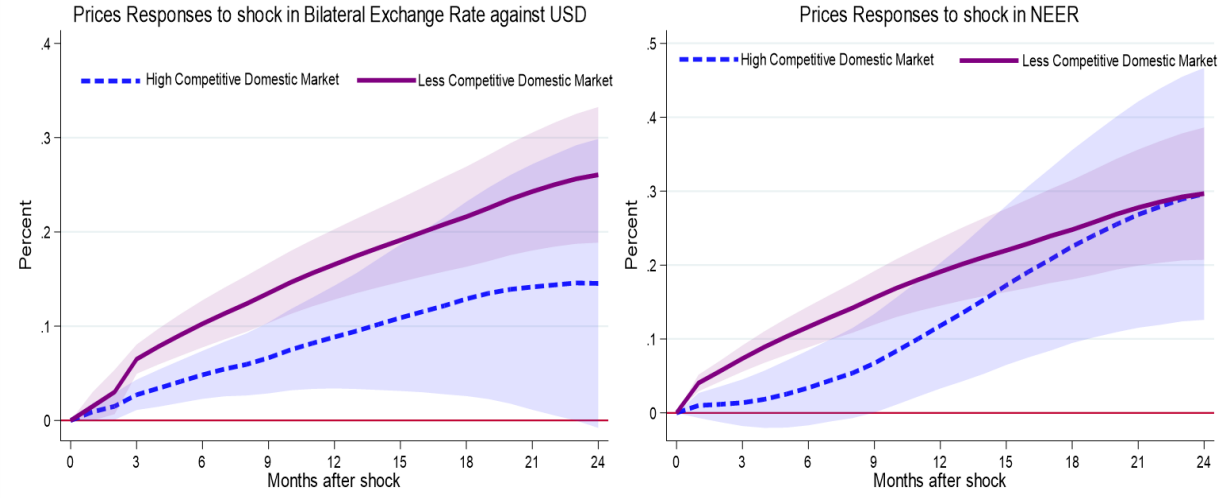
Annex Figure 3: Exchange rate passthrough to inflation and monetary policy effectiveness in SSA - Robustness check



Sources: Authors' estimates

Note: Shaded areas represent 95 percent confidence bands.

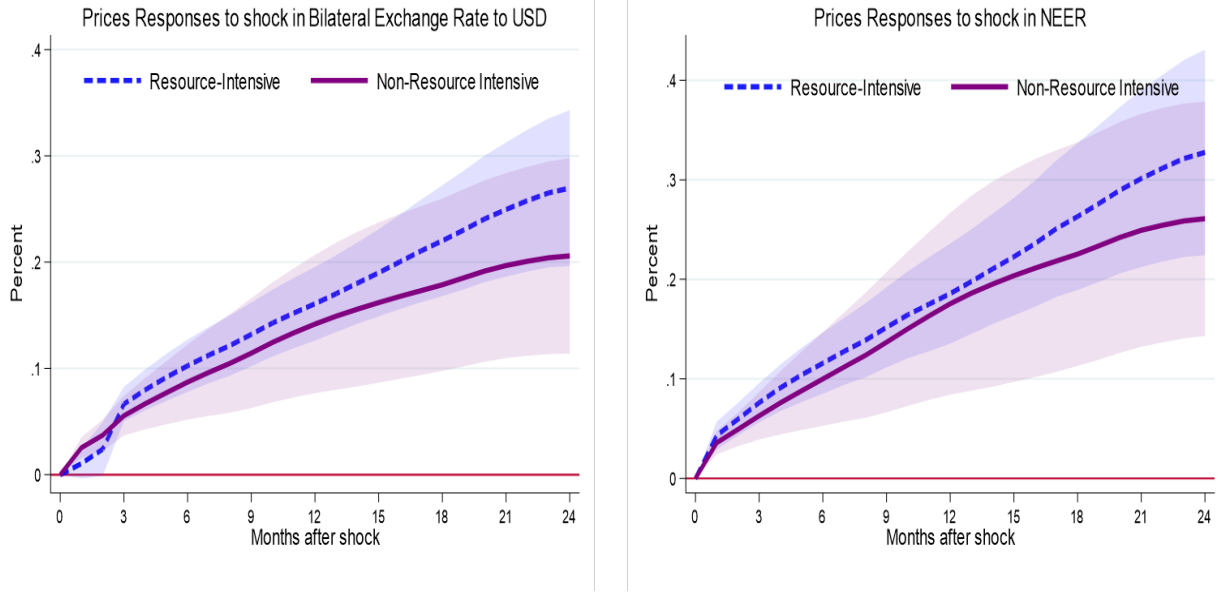
Annex Figure 4: Exchange rate passthrough to inflation and Domestic Market Competition – Alternative result using the Global Competition Index



Sources: Authors' estimates

Note: Shaded areas represent 95 percent confidence bands.

Annex Figure 5: Exchange rate passthrough to inflation and Natural resource status – Alternative result using a dummy variable that distinguishes between resource-intensive countries



Sources: Authors' estimates

Note: Shaded areas represent 95 percent confidence bands.

Annex Table 1: Countries grouped by exchange rate regimes, using IMF de facto classification (2022)

Pegged (20)	Managed float (18)	Floating (06)
Benin (Euro, 2012)	Botswana (2012)	Angola (2020)
Burkina Faso (Euro, 2012)	Gambia (2021)	Madagascar (2013)
Cote d'Ivoire (Euro, 2012)	Nigeria (2012)	Seychelles (2012)
Guinea-Bissau (Euro, 2012)	Tanzania (2016)	Uganda (2014)
Mali (Euro, 2012)	Burundi (2012)	Mauritius (2012)
Niger (Euro, 2012)	Democratic Republic of Congo (2012)	South Africa (2012)
Senegal (Euro, 2012)	Ethiopia (2020)	Zambia (2021)
Togo (Euro, 2012)	Guinea (2012)	
Cameroon (Euro, 2012)	Rwanda (2012)	
Central African Republic (Euro, 2012)	Ghana (2020)	
Congo Republic (Euro, 2012)	Malawi (2012)	
Gabon (Euro, 2012)	Mozambique (2020)	
Equatorial Guinea (Euro, 2012)	South Sudan (2015)	
Chad (Euro,2012)	Liberia (2020)	
Comoros (Euro, 2012)	Sierra Leone (2015)	
Cabo Verde (Euro, 2012)	Kenya (2015)	
Sao Tome y Principe (Euro, 2012)	Zimbabwe (2019)	
Eswatini (Rand, 2012)		
Lesotho (Rand, 2012)		
Namibia (Rand, 2012)		

Sources: IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* database

Note: The parentheses show the first year the country had the current classification during the estimation period from 2012-2022, along with the relevant currency peg if applicable.

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