Monetary Policy Shocks from the EU and US: Implications for Sub-Saharan Africa

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Abstract

This paper addresses the debate in the literature on how developing countries are affected by foreign monetary policy shocks. I analyze how contractionary monetary policy shocks originating in different regions, specifically the Euro Area ("EU") and United States ("US"), affect a set of rarely investigated sub-Saharan African ("SSA") countries. Foreign monetary policy shocks are identified using changes in central bank futures rates, and are inserted into a domestic structural vector autoregression ("SVAR"). Results differ depending on which of the EU or US shocks monetary policy and whether or not the recipient SSA country has a floating or fixed exchange rate regime. Specifically, floating exchange rate countries have a mostly negative GDP response following either shock due to a reliance on capital flows and external debt, and the implications these have for domestic interest rate responses. Fixed exchange rate countries have mixed GDP responses following the EU shock, as both trade and the effect of capital control usage on interest rates play an important role, while US shocks produce positive GDP responses as aid from the US dominates both trade and interest rates. The implications of these results for floating exchange rate countries is that diversification of foreign external debt and a reduction in reliance on international capital may be beneficial. For fixed exchange rate countries the implication is that capital controls can be a positive tool in the development process.

1 Introduction

Evaluating the economic effects and transmission mechanisms from the international transmission of monetary policy shocks from the developed to developing world is a question that has increased in importance as poor countries have become more financially integrated with world markets. Despite the relevance of this question, puzzles remain both in terms of the direction of domestic real economic effects, and which primary transmission mechanism, trade and/or interest rates, dominates. This paper addresses these puzzles by performing some new empirical investigations, as well as improving on the methodological trade-offs in the structural vector autoregression ("SVAR") international transmission literature that have been made between appropriately identified exogenous foreign monetary policy shocks and overparameterization. Specifically, I look at how contractionary monetary policy shocks from *different* regions, namely the Euro Area ("EU") and United States ("US"), affect a set of infrequently investigated sub-Saharan African ("SSA") countries, studied individually. I use a two-stage SVAR that has not, to the knowledge of this paper, been used in the international transmission literature. Contractionary monetary policy shocks are chosen given the historically low interest rate levels in much of the developed world including the EU and US.

I study 11 SSA countries including the floating exchange rate economies of South Africa, Ghana, Kenya, Tanzania, Uganda, Mauritius, and the fixed exchange rate economies of Gabon, Cote d'Ivoire, Botswana, Senegal, and Rwanda. I show that the output effects and transmission mechanisms will in part depend on the type of exchange rate regime in these countries, as well as the country originating the shock. Furthermore, the important features of an economy's response to a foreign monetary policy shock include country-specific trading relationships, reliance on international capital flows and external debt, a country's use of capital controls, and the dominance of aid.

In the first stage of my two-stage SVAR, in the spirit of Kuttner (2001), I use changes in the federal funds and euribor futures rates for the US and EU respectively, following central bank meetings. The use of futures rates has become more important in identifying monetary policy shocks as monetary policy has become more forward looking. This is confirmed by Barakchian and Crowe (2013) who find that many of the common SVAR setups used to identify US monetary policy shocks produce puzzling US real economy responses when looked at over the 1988-2008 period. I therefore estimate a factor model similar to Barakchian and Crowe (2013) for the US using six different federal funds futures rates maturities. I forego the factor model for the EU as the euribor futures rates, the widely used interest rate for mimicking central bank monetary policy in the EU[1], is not available at maturities other than three months. In the second stage I extract the shock series for both the EU and US and, following Romer and Romer (2004), cumulate it in order to produce an I(1) variable. I then add this I(1) shock series into a SVAR model for the SSA country of interest, treating the shock series as an exogenous regressor.

Using this two-stage model, I find significant differences exist depending on whether the EU or US central bank is instigating the shock, and whether or not the SSA country receiving the shock is a floating or fixed exchange rate economy. This latter result is different from the existing literature that finds that the exchange rate regime is usually not the cause for differences in GDP direction and dominant transmission mechanism.[2] Furthermore, even within the floating and fixed exchange rate regimes differences occur between individual countries. The implication then is that individualized country analysis is required in order to make

[1] See Bredin et al. (2009).

[2] e.g. Canova (2005) who states that the differences between the two regimes has more to due with magnitude differentials than differing transmission mechanisms or output responses.

generalized statements. I thus divide the analysis into four categories and look at each country separately: floating and fixed exchange rate countries following the EU monetary policy shock, and floating and fixed exchange rate countries following the US shock.

I find that floating exchange rate countries, following the contractionary monetary policy shock in the EU, experience real economic contractions on average. Interest rates are the dominant transmission mechanism for these countries despite large trading relationships with the EU. Countries with larger capital to GDP ratios either raise interest rates in response to a foreign increase to keep capital from flowing out of the country, at the risk of a GDP contraction, or fail to do so, have capital leave, and experience a fall in GDP regardless. Those with lower capital to GDP levels attempt to use countercyclical interest rate policy, though results are unsuccessful as some factor other than trade and interest rates dominates.

Fixed exchange rate regime countries following the EU shock experience a mixed set of real economy results in earlier periods, becoming more expansionary in the medium and long term, with interest rates and trade both acting as transmission mechanisms. The countries who experience non-contractionary effects seem to be the countries with one or both of the following: falling prices that cause an increase in trade and/or high capital control usage that gives flexibility to lower interest rates and defend the exchange rate peg. Countries experiencing contractions are also able to lower rates and use capital controls, but the lowering of rates causes an increase in prices which drags down trade by enough to cause a decrease in GDP. The importance of EU trade in both directions for these SSA countries is due to large trading relationships aided by the Everything But Arms multilateral trade agreement entered into in 2001.[3]

Real economy contractions are likely to occur for floating exchange rate countries following the US shock, similar to the EU shock case, with interest rates continuing to be the dominant effect due in part to capital concerns; this time increases in interest rates are almost exclusively the response. Moreover, there is another concern for these countries following the US shock as external debt is mostly denominated in US dollars, forcing these countries to respond with an increase in domestic interest rates to keep the real cost of this debt from rising due to the appreciation of the US dollar relative to the domestic currency.[4] The sensitivity of the real economy reaction to the shock is higher for these countries following the US shock compared with the EU shock due to this additional external debt concern.

Fixed exchange rate countries following the US shock are able to mostly avoid real GDP contractions. As neither trade nor interest rates act as a transmission mechanism, some other factor not investigated in this analysis is playing a significant role. One example might be aid. US aid to these fixed exchange rate countries has been increasing since 2000 on average, despite the US' policy of attempting to help the developing world by moving away from aid and towards trade, see e.g. AGOA[5].

The implication of this analysis for these SSA countries is that external monetary policy shocks are going to matter, with the country originating the shock and the exchange rate regime of the recipient country playing pivotal roles in determining how output responds and which of trade and/or interest rates will act as transmission mechanisms. For the most part, fixed exchange rate countries appear to be doing better than floating exchange rate countries, perhaps a bit counterintuitively. However, the reason may be that, without

[3]This initiative was entered into by the European Union in March 2001 and allowed for duty-free and quota-free imports by EU members from Least Developed Countries.

[4]The increase in US interest rates also increases the real value of the debt, however this would likely not cause these countries to necessarily respond with an increase in domestic interest rates.

[5]In 2000, the US Congress approved the African Growth and Opportunity Act ("AGOA"), a piece of legislation focused on trade.

the use of capital controls or a fixed exchange rate, floating exchange rate countries are forced to choose between two negative outcomes: raise interest rates to stop capital flow reversals and increasing real debt at the expense of lower GDP from decreased domestic demand, or lower rates (keep rates stable), and see those reversals in capital and increasing debt come to fruition, hurting GDP in other ways. The argument would then be that as fixed exchange rate countries move towards a floating exchange rate regime, a slower removal of capital controls, an increase in international reserves, diversification of external debt, and a more managed float may be beneficial.[6]

The rest of this paper is organized as follows: Section 2 develops and explains the two stage model, including identification and empirical methodology decisions. Section 3 analyzes the results for the main specification. Section 4 discusses robustness checks as well as an extension. Section 5 concludes.

2 Model

I introduce the two-stage SVAR method in this section. To the knowledge of this paper, it is the first time this method is used to evaluate the international transmission of monetary policy shocks. The bulk of papers in the international transmission literature use SVAR methodologies that require a potential trade-off between appropriately identified exogenous foreign monetary policy shocks and overparameterization; especially in small sample datasets. For example, Kim (2001) uses the Christiano, Eichenbaum, and Evans (1996) recursive setup to identify the US monetary policy shock, then separately adds the recipient country variables to deal with overparameterization.[7] However, as Barakchian and Crowe (2013) show, this procedure produces puzzling US real economy results if evaluated over the 1988-2008 period. Furthermore, adding recipient country variables one by one would not allow for a simultaneous investigation of domestic shocks.

Kozluk and Mehrotra (2009) evaluate a recipient country model where all recipient country variables are included at once and the monetary policy shock is identified by using a simple foreign policy instrument. However, Kim and Roubini (2000) have shown that this type of instrument, such as the federal funds rate ("FFR"), does not produce true exogenous monetary policy shocks.[8] Lastly, the issue with combining the Kim (2001) and Kozluk and Mehrotra (2009) models into a block-block model, such as in Mackowiak (2007), is that it dramatically increases the number of parameters being investigated, and in small datasets such as the one being used in this paper, this potentially becomes infeasible (see e.g. Jannsen and Klein (2011)).

[6] Lowering the reliance on foreign-currency debt in general is promoted in other papers including Vajs (2014).

[7] The CEE (1996) setup is as follows:

$$\mathbf{C}\mathbf{y}_t = \begin{pmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{pmatrix} \begin{pmatrix} US_{rgdp} \\ US_{cpi} \\ WW_{index} \\ US_{FFR} \end{pmatrix}$$

where US_{rgdp} is US real GDP, US_{cpi} is the US consumer price index, WW_{index} is a commodity price index intended to capture inflationary pressures, and US_{FFR} is the federal funds rate. Domestic variables would then be added one by one, each with their own structure below US_{FFR}.

[8] The setup is CEE (1996) with US variables replaced by domestic country variables, US FFR in the first row, and some domestic interest rate in the last row:

$$\mathbf{C}\mathbf{y}_t = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{pmatrix} \begin{pmatrix} US_{FFR} \\ DOM_{rgdp} \\ DOM_{cpi} \\ WW_{index} \\ DOM_{IR} \end{pmatrix}$$

2.1 Stage 1 Identification

As mentioned above, Barakchian and Crowe (2013) show that performing the CEE (1996) identification scheme for the US produces a real economy puzzle if viewed during the 1988-2008 period. Specifically, contrary to economic theory, a contractionary monetary policy shock in the US will increase real GDP. These authors argue that identifying exogenous monetary policy shock series' in a SVAR setting requires one to be fairly confident in both the information set being used, as well as the contemporaneous relationships being assumed. The CEE (1996) method fails in two regards: first, not accounting for the forward looking nature of US monetary policy leaves out important details, and second, the assumption that the monetary policy decision can be determined from looking at only a real economy variable, a price index, and a commodity price index is likely to be incorrect in a complex US economy. The authors argue that looking at financial market data on futures rates, such as the federal funds futures rates for the US, before and after their central banking meeting will produce better results for identifying truly exogenous monetary policy shocks. Specifically, any change in futures rates from right before the meetings with results directly after the meetings, will represent the true exogenous monetary policy shocks, as at the time of the meeting the private sector should have access to all information going into the decisions being made at the Federal Open Market Committee ("FOMC") and by definition futures rates are forward-looking. The same argument holds for the EU where EU futures rates will be represented by the euribor futures rates, and the European Central Bank ("ECB") meetings will be analyzed.

More formally, Barakchian and Crowe (2013), in the spirit of Kuttner (2001), Soderstrom (2001), and Faust et al. (2004), assume we can identify the exogenous monetary policy shocks as:

$$S_t = f(\Omega_t) + s_t \tag{1}$$

where S_t is the monetary policy stance and f is a linear function that describes the relationship between the monetary policy stance and the information set Ω.[9]

Let there be two different measures of the private sector's beliefs or expectations for the monetary policy stance taken by the ECB or FOMC, namely one right before the meeting, ${}_{t-1}\hat{S}_t$, and one right after any policy announcement, ${}_{t}\hat{S}_t$. Each of these measures are noisy versions of the private sector's true expectations:

$${}_{t-1}\hat{S}_t = E^p_{t-1}[S_t] + \xi_{t-1} = E^p_{t-1}[f(\Omega_t)] + \xi_{t-1} \tag{2}$$

$${}_{t}\hat{S}_t = E^p_{t}[S_t] + \xi_{t} = S_t + \xi_t = f(\Omega_t) + s_t + \xi_t \tag{3}$$

We make the assumption that $\xi_t - \xi_{t-1} = 0$ which implies that any noise is unchanged during the period representing the policy announcement. By further assuming that $E^p_{t-1}[f(\Omega_t)] - f(\Omega_t) = 0$, we are saying that the private sector's beliefs about the information set being used by the ECB or FOMC is right. Under these two assumptions if we subtract equation (2) from (3) we get:

$${}_{t}\hat{S}_t - {}_{t-1}\hat{S}_t = s_t \tag{4}$$

[9]The authors are essentially arguing that both $f()$ and Ω are problematic for previous US results using the CEE (1996) setup.

which means that an appropriate proxy for the shock, s_t, can be represented by the change in the private sector's belief concerning the stance of the ECB or FOMC around the time of the announcement.

The question then is what data to use to represent the private sector's beliefs. Barakchian and Crowe (2013) use the federal funds futures contracts to represent the private sector's beliefs, and this paper does the same. The euribor futures rate is used for the EU following Bredin et al. (2009). Therefore any change in a particular futures rate will be given by equation (4).

For the US, given the availability of different maturities for federal funds futures rates, I am able to follow Barakchian and Crowe (2013) and create this shock series variable for six different futures contracts with horizons from one to six months. Using a range of maturities allows the use of information from different series that will perhaps improve on the noise from looking at only one particular horizon. For the US shock, equation (4) needs to be weighted for the one-month futures rate to reflect how many days in the current month will be affected by the given change (see Kuttner (2001)). Formally, the equation will be $s_t = \frac{M}{M-d}({}_t\hat{S}_t - {}_{t-1}\hat{S}_t)$ where M is days in a given month, while d represents the date of the announcement. This required scaling comes from the fact that in the US the payoff from futures contracts depends on the monthly average federal funds rate, so the month in which the change occurs needs to be weighted based on how many days the new rate applies for. For the EU, euribor futures rates are not available at different maturities, and there is not an accurate substitute for EU monetary policy in which different maturities exist. Furthermore, the scaling performed for the US is not necessary as the monthly averaging does not occur. Equation (4) will thus suffice for the EU.[10]

Given the six different maturities for the US something must be done to create one shock series. As in Barakchian and Crowe (2013), I insert the six different shocks into a simple factor model estimated using maximum likelihood as follows. Let T and N be the time series and cross-section components respectively where T will be the sample size $t = 1, 2, ..., T$ and $i = 1, 2, ...N$ where $N = 6$ represents the six different futures rates being used. The factor structure therefore of observation $s_{i,t}$ will be:

$$\mathbf{s_{i,t}} = \pi_{\mathbf{t}}\phi_{\mathbf{i}}' + \mathbf{e_{i,t}} \tag{5}$$

If we let $\mathbf{s}$ and $\mathbf{e}$ be $T \times N$ matrices, the factor model in matrix form can be written as:

$$\mathbf{s} = \pi\phi^{'} + \mathbf{e} \tag{6}$$

where $\pi = (\pi_1, \pi_2, ...\pi_T)$ is the $T \times r$ matrix of factors, and $\phi = (\phi_1, \phi_2, ...\phi_N)$ is the $N \times r$ factor loading matrix.

Running this factor model suggests that two factors are sufficient, the first of which, given the positive correlation between it and the six different shock series, represents the exogenous monetary policy shock originating in these countries.[11]

Figure 1 shows the EU structural monetary policy shocks extracted from equation (4) for the period under analysis, 1999q1 - 2011q4, while Figure 2 shows the EU real economy response to these contractionary monetary policy shocks. The EU real economy response is estimated using the CEE (1996) SVAR setup

[10] See Abad and Chulia (2013), who reference the work of Bredin et al. (2009) for the scaling discussion.
[11] The first factor explains about 89% of the total variance.

described above, where all US variables have been replaced by EU variables, and the US_{FFR} is now the cumulated shock series for the EU. Cumulating the shock series ensures it is an I(1) variable allowing for its insertion into the CEE (1996) SVAR setup with other I(1) variables. This cumulation method comes from Romer and Romer (2004) and will be discussed in greater detail in Stage 2. As can be seen, the real economy response follows conventional economic wisdom.

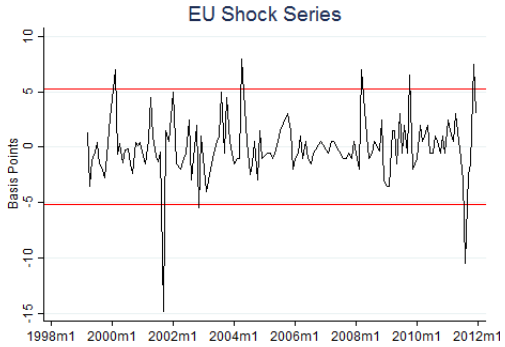

Figure 1: EU Monetary Policy Shock Series

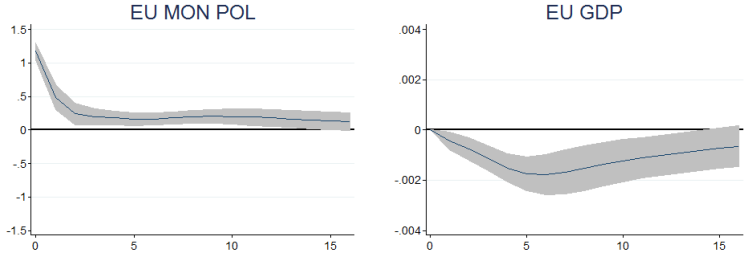

Figure 2: EU Monetary Policy Shock and Real Economy Reaction

Figure 3 shows the structural US monetary policy shocks extracted from the factor model for the period under analysis 1992q1 - 2008q2.[12,13] This shock series is perfectly correlated with the shock series produced in Barakchian and Crowe (2013). Furthermore, Figure 4 indicates that these contractionary monetary policy shocks produce the expected results for real GDP in the US when inserted into the CEE (1996) setup.[14]

[12]Ideally this paper would have looked at 1992q1 - 2011q4 for both the EU and US shocks. I start in 1999q1 for the EU due to the introduction of the Euro. I stop in 2008q2 for the US because they hit the zero lower bound and I did not want to introduce non-linearities into the model. Further discussion on time periods will occur in Section 3.

[13]Similar to the graph in Barakchian and Crowe (2013), the y-axis is in terms of basis points measured by taking the extracted shock series and dividing by the sum of the six coefficients from the factor model estimation. The horizontal lines represent two standard error bands.

[14]The EU and US monetary policy shock series is monthly due to the futures series' being monthly. The series is cumulated and the last month of each quarter is used as the quarterly change for the actual analysis of macroeconomic variables.

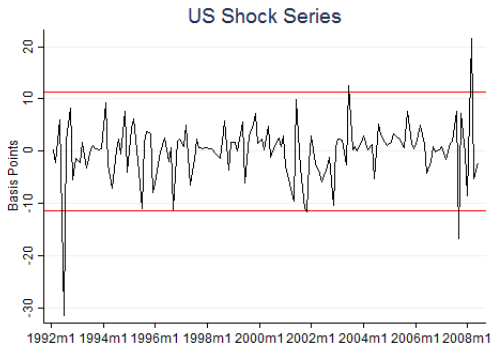

Figure 3: US Monetary Policy Shock Series

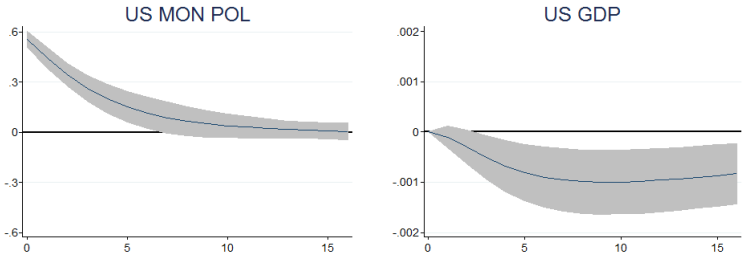

Figure 4: US Monetary Policy Shock and Real Economy Reaction

2.2 Stage 2 Identification

The shock series' that we have extracted come from differenced futures rates, and, after testing, are confirmed stationary, I(0), variables. However, to use these shock series as regressor variables in the second stage SVAR, they must be I(1) variables as the SSA variables comprising the remainder of the SVAR are in levels. I follow Romer and Romer (2004) and cumulate the EU or US monetary policy shock series turning them into I(1) variables. I then insert the respective shock variables into the domestic SVAR for the SSA country of interest.

Formally, I assume that the SSA economy can be described by an equation with the following structural form:

$$G(L)Y_t = C(L)X_t + e_t \tag{7}$$

where Y_t is a $n \times 1$ data vector of endogenous SSA variables,
$Y_t^{'} = [Shock_t\ Trade_t\ RGDP_t\ CPI_t\ XR_t\ IR_t]$[15], X_t is a data vector of foreign exogenous variables, $X_t^{'} = [Comm_t\ Oil_t]$[16], $G(L)$ is a $n \times n$ matrix polynomial in the lag operator, $C(L)$ is a $n \times k$ matrix polynomial in the lag operator, and lastly, e_t is a $n \times 1$ vector of structural disturbances, with $var(e_t) = \Lambda$, where Λ is

[15] $Shock_t$ represents either the EU or US monetary policy shock cumulated to be an I(1) variable, $Trade_t$ is real bilateral trade balance with either the EU or US, $RGDP_t$ is real GDP, CPI_t is the consumer price index, XR_t, is the nominal bilateral exchange rate with either the EU or US, and IR_t represents an appropriate central bank nominal interest rate used by the given SSA country.

[16] For the exogenous variables, I follow Cheng (2006) and use both a commodity price index which excludes oil, as well as an oil specific index.

a diagonal matrix in which the diagonal elements represent variances of structural disturbances and are by definition mutually uncorrelated.

The corresponding reduced-form VAR to (1) can be written as:

$$Y_t = A(L)Y_{t-1} + B(L)X_t + \varepsilon_t \tag{8}$$

where the $A(L)$ and $B(L)$ are both matrix polynomials, and ε_t is a vector of reduced form errors with $var(\varepsilon_t) = \Sigma$.

If we let H be the coefficient matrix of contemporaneous terms, and let $J(L)$ be a matrix of non-contemporaneous terms, we get:

$$G(L) = H + J(L) \tag{9}$$

Therefore the relationship between the structural and reduced-form equations can be written as:

$$A(L) = -H^{-1}J(L) \tag{10}$$

$$B(L) = H^{-1}C(L) \tag{11}$$

The error term relationship can be written as $\varepsilon_t = H^{-1}e_t$ or $e_t = H\varepsilon_t$, implying the following:

$$\Sigma = H^{-1}\Lambda H^{-1'} \tag{12}$$

Using the Choleski or recursive decomposition, H is a triangular matrix where the proper ordering of the variables is required. In the non-recursive modeling, maximum likelihood estimates of H and Λ are necessary and are obtained from a sample estimate of Σ. Note that in the right hand side of equation (12) there are $n \times (n+1)$ free parameters that require estimation. Furthermore, Σ has $n \times (n+1)/2$ parameters, so if we normalize n diagonal elements of H to be 1, we require at a minimum $n \times (n-1)/2$ restrictions on H in order to have full identification.

As Bernanke and Blinder (1992) among others argue, the important insight of the SVAR research is that one need only appropriately identify the shock of interest in order to determine the impulse responses of other macroeconomic variables to that shock due to the mutually uncorrelated nature of the error terms.[17] Therefore, by having identified the large open economy contractionary monetary policy shock in stage 1, and inserting it in the first row of the stage 2 domestic model given that it is unlikely to be affected by any SSA variables contemporaneously, the ordering of the other stage 2 domestic variables is irrelevant. I therefore include the foreign monetary policy shock and other SSA variables of interest for the given country as follows[18,19]:

[17] This orthogonality of the residuals implies that one need not be concerned with omitted variable bias. See Bernanke and Blinder (1992) for further discussion.

[18] Lags are chosen to remove any misspecification from the SVAR. The focus is on autocorrelation and stability tests. This results in 2 lags being used throughout except for Ghana following the US shock which uses 1 lag.

[19] I also assume that none of the lagged SSA variables have any effect on the foreign monetary policy shock and so restrictions setting these coefficients to zero are put in.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon^{Shock} \\ \varepsilon^{trade} \\ \varepsilon^{rgdp} \\ \varepsilon^{cpi} \\ \varepsilon^{xr} \\ \varepsilon^{ir} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} \end{bmatrix} \begin{bmatrix} e^{Shock} \\ e^{trade} \\ e^{rgdp} \\ e^{cpi} \\ e^{xr} \\ e^{ir} \end{bmatrix} \tag{13}$$

3 Results

This section will analyze the extent to which a contractionary monetary policy shock in each of the EU and US affects a set of SSA countries including floating exchange rate economies South Africa, Ghana, Kenya, Tanzania, Uganda, Mauritius, and fixed exchange rate economies Gabon, Cote d'Ivoire, Botswana, Senegal, and Rwanda.[20] The data period analyzed differs depending on whether it is the EU shock or the US shock being evaluated. For the EU I use the period following the introduction of the Euro in 1999q1, up until 2011q4. For the US I use the period beginning in 1992q1, around the time capital flows began to increase towards developing countries, and I stop in 2008q2 when the US hits the zero lower bound. I do not extend past the zero lower bound as my overall time period would include non-linearities which opens up other potential analytical issues.[21] As the EU does not hit the zero lower bound I am able to use up until 2011q4.[22] Given the availability of data for each country in question, the period will change slightly for a given country.[23]

The first question to answer is what will happen to the overall real economies of these SSA countries, i.e. real GDP, or some equivalent measure. The literature is mixed on what to expect depending on which of substitution versus income effects dominate and which exchange rate regime prevails in the domestic economy.[24] Should substitution effects dominate, contractionary monetary policy shocks in the EU or US will cause appreciations in their currency relative to the currency of floating exchange rate SSA countries, leading to increased imports including floating SSA goods, resulting in increased trade balance and GDP for these floating SSA countries. Fixed exchange rate countries will not receive this exchange rate benefit.

Should income effects dominate, there will be contractions in GDP for both sets of countries but the story of why will depend on whether trade or interest rates are the dominant transmission mechanism. If trade is dominant then contractionary monetary policy shocks will lead to falls in real GDP in the EU or US causing them to import less, meaning trade and GDP will fall in SSA countries regardless of exchange rate regime. If interest rates are dominant then increases in EU or US interest rates will cause increases in the world

[20] Appendices F and G describe the exchange rate regimes and central bank mandates of these countries over the period under analysis.

[21] Furthermore, after 2008q2, the US enters a period of unconventional monetary policy including quantitative easing ("QE") programs, as well as operation twist ("OT"). As these are not representative of normal central banking periods, extending past 2008q2 is deemed inappropriate.

[22] Using the 1999q1-2008q2 overlapping period is too small a sample size to produce reliable results; thus part of the financial crisis will be included in the results following the EU shock. While a concern, the ECB had not entered into zero lower bound territory, so there is some confidence that this time period still represents "normal" central banking activity despite the recession. Furthermore, dummy variables are included in the SVAR to account for outlier periods.

[23] See Appendix E for more detail on time periods for SSA countries.

[24] Kim (2001), Kozluk and Mehrotra (2009), and Jannsen and Klein (2011) all find contractions for their small open economies, while Canova (2005) and Mackowiak (2006) both find expansionary responses.

interest rate, increases in SSA interest rates, and a fall in world aggregate demand, causing ambiguous trade results but a lowering of GDP from decreases in domestic demand. This chain of events occurs regardless of exchange rate regime.

Furthermore, in addition to being unsure *a priori* about the reaction of real GDP due to the relative importance of substitution versus income effects, it is also unclear which of trade and/or interest rates will dominate for these SSA countries; this paper's second question. Table 1 indicates that these countries have significant trading ties with each of the EU and US; though relationships with the EU are much higher for all countries.[25,26] This may lead the researcher to expect stronger trade effects.

However, there are multiple reasons to believe that interest rates may be the dominant transmission mechanism. First, as Table 2 indicates, almost all countries have significant external debt as a percentage of GNI and much of this debt is denominated in either Euros or US dollars with the US dollar debt representing a larger share in most. As a contractionary monetary policy shock in the EU or US will lead to an appreciation of the EU or US currency, the debt burden of floating exchange rate countries will rise unless they increase their interest rates as well. So the decision for floating exchange rate countries is do you allow the EU or US currency appreciation to occur in the hopes that trade will increase or do you respond with increases in interest rates in order to offset the appreciation thus keeping your debt burden stable but potentially harming other parts of your economy. Fixed exchange rate countries do not have to concern themselves with these similar exchange rate issues as it relates to debt.

Second, both floating and fixed exchange rate countries may have capital flow reversal concerns should they not respond to an increase in foreign interest rates with an increase of their own. This is true especially given that the EU and US are large economies, implying that other countries will increase their interest rates in response. As Figures 5 and 6 show, both sets of countries have seen increases in capital's relevance with respect to GDP over the period under analysis.[27]

One potential way to avoid the capital flow reversals is to use capital controls. As Table 34 in Appendix H indicates, fixed exchange rate countries are more likely to use capital controls as a tool to stem the capital flow reversals, defend the exchange rate peg, and continue to have flexibility with monetary policy.[28] This flexibility may allow for countercyclical interest rate policy to offset the negative effects of the contractionary foreign monetary policy shock.[29]

To further complicate expectations, as Mishra and Montiel (2012) point out, domestic monetary policy transmission has been relatively ineffective in SSA countries, including the countries in this study. Therefore, if domestic monetary policy does not work, should we expect international transmission of shocks to have any effect at all? The literature has been somewhat mixed on this issue as Cushman and Zha (1997) and Canova (2005) find that foreign shocks have larger effects on domestic countries than those countries' domestic

[25]Data is from 1992q1 - 2011q4 to capture all dates used in this analysis.

[26]Despite the much larger trading relationships with the EU, the US often ranks as one of the larger trading partners for these countries and is thus still relevant.

[27]This foreign direct investment data reflects net inflows of investment to acquire a lasting management interest in an enterprise operating in an economy that does not belong to the investor. This data therefore reflects committed FDI. Data on other forms of capital including portfolio flows or portfolio investment for these countries are not as readily available. However, where available, the general story of the importance of capital for these individual countries does not change. All capital data comes from the IMF.

[28]This table indicates the average ranking of these countries based on their capital controls usage. The higher the score the less amount of capital controls being used.

[29]This argument is representative of the broader 'trilemma' or 'impossible trinity' discussion whereby a country who has a fixed exchange rate and wants independent monetary policy will need to use capital controls to some degree.

monetary policies have had on their own economies, while Hoffmaister and Roldos (1997) find that domestic shocks do play an important role in explaining the variance in domestic macroeconomic variables.

Percent (%) of Total Trade	Exports EU	Imports EU	Exports US	Imports US
South Africa	22.1	28.4	9.6	9.5
Ghana	36.5	22.6	8.4	7.5
Kenya	16.9	16.5	4.2	6.1
Tanzania	24.7	13.7	2.3	3.6
Uganda	25.3	18.1	2.3	4.0
Mauritius	36.8	23.3	14.1	2.6
Gabon	19.0	60.4	44.3	7.6
Cote d'Ivoire	45.8	39.0	7.8	3.9
Botswana	30.6	35.9	16.6	9.4
Senegal	31.2	45.7	0.5	4.3
Rwanda	27.9	20.3	4.1	6.7

Table 1: SSA Country Trade with EU and US

Percent (%) of Total External Debt	Euro	USD	Debt as % of GNI*
South Africa	10.1	69.4	22.2
Ghana	11.9	62.6	73.0
Kenya	16.8	44.4	52.5
Tanzania	4.6	46.5	79.8
Uganda	5.1	59.9	53.7
Mauritius	45.4	34.7	20.8
Gabon	41.7	27.5	69.7
Cote d'Ivoire	49.7	39.2	117.1
Botswana	5.6	16.6	10.0
Senegal	15.5	43.2	59.3
Rwanda	6.2	51.4	56.4

*This percentage includes private debt as well

Table 2: SSA Country External Debt Denomination

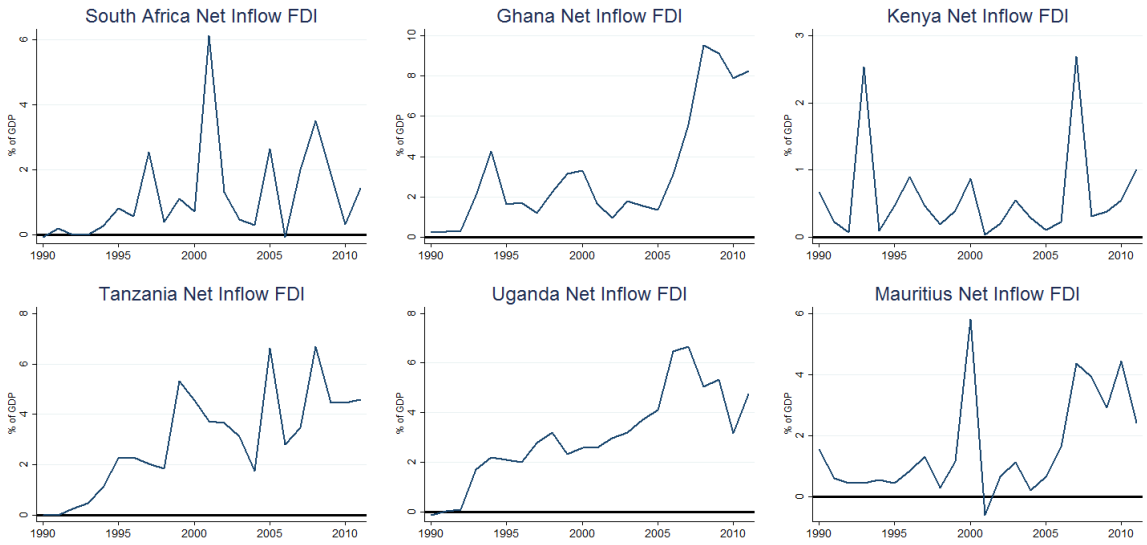

Figure 5: SSA Country FDI Inflows as % of GDP (Floating Exchange Rate Regime)

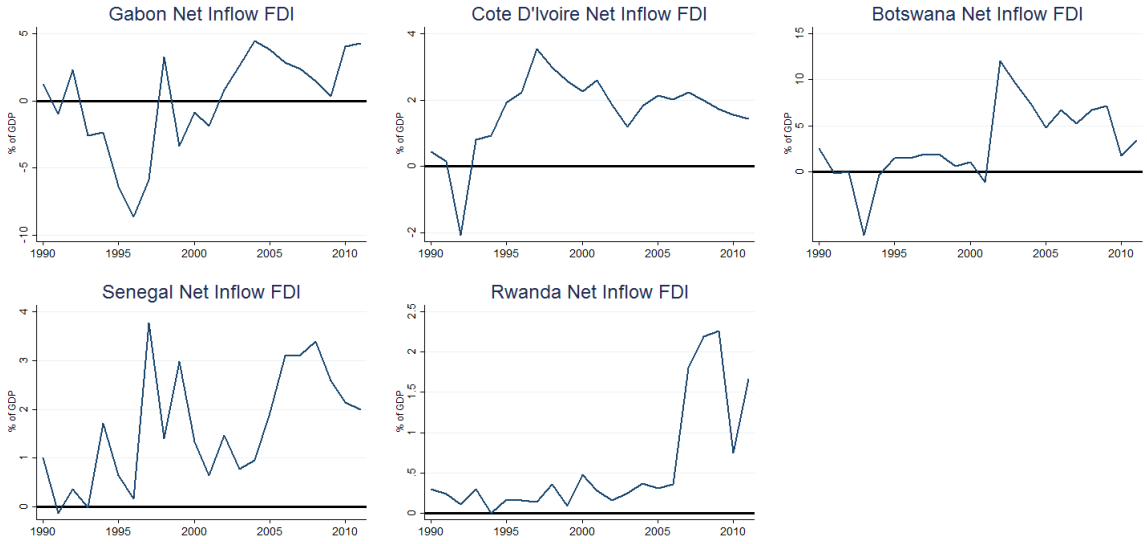

Figure 6: SSA Country FDI Inflows as % of GDP (Fixed Exchange Rate Regime)

3.1 EU Shock Results

3.1.1 Main Results

I begin by looking at how the contractionary monetary policy shocks from the EU affect the real GDP of the 11 SSA countries and determine which mechanism(s), trade and/or interest rates, are at the heart of the results. The discussion will focus on a comparison of floating versus fixed exchange rate economies.[30]

[30]For these and all results, stability conditions have been tested using the eigenvalue method discussed in both Hamilton (1994) and Lutkepohl (2005). As all eigenvalues in all estimations have a modulus less than 1, the stability conditions have been met.

Tables 3 and 4 show the real GDP responses to a contractionary EU monetary policy shock for both floating and fixed exchange rate countries respectively, how much of the variance in GDP can be explained by the shock, as well as if the patterns and magnitudes of trade and/or interest rates match the real economy results thus allowing us to label them transmission mechanisms. The arrows represent a significant change in real GDP in a given direction. The confidence intervals used to determine the significance are based on asymptotic standard errors with 68% bands. FEVD represents the average forecast error variance decomposition for real GDP, which tells us how much of the forecast error variance of real GDP can be explained by the foreign contractionary monetary policy shock. Furthermore, the 'Y', 'N', imply that trade and/or interest rates do or do not act as transmission mechanisms for the EU shock. The assumptions being made when determining whether a 'Y' or 'N' is appropriate is based on the economic theory described above: namely that if trade increases (decreases), real GDP will increase (decrease), and if interest rates fall (rise), real GDP will increase (decrease).[31]

The focus of these tables is the first 8 quarters, despite the impulse response functions going out 16 quarters. Papers such as Kim (2001), Canova (2005), and Kozluk and Mehrotra (2009) tend to focus the discussion on the real economy results for the first two years. The discussion on later quarters usually revolves around whether we see the effect of the shock return to its initial condition indicating the neutrality of monetary policy in the long run.

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
South Africa	↓	25.0%	N	N
Ghana	↑↓	23.1%	N	Y
Kenya	↓↑	14.2%	N	N
Tanzania	↑	7.3%	N	Y
Uganda	↓	1.9%	N	N
Mauritius	-	0.4%	Y	Y

Table 3: Floating Exchange Rate Country Responses Following EU Shock

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
Gabon	↑	21.3%	Y	Y
Cote d'Ivoire	↑↓	10.6%	N	N
Botswana	↑	48.9%	Y	Y
Senegal	↓↑	7.4%	Y	Y
Rwanda	↓↑	4.5%	Y	N

Table 4: Fixed Exchange Rate Country Responses Following EU Shock

At first glance, Table 3 indicates a mixed set of real GDP results for floating exchange rate countries following a EU shock. However, if we look at Figure 7 and Table 5 below, we see contractionary periods outweighing expansions especially over the first 1-2 years. In fact, the average response over the first year was -0.16% for these countries, and -0.11% over the first two years.[32] South Africa and Uganda are entirely contractionary.

[31] Figures for each country can be found in Appendix A

[32] It can also be noted that 5 of the 6 countries averaged point estimate contractions over the first year, while 4 of 6 had

Kenya is almost always contractionary, except for a two quarter expansionary period in quarters 3 and 4. Ghana experiences both contractions and expansions, while Mauritius, though insignificant, has a point estimate in contractionary territory for most of the first two years. Only Tanzania is purely expansionary.

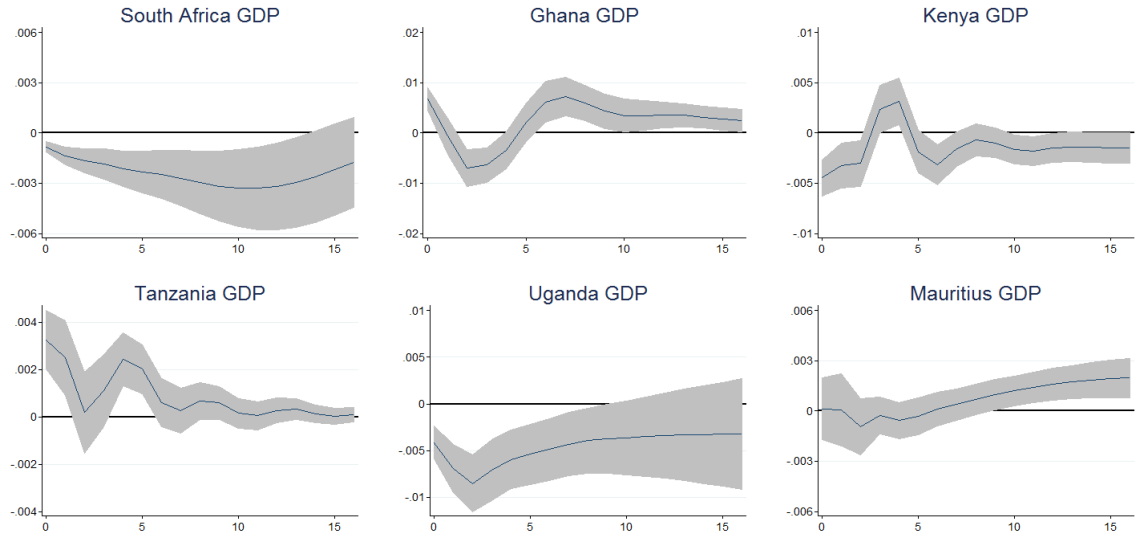

Figure 7: SSA Country GDP Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative*	Positive*	Negative	Positive	Negative	Positive
South Africa	5	0	9	0	14	0
Ghana	2	1	2	4	2	12
Kenya	3	2	4	2	8	2
Tanzania	0	3	0	4	0	4
Uganda	5	0	9	0	10	0
Mauritius	0	0	0	0	0	8

Table 5: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Floating EU
*These figures represent significant contractionary or expansionary periods.

Table 3 also indicates that interest rates are the more dominant transmission mechanism over trade. The explanation of why the general story for these countries is real economic contractions with interest rates as the dominant transmission mechanism has to do with the importance of international capital. Mauritius and Tanzania, given their reliance on capital flows as shown in Figure 5 above, react to EU increases in interest rates with increases of their own. For Mauritius this causes an insignificant drop in GDP, while Tanzania sees its impact increase in GDP quickly rebound back to initial levels. The falls in GDP from these increases in interest rates are due to decreases in domestic demand. For Uganda, they do not respond with a significant increase in interest rates however, given the importance of capital to their economy, GDP experiences a further contraction after the initial fall showing the dangers of inaction. Ghana is the one country who, despite having a heavy reliance on capital, is able to experience an expansion with interest rates as a transmission mechanism, though they seem to be concerned about capital enough to increase

point estimate average contractions over the first two years. Point estimate implies that the contraction may or may not be significant but does move in that direction.

interest rates back to initial levels causing the subsequent fall in GDP. The two countries who have low reliance on capital, South Africa and Kenya are able to lower rates, though they are unsuccessful as some third factor seems to be driving their results.[33]

Table 4 also shows a mixed set of results for fixed exchange rate countries. This time however, an analysis of Figure 8 and Table 6 confirms this finding, especially over the first year, with expansionary results being more dominant when extended to the medium and long term.[34] Cote D'Ivoire, Senegal, and Rwanda all have fairly mixed results with Cote D'Ivoire experiencing expansions on impact followed by contractions, and Senegal and Rwanda having the reverse occur. Gabon and Botswana are entirely expansionary stories.

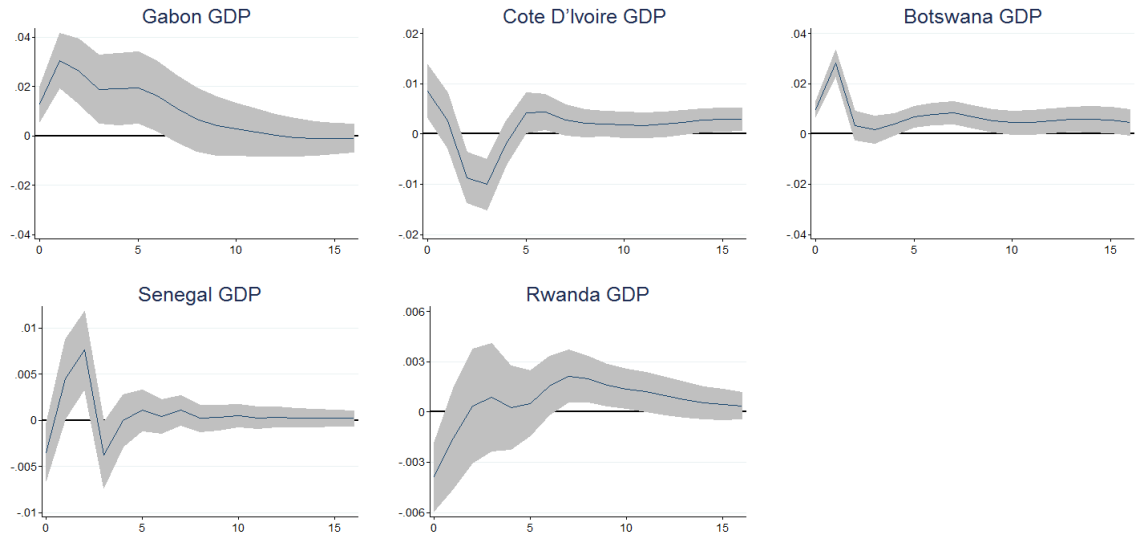

Figure 8: SSA Country GDP Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
Gabon	0	5	0	7	0	7
Cote D'Ivoire	2	1	2	3	2	6
Botswana	0	2	0	6	0	11
Senegal	2	2	2	2	2	2
Rwanda	1	0	1	2	1	5

Table 6: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Fixed EU

Furthermore, Table 4 also shows that both trade and interest rates play a dominant role, different than the floating exchange rate countries case. If we look at some of the countries that experience expansions such as Gabon, and after an initial fall, Senegal, these are countries that have a large amount of capital controls. These countries are thus able to be flexible with monetary policy and can either increase interest rates in order to keep capital flowing in (e.g. Gabon on impact, despite the increase in GDP) or lower interest rates

[33] One option for this third factor is the equity market. Given the higher levels of development for South Africa and Kenya, it could be that the effect of a slow down in the equity market during recessionary periods in the EU and US causes a negative wealth effect on these countries, thus lowering demand and real GDP.

[34] In the first year, 2 of the 5 countries averaged contractions, while 3 averaged expansions. When extended to two years, all five averaged expansions.

and maintain the peg using capital controls (e.g. Senegal, which results in an increase in GDP in period 1). Furthermore, the expansionary economies have, on average, trade as a strong transmission mechanism where prices fall compensating them for the lack of currency benefit. The inability of domestic producers to distinguish between foreign and domestic consumers implies that foreign pressures will have an effect on domestic prices. Therefore the use of CPI as a measure of price level affecting trade is appropriate. Trade as a strong transmission mechanism may in part be due to the push by EU countries to move away from aid and towards trade, see, e.g. Everything but Arms ("EBA").[35,36]

The fixed exchange rate countries experiencing contractions, such as Rwanda early on, have trade as a strong transmission in a negative direction, where the fall is due to an increase in prices from a lowering of rates with no currency benefit to be had. The ability of a country like Rwanda to lower rates again comes from the usage of capital controls. Senegal has a similar trade situation on impact to Rwanda, but has even more flexibility to lower interest rates due to their increased capital control usage. This further lowering generates the more significant rebound.

The fact that overall it seems that fixed exchange rate countries are better off due to the shock compared with floating exchange rate countries is perhaps slightly counterintuitive as floating rates are supposed to act as a measure of protection against foreign shocks (see, e.g. Canova (2005)). The issue however for these floating exchange rate SSA countries is that their reliance on international capital flows makes them somewhat more susceptible to a foreign monetary policy shock due to, on average, lower capital control usage.[37] This idea of overreliance on foreign capital and thus the use of limited capital controls to restrict inflows has been part of the rethink of the IMF.[38] The broader implication for developing countries may be that, while floating exchange rates are preferable for long run development, there will be a period during this development where the combination of fixed exchange rates and capital controls will help in dealing with foreign monetary policy shocks. Therefore, considering whether slowly moving towards complete liberalization of the exchange rate is better than a rapid change may be beneficial.

3.1.2 Floating and Fixed Exchange Rate Country Examples

To put the general results in context I show a floating and fixed exchange rate country example. For floating exchange rate countries I use Ghana who, after an initial expansion, incurs a contraction for four quarters before eventually rebounding.[39] Ghana also has interest rates as a transmission mechanism, while trade is not. For fixed exchange rate countries I use Senegal who, after an initial contraction experiences an expansion before returning to initial levels and staying there. Senegal has both interest rates and trade as a transmission mechanism.

As can be seen in Figure 9, Ghana experiences an immediate expansion, before falling by approximately 1.5%. Most papers looking at domestic transmission in Ghana find insignificant effects on real GDP (see e.g. Abradu-Otoo et al. (2002)). The implication then is that international transmission of monetary policy

[35] This initiative was entered into by the EU in March 2001 which allowed for duty-free and quota-free imports by EU members from Least Developed Countries.

[36] As can be seen in Figure 66 in Appendix C, aid has been declining from the EU towards these fixed exchange rate countries since EBA began.

[37] As can be seen in Table 34 in Appendix H, floating exchange rate countries, on average, use less capital controls than fixed exchange rate countries.

[38] Gallagher (2011)

[39] During those four contractionary quarters, two of the periods are significant while two are not.

shocks seems to have a larger effect than domestic shocks of the same nature, consistent with other papers including Canova (2005).

Trade is not a strong transmission mechanism as, despite having some periods in which it moves in a similar direction as GDP, as indicated by Figure 9 and Table 7, those periods are mostly insignificant. Interest rates on the other hand seem to be a strong transmission mechanism as they appear to largely move in the opposite direction as GDP and are significant enough. As mentioned above, Ghana lowers rates successfully on impact, but, seemingly concerned over capital flows, returns the rate back to zero, causing the fall in GDP. This contraction lasts awhile before rates are again lowered in order to stimulate GDP. One potential concern would be that despite rates returning back to the zero line, GDP overshoots the zero line into negative territory. There could be many reasons but perhaps the uncertainty over what the Ghanaian central bank will do causes this volatility.

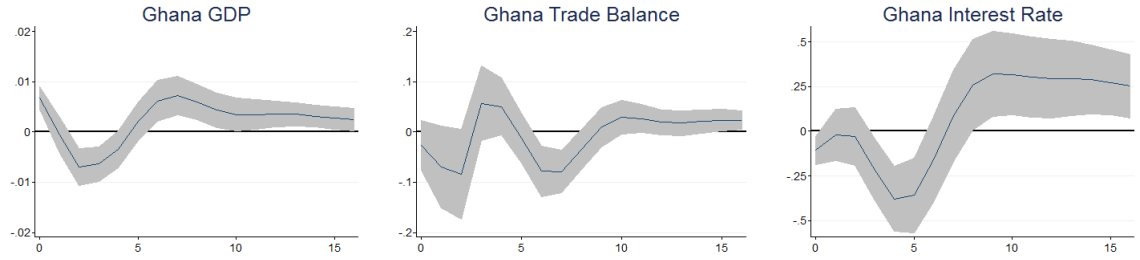

Figure 9: Ghana Economic Response to EU Shock

Period	GDP Direction	Trade Direction	Interest Rate Direction
Impact	↑	↓	↓
Per 1-2	↓	↓	↑
Per 2-8	↑	↑↓	↓↑

Table 7: Comparison of Real GDP and Transmission Mechanism Direction

For Senegal, a fixed exchange rate country, there is again a fall in GDP, this time of approximately 0.5%. Trade seems to work as a transmission mechanism with similar pattern movements to GDP as indicated by Figure 10 and Table 8; especially early on. In the later periods trade tends towards zero as does GDP. Interest rates also appear to work as a transmission mechanism. The impact decrease in interest rates seems to help cause the relatively quick rebound in GDP. This ability to lower rates and maintain the peg comes from Senegal's high use of capital controls.

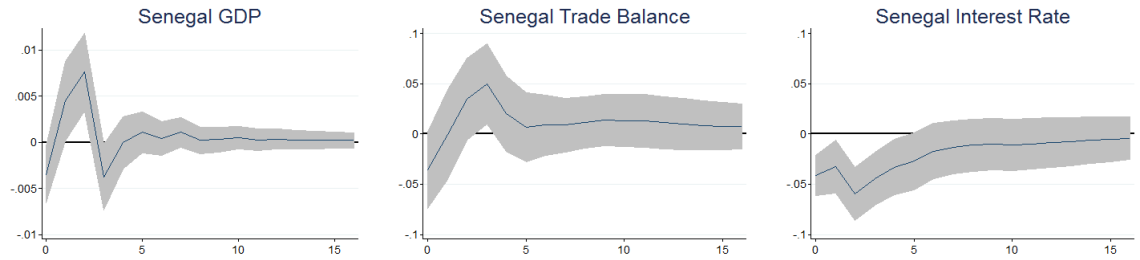

Figure 10: Senegal Economic Response to EU Shock

Period	GDP Direction	Trade Direction	Interest Rate Direction
Impact	↓	↓	↓
Per 1-2	↑	↑	↑↓
Per 3	↓	↑	↑
Per 4-5	↑	↓	↑
Per 6-8	-	-	-

Table 8: Comparison of Real GDP and Transmission Mechanism Direction

3.2 US Shock Results

3.2.1 Main Results

Tables 5 and 6 below show a similar analysis for the US to the one performed for the EU.

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
South Africa	↓	1.6%	N	N
Ghana	↓	40.7%	N	Y
Kenya	↓↑	11.8%	Y	Y
Tanzania	↓	7.0%	N	Y
Uganda	↓↑	7.3%	N	Y
Mauritius	↑↓	11.5%	Y	Y

Table 9: Floating Exchange Rate Country Responses Following US Shock

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
Gabon	↑	4.0%	N	N
Cote d'Ivoire	↑↓	5.2%	N	N
Botswana	↑	12.9%	N	N
Senegal	↑	7.1%	N	N
Rwanda	↓	2.4%	N	Y

Table 10: Fixed Exchange Rate Country Responses Following US Shock

The results indicate that, similar to the EU case, floating exchange rate countries can expect economic contractions following a US contractionary monetary policy shock. Furthermore, an analysis of Figure 11 reinforces this point, as does Table 11, especially in the first year. In fact, the average real GDP response in the first year across these countries is -0.06%. The average response is -0.04% when moved out to two years.[40] South Africa, Ghana, and Tanzania are all entirely contractionary stories. Kenya and Uganda are contractionary early and expansionary after the first couple periods, while Mauritius is difficult to interpret as it oscillates back and forth.

A similar story also appears whereby the interest rate is the more dominant transmission mechanism over trade. The reliance on capital story remains relevant here as all countries who have high levels of capital

[40]While 3 countries each averaged expansions and contractions over both one and two years, 2 of the 3 had significant contractions while none of the expansions were significant.

as a percentage of GDP, including Ghana, Tanzania, Uganda, and Mauritius, increase their interest rates to keep capital from flowing out. The countries that are not as reliant on these flows, such as South Africa and Kenya, have more flexibility in lowering interest rates to try and reverse any economic contractionary effects; which seems to work for Kenya. For South Africa it does not appear to work, however the fall in GDP seems to have little to do with the foreign shock as indicated by the FEVD.[41]

In addition to the capital flow issue, many of these countries have high external debt levels denominated in US dollars and are thus increasing interest rates in order to offset the likely rise in the real cost of their external debt from the appreciation of the US dollar. The increased negative effect on GDP from the external debt issue following the US shock, as compared to the EU shock, is represented by the higher average FEVD across these countries. This debt and capital combined story is consistent with the explanation used in DSGE papers on international transmission of monetary policy shocks, including Demirel (2009). The story is that the increase in foreign interest rates causes a fall in investment and a capital flow reversal as there is an opportunity cost to domestic investment. There is also a depreciation of the domestic currency which causes a worsening of the net debt position. This negative wealth effect causes a fall in consumption, and it is this fall, coupled with the decrease in investment, that lowers real GDP.

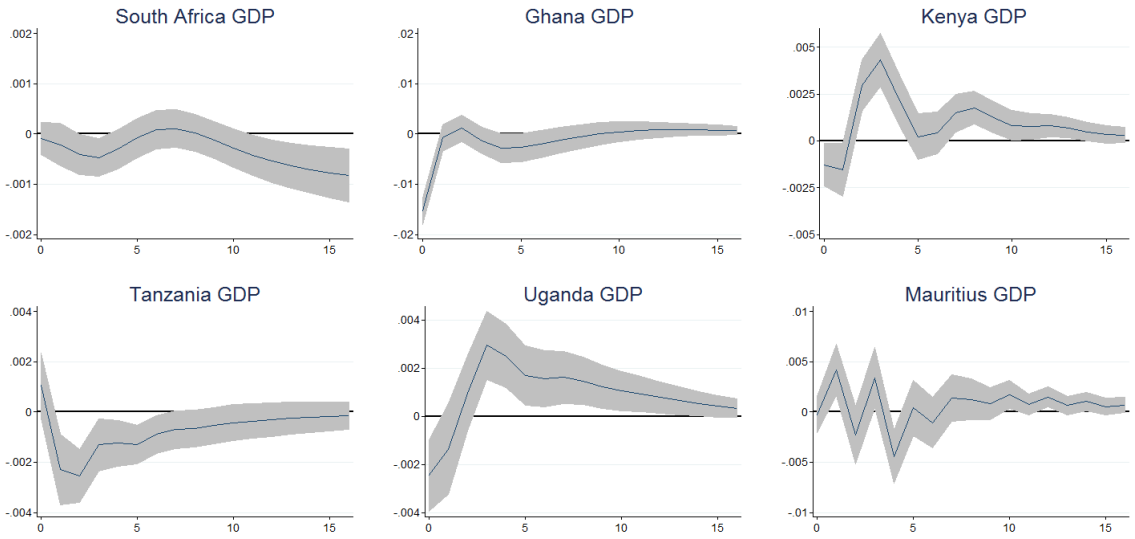

Figure 11: SSA Country GDP Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
South Africa	2	0	2	0	8	0
Ghana	2	0	2	0	2	0
Kenya	2	3	2	5	2	10
Tanzania	4	0	4	0	6	0
Uganda	1	2	1	6	1	12
Mauritius	1	2	1	5	1	5

Table 11: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Floating US

[41] The negative effects of equity markets could again be a potentially important factor for South Africa.

For fixed exchange rate countries, the story is different from the EU shock case, as well as the floating exchange rate US shock case. As Table 10 indicates, these fixed exchange rate countries following the US shock are able to mostly avoid contractions and it appears that neither trade nor interest rates is a transmission mechanism. The expansionary results are confirmed by Figure 12 and Table 12 below, as well as the fact that the average real GDP response over either the first year or the first two years is approximately 0.2%.[42] Specifically, Gabon, Botswana, and Senegal have purely expansionary results, Cote D'Ivoire is mixed, while other than an impact fall in GDP, the results are insignificant for Rwanda.

Given that neither trade nor interest rates are playing a significant role, it is possible that some other non-investigated factor is playing a role here. One example might be aid, which from the US to these countries has not necessarily followed a procyclical pattern, as can be seen in Figure 67 in Appendix C for fixed exchange rate countries.[43] Therefore, aid or some factor like it is may be overwhelming any trade or interest rate effects. The implication is that either the pivot the US made in the early 2000s from aid to trade (see, e.g. AGOA[44]) has not been successful as of yet for fixed exchange rate countries, or aid continues to flow in at too high a level to allow trade and interest rates to play a significant role. As can be seen in Figure 67, aid has been increasing over the sample period despite the pivot towards trade, in direct contrast to the case of the EU.

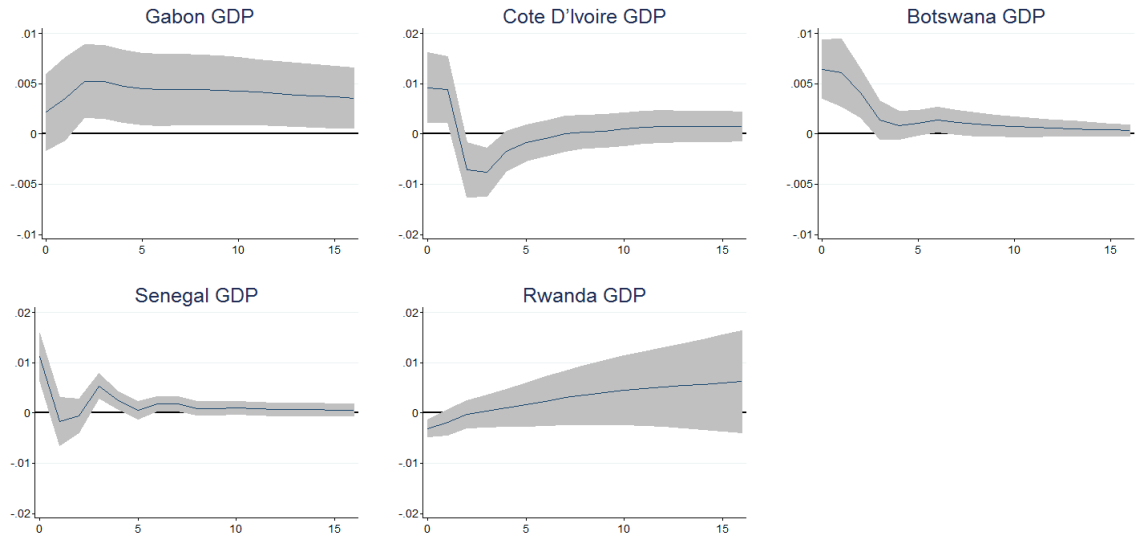

Figure 12: SSA Country GDP Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

[42]Over the first year, 3 of the 5 countries experienced expansions while 2 had contractions; though none of the contractions were significant, while 2 of the 3 expansion were. Furthermore, over the first two years, 4 of the 5 countries averaged expansions.

[43]This ambiguity over the procyclicality of aid from the donor country is consistent with some empirical papers including Pallage and Robe (2001) who find that there is a lack of conclusive evidence linking business cycles in donor countries to aid in Africa during the 1969-1992 period. Furthermore, Faini (2006) finds statistical insignificance when analyzing the relationship between the output gap (their business cycle measure) and aid during the 1980-2004 period.

[44]A piece of legislation passed by US Congress in 2000 focused on trade.

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
Gabon	0	3	0	7	0	15
Cote D'Ivoire	2	2	2	2	2	2
Botswana	0	3	0	4	0	4
Senegal	0	3	0	5	0	5
Rwanda	1	0	1	0	1	0

Table 12: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Fixed US

3.2.2 Floating and Fixed Exchange Rate Country Example

As before, I look at floating and fixed exchange rate country examples to put this discussion in context. I use Uganda for the floating exchange rate countries and Senegal for the fixed exchange rate countries.

As Figure 13 indicates, Uganda experiences a contraction in period 1 of around 0.2%. Other papers (see e.g. Cheng (2006)) on Uganda have found insignificant effects on the real economy from a domestic monetary policy shock implying that international transmission of monetary policy shocks is a stronger effect.[45]

Trade is clearly not a transmission mechanism as it always moves in the opposite direction of real GDP and is too small to be expected to create a real GDP change of this magnitude.[46] Interest rates, on the other hand, are a strong transmission mechanism. The initial and period 1 increase in interest rates totaling approximately 50 bps contributes to the fall in the real economy, while the subsequent lowering of interest rates causes the recovery. Table 13 indicates a complete matching of patterns between interest rates and real GDP.

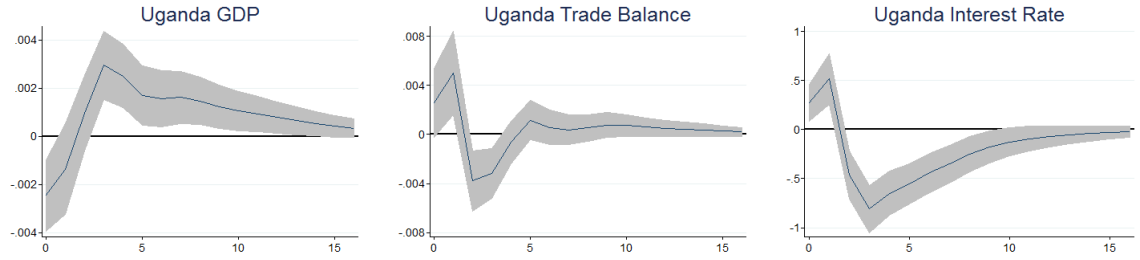

Figure 13: Uganda Economic Response to US Shock

Period	GDP Direction	Trade Direction	Interest Rate Direction
Impact	↓	↑	↑
Per 1-3	↑	↑↓	↑↓
Per 4-8	↓	↑	↑

Table 13: Comparison of Real GDP and Transmission Mechanism Direction

As Figure 14 indicates, Senegal experiences an expansion following the shock, rebounding down to the original starting point relatively quickly. As can be seen in Table 14, while there is some pattern matching of

[45]Though beyond the scope of this paper, future research should look to help explain reasons for the dominance of foreign monetary policy shocks on the domestic economy of these SSA countries.

[46]Remember that the y-axes for trade balance and interest rates do not need to be multiplied by 100 to get the percentage change.

both trade and interest rates to real GDP, the magnitudes of the transmission mechanisms are far too small to be causing any significant real GDP change. Therefore, neither trade nor interest rates are transmission mechanisms for Senegal. The lack of transmission mechanism brings in the possibility that some third factor like aid may be playing a role. US aid to Senegal was almost double the 2000 level in 2008 despite the US' move to replace aid with trade.[47] Therefore, it may be the case that aid to Senegal was sufficient to allow for the initial increase in real GDP despite US monetary and economic contractions. Furthermore, even though real GDP returns to initial levels after the impact expansion, aid may have been enough to offset any potential negative trade or interest rate effects in these subsequent periods.[48]

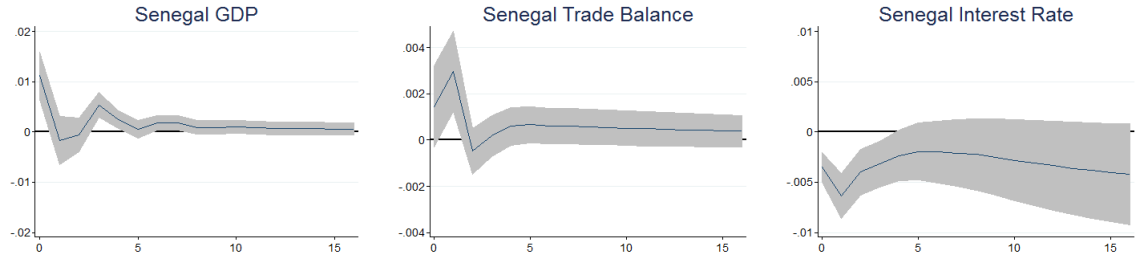

Figure 14: Senegal Economic Response to US Shock

Period	GDP Direction	Trade Direction	Interest Rate Direction
Impact	↑	↑	↓
Per 1	↓	↑	↓
Per 2-3	↑	↓↑	↑
Per 4-5	↓	↑	↑
Per 6-8	-	-	-

Table 14: Comparison of Real GDP and Transmission Mechanism Direction

4 Robustness Checks and Extension

My first robustness check looks at overall trade balances instead of the bilateral trade data that has been used to this point. Bilateral trade was used in the primary specification due to the size of the trading relationships with the EU and US and to isolate those effects. Overall trade balances will allow us to determine whether the global consequences of the EU or US monetary policy shocks for these SSA countries alter any of the bilateral results.

My next robustness check then looks at whether the methodology for identification of the monetary policy shock affects the results when we use the more standard block-block method, where the CEE (1996) SVAR setup is used to generate the foreign monetary policy shock. This check is analyzed only for the EU shock as Barakchian and Crowe (2013) have already shown the failure of this method for the US. Running the CEE (1996) setup for the EU does not produce the same puzzle as I will show below. This comparison will also allow us to make some comment on how big an issue overparameterization is for the EU shock results.

[47] See Figure 67 in Appendix C for US aid to Senegal in constant dollars. The story is the same if current dollars are analyzed.

[48] Average aid to Senegal (in current dollars) from the US since 2000 was approximately $37 million which represented 0.46% of GDP. Furthermore, total aid to Senegal averaged approximately $610 million which amounted to 7.61% of GDP.

Lastly, as an extension I create aggregate measures for the floating and fixed exchange rate countries using geometric means as in Kim (2001).[49] This will allow me to see whether results for a typical floating and fixed exchange rate country match the findings when we look at countries individually and generalize.

4.1 Overall Trade Balance - EU Results

Tables 7 and 8 show the results for both the floating and fixed exchange rate countries following the EU shock.[50]

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
South Africa	↓	34.7%	N	N
Ghana	↑↓	16.8%	N	Y
Kenya	↓↑	26.8%	N	N
Uganda	↓	64.3%	N	N
Mauritius	-	1.6%	Y	Y

Table 15: Floating Exchange Rate Country Responses Following EU Shock

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
Gabon	↑	14.1%	N	Y
Cote d'Ivoire	↑↓	5.3%	Y	N
Botswana	↑	32.1%	N	N
Senegal	↑	4.8%	N	Y
Rwanda	↑	22.9%	N	Y

Table 16: Fixed Exchange Rate Country Responses Following EU Shock

Table 15 indicates that, as in the primary specification, there are mixed real economy results for the floating exchange rate countries. However, again similar to the primary specification, an analysis of Figure 15 and Table 17 below indicates that a more contractionary story is prevalent, especially in the first two years. Specifically, South Africa and Uganda are completely contractionary, Kenya is contractionary for most of the first year and in the later periods, though it is expansionary in the middle. Ghana is mixed in the early part of the expansion before expanding later. The similarity of these real GDP results to the primary specification is not surprising given the Bernanke and Blinder (1992) argument that the orthogonalized errors in the SVAR, which come from properly identifying the foreign monetary policy shock, imply that omitted variables are not a concern. Therefore, replacing bilateral trade with global trade should not change the impulse response functions of variables other than trade, such as real GDP and interest rates.

Looking at the transmission mechanisms, including overall trade does not change any of the results as Mauritius remains the only country with trade as a significant transmission mechanism. As it is not possible to investigate Tanzania, interest rates lose one country in which they were relevant. However, the remaining

[49] For interest rates and trade balance, arithmetic mean is used.

[50] Note that Tanzania is left out of the analysis. This is due to weak real effective exchange rate data.

countries all maintain their previous interest rates results as expected, and given the fact that the GDP story remains the same, the capital flow story from the primary specification remains relevant.

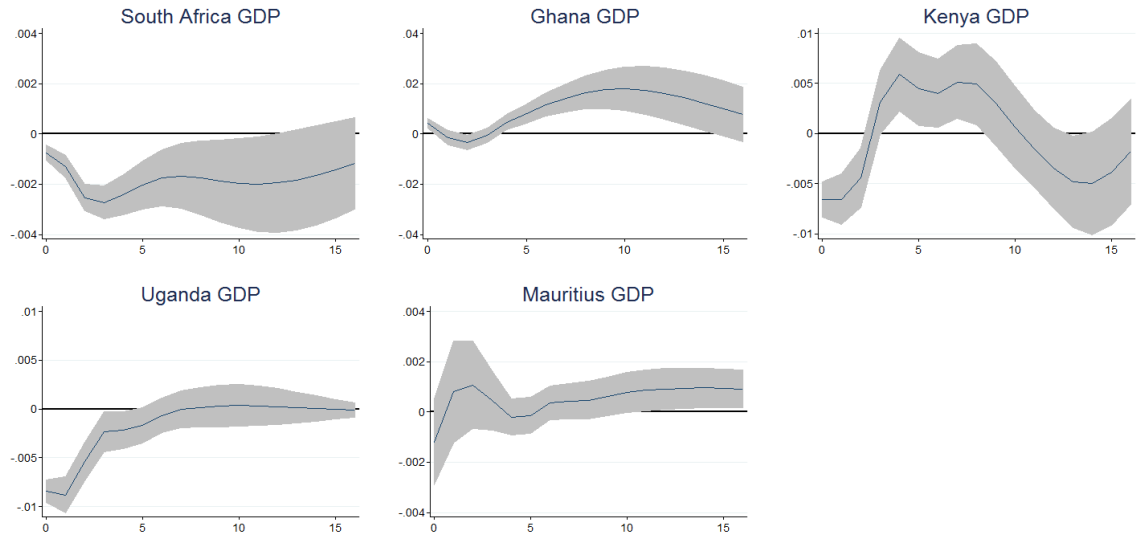

Figure 15: SSA Country GDP Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
South Africa	5	0	9	0	12	0
Ghana	1	2	1	6	1	12
Kenya	3	1	3	5	4	5
Uganda	5	0	5	0	5	0
Mauritius	0	0	0	0	0	6

Table 17: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Floating EU

Fixed exchange rate country results are similar to the primary specification though with more expansionary GDP movement. Table 18 confirms this result in terms of periods of significance. If one analyzes Figure 16 below, one can explain why there is an even more expansionary story than before. The main difference is that both Senegal and Rwanda lose the significance of their early contractions. The point estimates still indicate contractions though now they are not significant. The Bernanke and Blinder (1992) argument that there is no omitted variable bias still holds, despite any differences in the graphs. The reason is that there is always the potential for some correlation between omitted variables and the coefficient of interest on the shock term affecting the impulse response functions. In this case, the correlation pushes the GDP for Senegal and Rwanda up by enough in the early periods so that there is no significant contraction.

Trade is no longer a transmission mechanism as it is not strong enough nor is its overall movement in the same direction as GDP changes. In fact, trade tends to mostly move negatively. This increased negative effect of trade comes from the fact that as other countries respond to the increase in EU interest rates with increases of their own, aggregate demand in those countries falls as well and fixed exchange rate countries get no currency benefit. The explanation from the primary specification for interest rates as a transmission

mechanism remains the same as countries like Gabon, Senegal, and Rwanda, given their use of capital controls, can lower their interest rates in response and create an expansion of GDP.

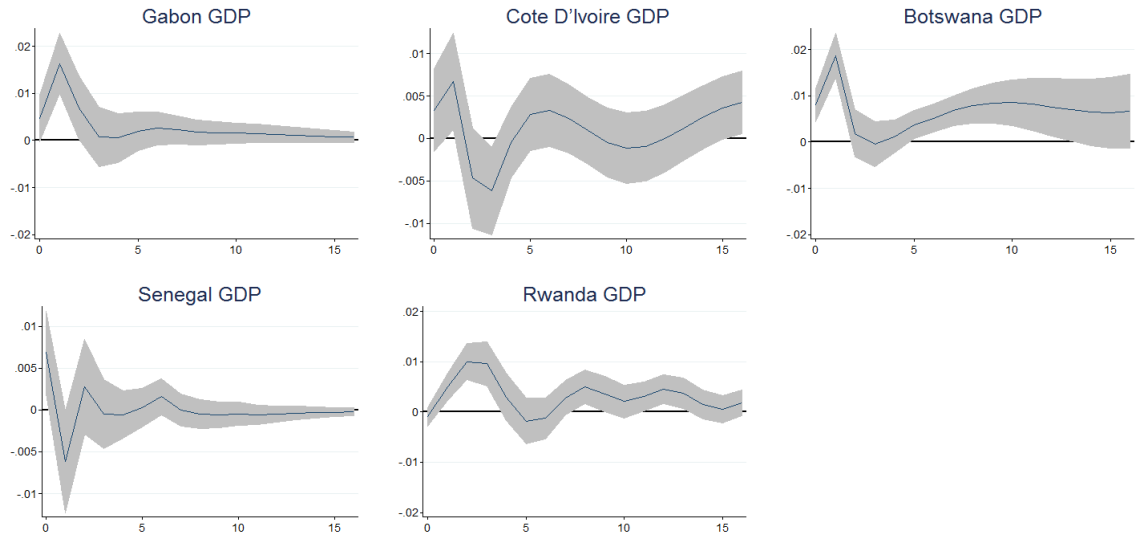

Figure 16: SSA Country GDP Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
Gabon	0	2	0	2	0	2
Cote D'Ivoire	1	1	1	1	1	2
Botswana	0	2	0	6	0	11
Senegal	1	1	1	1	1	1
Rwanda	0	3	0	4	0	8

Table 18: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Fixed EU

4.2 Overall Trade Balance - US Results

Tables 9 and 10 show the results for both the floating and fixed exchange rate countries following the US shock.

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
South Africa	↓	12.9%	N	N
Ghana	↓↑	12.9%	Y	Y
Kenya	↓↑	12.7%	N	Y
Uganda	↑	4.2%	N	Y
Mauritius	↑	23.4%	N	Y

Table 19: Floating Exchange Rate Country Responses Following US Shock

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
Gabon	↑	3.5%	N	N
Cote d'Ivoire	↑↓	11.6%	N	N
Botswana	↑	3.6%	Y	Y
Senegal	↑↓	50.4%	Y	N
Rwanda	↓	40.9%	N	N

Table 20: Fixed Exchange Rate Country Responses Following US Shock

Table 19 indicates a seemingly mixed set of results for floating exchange rate countries, whereas the primary specification indicated a more clearly defined contractionary set of results. Table 21 would seem to support a mixed set of results with expansions even appearing more dominant. However, if one analyzes Figure 17, these contradictory results compared to the primary specification can be explained. South Africa continues to be a purely contractionary story. Ghana experiences an immediate contraction before returning to its initial level, followed by a set of back and forths between very mild expansions and its initial level. This is similar to the primary specification except that once Ghana returned to its initial levels it had a smoother more insignificant effect. Kenya similarly experiences an initial contraction of a couple periods followed by an expansion. Uganda loses the significance of its early contractions, though the point estimate continue to show these contractions. Mauritius is the one pattern that seems to be much different going from mixed results in the primary specification to mostly expansionary results. Lastly, one of the significant contractionary economies in the primary specification, Tanzania, is not estimated in this robustness check due to a shortage of real effective exchange rate data.

Interest rates remain a dominant transmission mechanism and trade remains irrelevant except in the case of Ghana. Interest rates are increased for Uganda and Mauritius due to their reliance on capital flows, which causes an insignificant fall in Uganda's GDP before they expand, and causes Mauritius' expansion to rebound quickly back down. As before, Kenya and South Africa lower rates which works better for Kenya than it does for South Africa. Ghana is an exception as, despite being reliant on capital flows, they lower their rates successfully, similar to what we saw in the case of the EU floating exchange rate countries.

Figure 17: SSA Country GDP Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
South Africa	4	1	8	1	16	1
Ghana	1	2	1	3	1	5
Kenya	1	3	1	7	1	12
Uganda	0	1	0	4	0	4
Mauritius	0	2	0	4	0	12

Table 21: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Floating US

Table 20 indicate that fixed exchange rate countries, as expected, continue to be able to avoid a real economic contraction following the US shock. This result is confirmed by Figure 18 and Table 22 below. As neither trade nor interest rates play a dominant role, the implication is that there is a continued importance of a third factor like aid. That being said, the inclusion of overall trade does allow for trade as a transmission mechanism in a couple of instances. In both cases (Botswana and Senegal) trade plays a positive role on GDP. The positive nature of trade for Senegal, despite having a fixed exchange rate, is due to the lowering of prices in response to the interest rate increase in the EU. The positive effects for Botswana comes from the fact that they do experience the depreciation effect because they are not pegged to the Euro.

Figure 18: SSA Country GDP Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
Gabon	0	1	0	1	0	1
Cote D'Ivoire	2	2	2	3	2	5
Botswana	0	1	0	1	0	1
Senegal	1	2	1	3	2	3
Rwanda	4	0	4	0	4	0

Table 22: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Fixed US

4.3 Block-Block Method - EU Results

The block-block methodology contains a large open economy block, which uses the CEE (1996) monetary policy shock identification method, as well as an SSA block containing the same SSA variables as in the primary specification except the shock variable which is generated from the large open economy block. This analysis is performed for the EU shock only, as it is known from Barakchian and Crowe (2013) that the CEE (1996) setup produces a real economy puzzle for the US.

Formally, the bivariate block VAR model can be written as:

$$\begin{bmatrix} y_{it} \\ w_t \end{bmatrix} = \begin{bmatrix} A^i_{11}(L) & A^i_{12} \\ 0 & A_{22}(L) \end{bmatrix} \begin{bmatrix} y_{it-1} \\ w_t \end{bmatrix} + \begin{bmatrix} A^i_{13}(L) \\ A_{23}(L) \end{bmatrix} x_t + \begin{bmatrix} \varepsilon_{it} \\ e_t \end{bmatrix} \tag{14}$$

where the error terms have the following property: $(\varepsilon_{it}, e_t)' \sim (0, \Sigma_i)$, where $\Sigma_i = blockdiag(\Sigma_{\varepsilon_i}, \Sigma_e)$.

In this setup, w_t represents the EU block variables, while y_{it} represents the given SSA country block. Exogenous variables are represented by x_{it}.[51,52]

[51]The zero in the bottom left-hand corner of the LHS matrix reflects the fact that SSA variables are unlikely to have any effect on the EU variables.

[52]I run this block-block model in two stages where the EU model is run first, the shock series is extracted and cumulated, and inserted into the SSA block similar to the primary specification method.

The variables in the EU block are as follows:

$$w_t^{'} = [y \ cpi \ index \ ir] \tag{15}$$

where y represents real GDP, *cpi* is a consumer price index, *index* is a commodity price index which includes all commodities including oil, and *ir* is the EU 3-month interbank rate, EURIBOR. The exogenous variable affecting the EU, x_{1t}, is the US federal funds rate.

The variables in the SSA block are as follows:

$$y_{it}^{'} = [Trade_t \ RGDP_t \ CPI_t \ XR_t \ IR_t] \tag{16}$$

where the definition for each is the same as in the primary specification.

For the SSA countries, the exogenous variables, x_{2t}, are represented by two separate commodity price indices, specifically one that includes all commodities other than oil and one that contains only oil.

The structural model underlying the above reduced-form version can be rewritten as:

$$\begin{bmatrix} G_0^i & A_0^i \\ 0 & H_0 \end{bmatrix} \begin{bmatrix} y_{it} \\ w_t \end{bmatrix} = \begin{bmatrix} B_{11}^i(L) & B_{12}^i \\ 0 & B_{22}(L) \end{bmatrix} \begin{bmatrix} y_{it-1} \\ w_t \end{bmatrix} + \begin{bmatrix} 0 \\ B_{24}(L) \end{bmatrix} x_{1t} + \begin{bmatrix} B_{13}^i(L) \\ 0 \end{bmatrix} x_{2t} + \begin{bmatrix} u_{it} \\ v_t \end{bmatrix} \tag{17}$$

where the error terms now have a different property, namely $(u_{it}, v_t)^{'} \sim (0, I)$.

As can be seen in Figure 19, the results on the EU economy from a EU monetary policy shock are as predicted by economic theory, specifically a real economy contraction from a contractionary monetary policy shock. One difference for these EU results compared with the primary specification is the persistence of the actual shock.

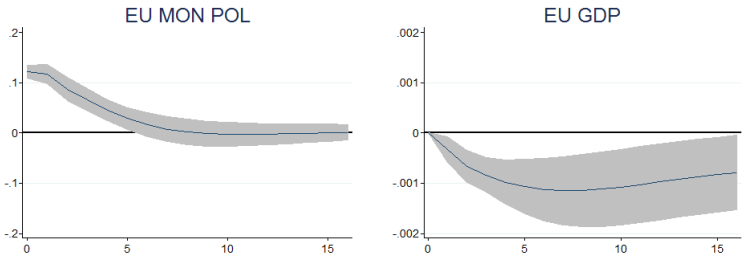

Figure 19: EU Monetary Policy Shock and Real Economy Reaction

Tables 11 and 12 show the results for floating and fixed exchange rate countries when the block-block analysis is performed.

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
South Africa	-	2.0%	N	N
Ghana	↑↓	12.3%	N	Y
Kenya	-	1.6%	N	N
Tanzania	-	2.6%	N	Y
Uganda	↓	6.7%	N	Y
Mauritius	↑↓	14.5%	Y	Y

Table 23: Floating Exchange Rate Country Responses Following EU Shock

	Real GDP Change	FEVD	Trade as Transmission Mechanism	Interest Rate as Transmission Mechanism
Gabon	↓	16.1%	N	Y
Cote d'Ivoire	↓	3.3%	N	N
Botswana	↑	17.7%	Y	Y
Senegal	↑↓	14.6%	Y	Y
Rwanda	↓	8.8%	Y	Y

Table 24: Fixed Exchange Rate Country Responses Following EU Shock

Table 23 indicates a similarly mixed set of results to what these equivalent tables showed in the primary specification for floating exchange rate countries; though with more insignificance. Table 25 would continue to support a mixed set of results in the first year, while highlighting the insignificance of the real GDP changes. However, if one looks over the first two years, or in the long run, a more contractionary picture emerges. Furthermore, an analysis of Figure 20 indicates a mostly contractionary story where most of those insignificant changes have contractionary point estimates. Only Tanzania has a majority of expansionary periods when point estimate analysis is allowed.

Furthermore, those who had interest rates as transmission mechanisms before continue to with this setup, with the addition of Uganda. The explanation for these floating exchange rate countries of increasing interest rates as a response due to their reliance on international capital flows continues to be the case here, where even Ghana now increases interest rates. The two countries that do not raise interest rates, South Africa and Kenya, are the countries that had low international capital reliance and thus had flexibility to lower rates; in this case successfully. Trade continues to not be a transmission mechanism, similar to the primary specification.

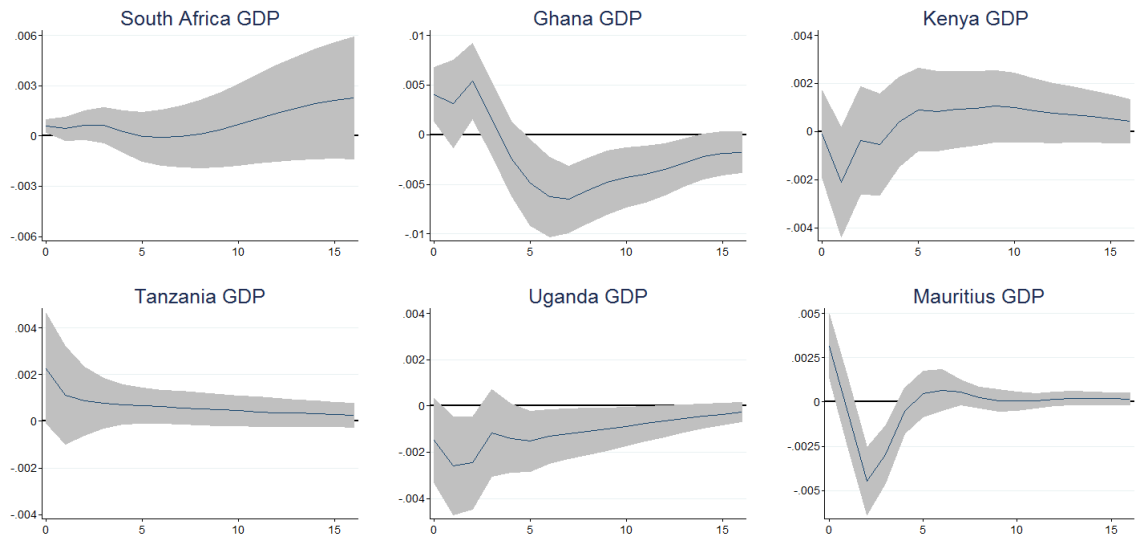

Figure 20: SSA Country GDP Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
South Africa	0	1	0	1	0	1
Ghana	0	2	4	2	9	2
Kenya	0	0	0	0	0	0
Tanzania	0	0	0	0	0	0
Uganda	2	0	6	0	9	0
Mauritius	2	1	2	1	2	1

Table 25: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Floating EU

Fixed exchange rate countries seem to again have mixed results when Table 24 is analyzed. However both Table 26 and Figure 21 indicate a more contractionary story compared with the primary specification where expansions slightly dominated contractions after early mixed results. Trade and interest rates both continue to be strong mechanisms. The explanation for the more contractionary results could be that given the persistence of the shock (Figure 19) compared with the primary specification (Figure 2), the countries that were willing to use countercyclical policy such as Gabon and Senegal were not so in this case. Gabon experiences a contraction with interest rates as transmission mechanisms in this analysis, whereas they experienced expansions with interest rates as transmission mechanism in the primary specification. Trade still plays a mixed role as it increases for Botswana due to a lowering of prices, while it falls for Rwanda due to an increase in prices from, in part, lowering interest rates and not being able to incur any currency benefit.

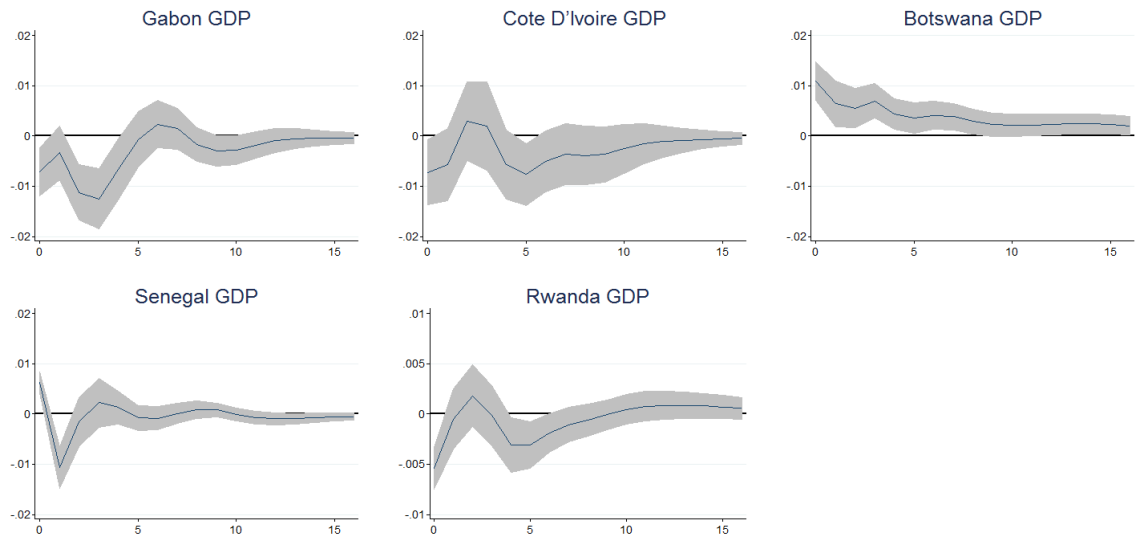

Figure 21: SSA Country GDP Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

	Impact - 4 Quarters		Impact - 8 Quarters		Impact - 16 Quarters	
	Negative	Positive	Negative	Positive	Negative	Positive
Gabon	4	0	4	0	5	0
Cote D'Ivoire	1	0	2	0	2	0
Botswana	0	5	0	9	0	15
Senegal	1	1	1	1	1	1
Rwanda	2	0	2	0	3	0

Table 26: Contractionary vs. Expansionary Periods of GDP Impulse Response Functions - Fixed EU

The implication of these results is that interpreting the responses of domestic economies to foreign shocks is *somewhat* dependent on the creation of the foreign shock series and thus the method of identification. As this paper believes that central banks in the EU, as was the case for the US, have become more forward-looking in setting monetary policy, and overparameterization is an issue in analyzing block-block results, using a shock series that looks at futures rates is more appropriate.

4.4 Representative Floating and Fixed Country

Many papers that have investigated multiple countries' reaction to a foreign shock have used a representative country approach whereby they create aggregate economic measures using the geometric mean of their variables of interest.[53] This allows them to investigate one set of representative results in their analysis as opposed to looking at all countries individually. I create both a floating and fixed exchange rate representative country using the same division of countries for each group as in the rest of the paper. Given my investigation of individual countries I can compare how looking at these countries as one entity changes my conclusions, which would occur if the aggregation strategy masked the disparate individual results thus bringing into question whether this method is truly representative.

[53]Kim (2001), Canova (2005), Mackowiak (2006, 2007) among others.

4.4.1 EU Results

Figures 13 and 14 detail the results for both floating and fixed exchange rate countries following a contractionary monetary policy shock in the EU.

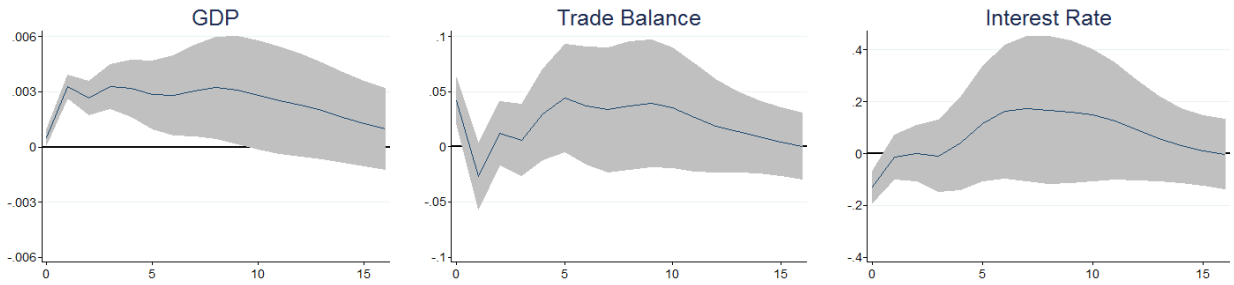

Figure 22: Floating Exchange Rate Representative Country Economic Responses to EU Shock

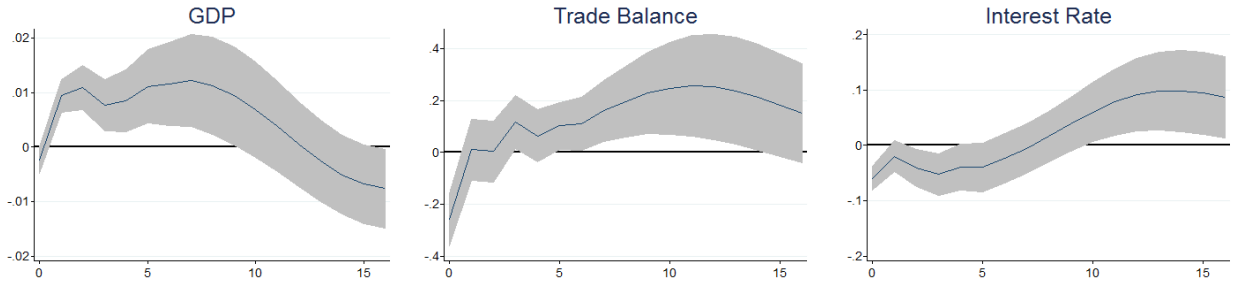

Figure 23: Fixed Exchange Rate Representative Country Economic Responses to EU Shock

As Figure 22 shows for floating exchange rate countries, a GDP expansion occurs. By contrast, in the main specification, results for GDP were primarily contractionary. Figure 22 also shows, as does Table 27 below, that the transmission mechanisms story matches the primary specification. Specifically, interest rates are dominant over trade as trade is mostly insignificant and moves in the wrong direction. However, these mechanisms are causing GDP to move in the wrong direction.

Period	GDP Direction	Trade Direction	Interest Rate Direction
Impact	-	↑	↓
Per 1	↑	↓	↑
Per 2-5	↓	↑	↑
Per 6-8	-	-	-

Table 27: Comparison of Real GDP and Transmission Mechanism Direction - Floating EU

Figure 23 for fixed exchange rate countries indicates an expansionary response of real GDP. In the primary specification, GDP results were mixed early and became expansionary in the medium term. Therefore, these results would be somewhat consistent with the primary specification but would not allow us to see the true dynamics that the country-by-country analysis provides. Both trade and interest rates are transmission

mechanisms, as both Figure 23 and Table 28 show, though interest rates are weak. Both trade and interest rates as transmission mechanisms matches the primary specification.

Period	GDP Direction	Trade Direction	Interest Rate Direction
Impact	-	↓	↓
Per 1-2	↑	↑	↑↓
Per 3	↓	↑	↓
Per 4-8	↑	↑	↑

Table 28: Comparison of Real GDP and Transmission Mechanism Direction - Fixed EU

The implication for floating exchange countries, and to a certain extent fixed exchange rate countries, is that following the EU shock, if these countries are investigated only under the lens of aggregate measures, the conclusions may not match generalizations formed by looking at each country individually. Large differences between these countries cause aggregation to mask individual country idiosyncrasies.

4.4.2 US Results

Figures 15 and 16 detail the results for typical countries in both sets of exchange rate regimes following a contractionary US monetary policy shock.

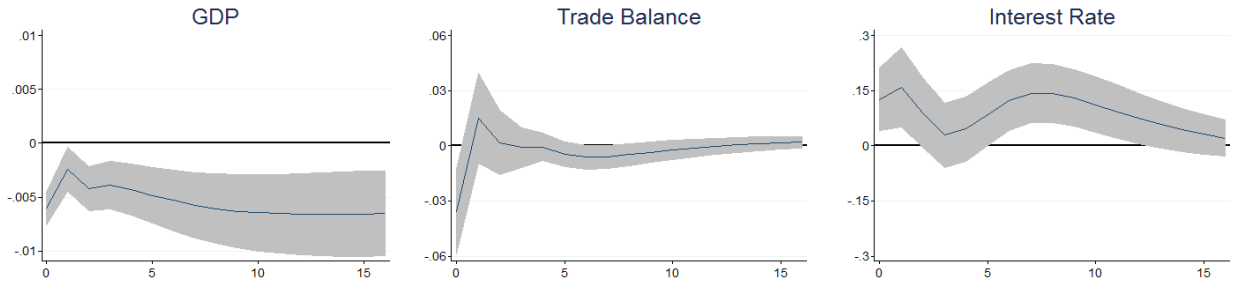

Figure 24: Floating Exchange Rate Representative Country Economic Responses to US Shock

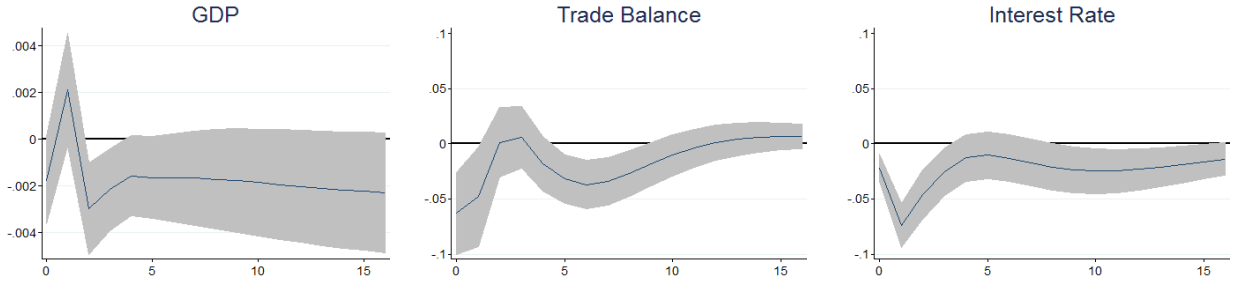

Figure 25: Fixed Exchange Rate Representative Country Economic Responses to US Shock

As Figure 24 indicates for floating exchange rate countries, one can expect immediate and long-lasting economic contractions following the US shock. The significant contractions is consistent with the individual country results, with the length of the contraction being an additional trait. Trade patterns identically

match GDP patterns indicating the importance of trade as a transmission mechanism. Interest rates appear to have a strong initial effect, and the increase in period 1 seems to limit the increase in GDP coming from strong trade increases. The subsequent patterns line up as well so it appears that interest rates work as a transmission mechanism in addition to trade. Both the trade and interest rate stories are confirmed by Table 29. Interest rates as a transmission mechanism is consistent with the primary specification, while trade's importance is new.

Period	GDP Direction	Trade Direction	Interest Rate Direction
Impact	↓	↓	↑
Per 1	↑	↑	↑
Per 3-8	↓	↓	↓↑

Table 29: Comparison of Real GDP and Transmission Mechanism Direction - Floating US

Fixed exchange rate countries also experience an economic contraction though with a delay that follows an insignificant contraction and expansion. This contraction is not consistent with the primary specification. Both Figure 25 and Table 30 indicate that trade does not appear to be a strong mechanism for these countries consistent with the primary specification. Figure 25 and Table 30 also indicate that interest rates are unsuccessful matching GDP on impact and in later periods, though they do match for a couple periods early on. Any matching would be inconsistent with the primary specification.

Period	GDP Direction	Trade Direction	Interest Rate Direction
Impact	↓	↓	↓
Per 1	↑	↑	↓
Per 2	↓	↑	↑
Per 3-4	↑	↓	↑
Per 5-8	↓	↓↑	↓

Table 30: Comparison of Real GDP and Transmission Mechanism Direction - Fixed US

Therefore, while average GDP results for floating exchange rate countries more closely align with the primary specification than averages for fixed exchange rate countries, there are still enough differences in both to warrant caution against using averaged results to generalize reactions to US monetary policy shocks. Large differences across these countries could again explain the problems arising from aggregation.

4.4.3 Representative Country Discussion

Representative country analysis would appear to lead to conclusions that are different than what one would come up with by analyzing the individual nature of each country separately and making generalizations. Large differences in individual countries are clearly masked by using the aggregation strategy. Overall, this paper would caution against the use of representative floating and/or fixed exchange rate country analysis when evaluating the international transmission of foreign monetary policy shocks.

5 Conclusion

This paper looks at how two different large open economy monetary policy shocks, specifically from the EU and US, affect a set of infrequently investigated SSA economies, studied individually, including floating exchange rate countries South Africa, Ghana, Kenya, Tanzania, Uganda, and Mauritius, and fixed exchange rate economies Gabon, Cote d'Ivoire, Botswana, Senegal, and Rwanda. I use a novel two-stage model, in terms of its application in the international transmission literature, to analyze these effects, where the first stage involves creating the monetary policy shock series for the EU and US by using changes in appropriate futures interest rates around respective central bank meetings in the spirit of Kuttner (2001). Following Barakchian and Crowe (2013), I use a factor model over six different horizons for the US shock, given the multiple maturities available for the US federal funds futures rates. The euribor futures rate, the established appropriate monetary policy rate (see Bredin et al. (2009)), does not have different maturities so the three-month rate is used and there is no need for the factor model. The shock series for each of the EU and US is then cumulated, as in Romer and Romer (2004), so it is I(1), and used as a regressor in the second stage SSA economy SVAR.

Results indicate that there are differences depending on who the originator of the shock is, i.e. the EU or US, and whether the country has a floating or fixed exchange rate regime. Following the EU shock, floating exchange rate countries mostly experience contractions. Interest rates are the only transmission mechanism, and it appears that countries who have more reliance on international capital flows are the ones either increasing their interest rates in response to the foreign shock, thus keeping capital from flowing out but sacrificing real economic growth, or failing to raise rates and experiencing contractions nonetheless. Countries with lower reliance on international capital flows use countercyclical interest rate policy in an attempt to offset the shock, though unsuccessfully as some third factor is driving their results. Fixed exchange rate countries following the EU shock experience more mixed real economy results in earlier periods, becoming more expansionary in the medium and long term. Both interest rates and trade act as transmission mechanisms for these countries. The economies that experience expansions see increased trade from a lowering of prices and/or are able to use capital controls to maintain the peg and lower interest rates. Those economies experiencing contractions see increases in prices from the lowering of interest rates, resulting in decreased trade that dominates other effects.

Following the US shock, the floating exchange rate countries are again sensitive to the foreign shock, in general experiencing contractions with interest rates working as the dominant transmission mechanism. The capital story remains the same, however there is more consistency in terms of interest rate increases from those who rely on international capital. A second story also arises as the increase in US interest rates will lead to an appreciation of the US currency making debt burdens more expensive unless domestic interest rates are increased. As most of these countries have the bulk of their debt denominated in US dollars, they are more sensitive to this issue than they were in the case of the EU shock. Fixed exchange rate economies are less affected by US monetary policy shocks, experiencing GDP expansions. As neither interest rates nor trade is a transmission mechanism, some other factor, such as aid, plays a dominant role in preventing economic contractions, indicating that the attempt to move away from aid towards trade has not been successful for the US.

Given that this analysis shows stronger negative effects for floating exchange rate countries from both foreign contractionary monetary policy shocks, and the fact that as many of these SSA countries develop they

will most likely consider adopting less capital controls while moving towards a floating exchange rate, the implication is that one should think about ways to cushion the blow. Examples may include a slower removal of capital controls, building up international reserves, diversifying external debt, and a more managed float in the interim as the domestic economy becomes more developed and is able to better absorb negative shocks.

A Primary Specification Figures

A.1 Macroeconomic Responses to EU Monetary Policy Shock - Floating and Fixed Exchange Rate Countries.

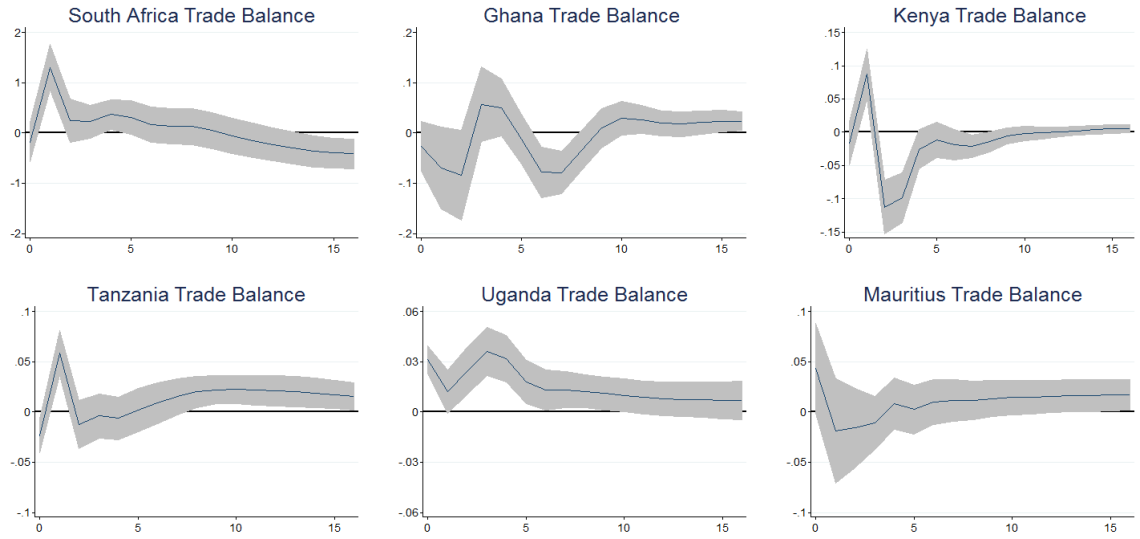

Figure 26: SSA Country Trade Balance Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

Figure 27: SSA Country Trade Balance Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

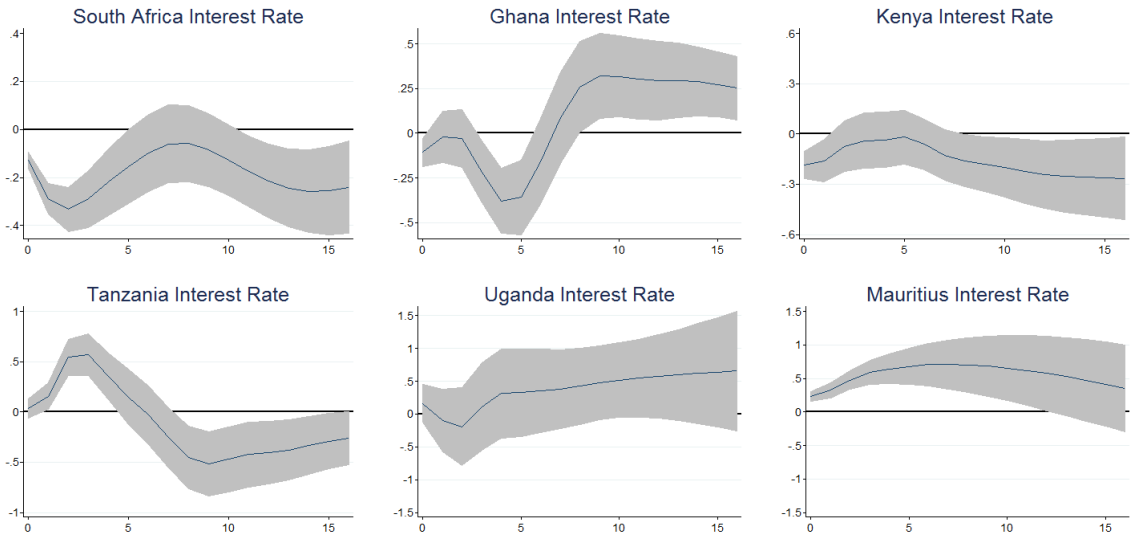

Figure 28: SSA Country Interest Rate Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

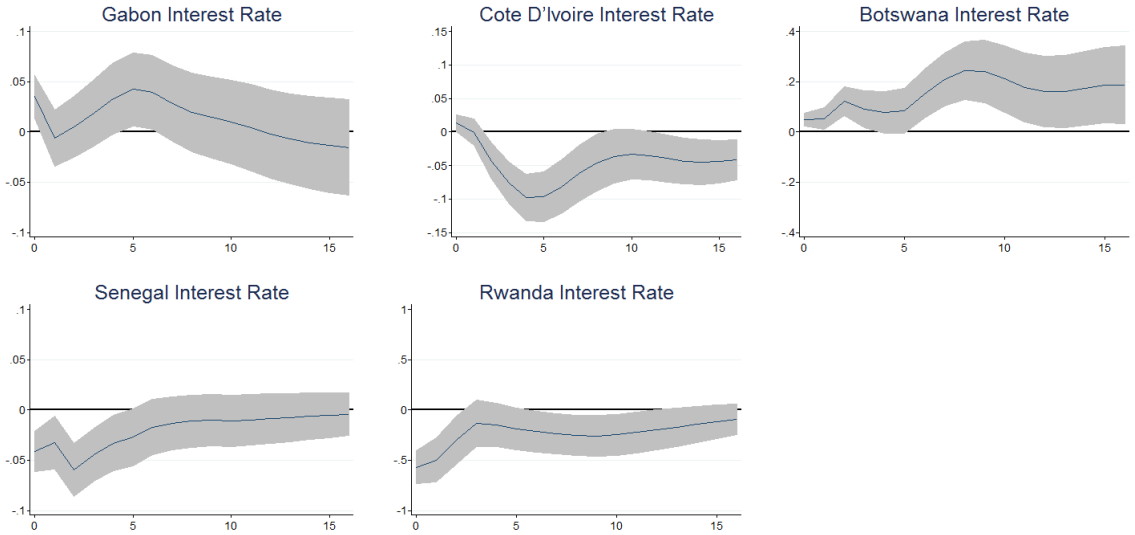

Figure 29: SSA Country Interest Rate Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

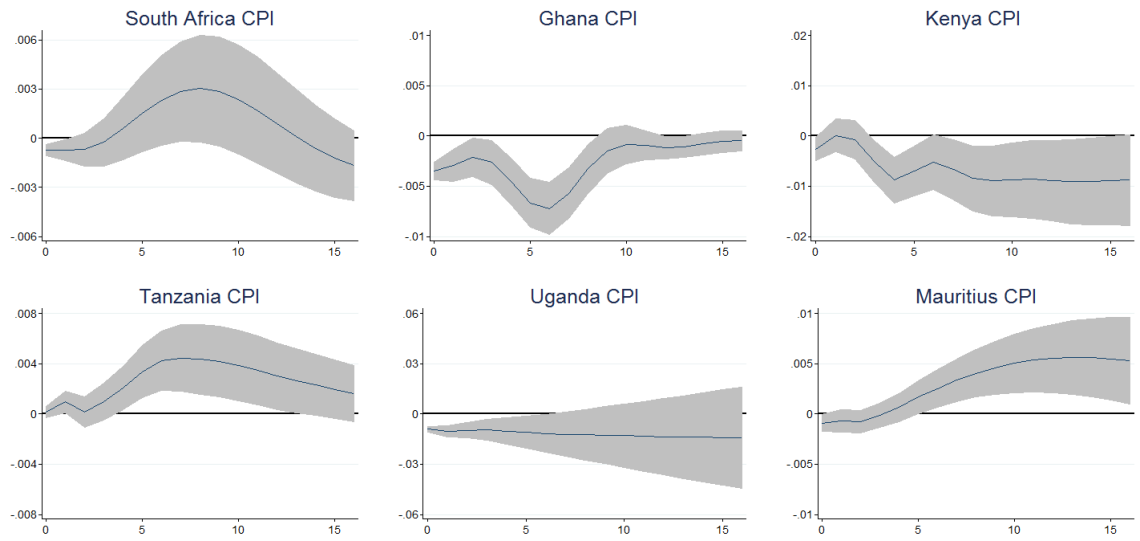

Figure 30: SSA Country CPI Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

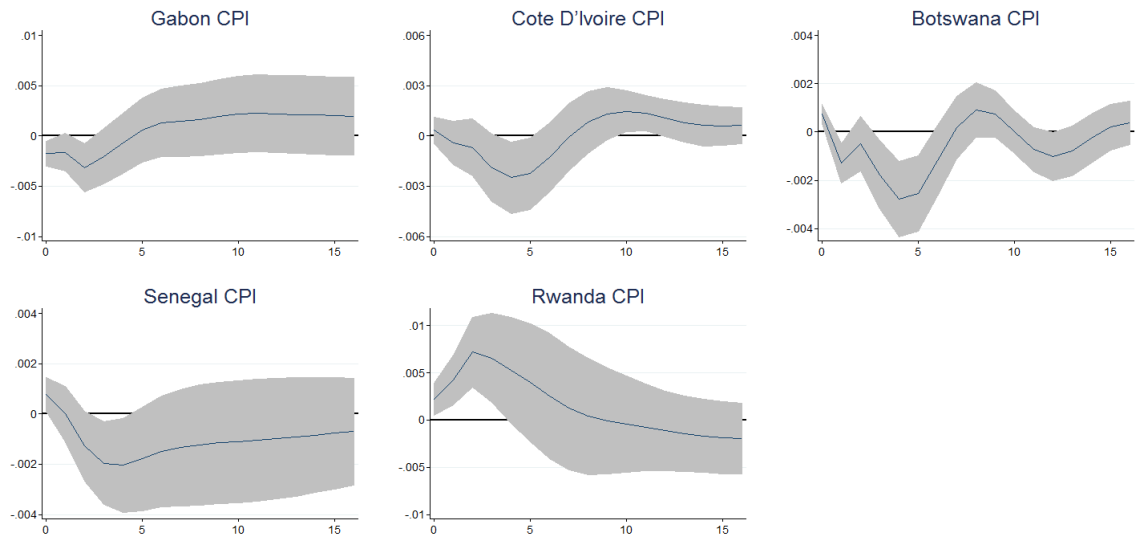

Figure 31: SSA Country CPI Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

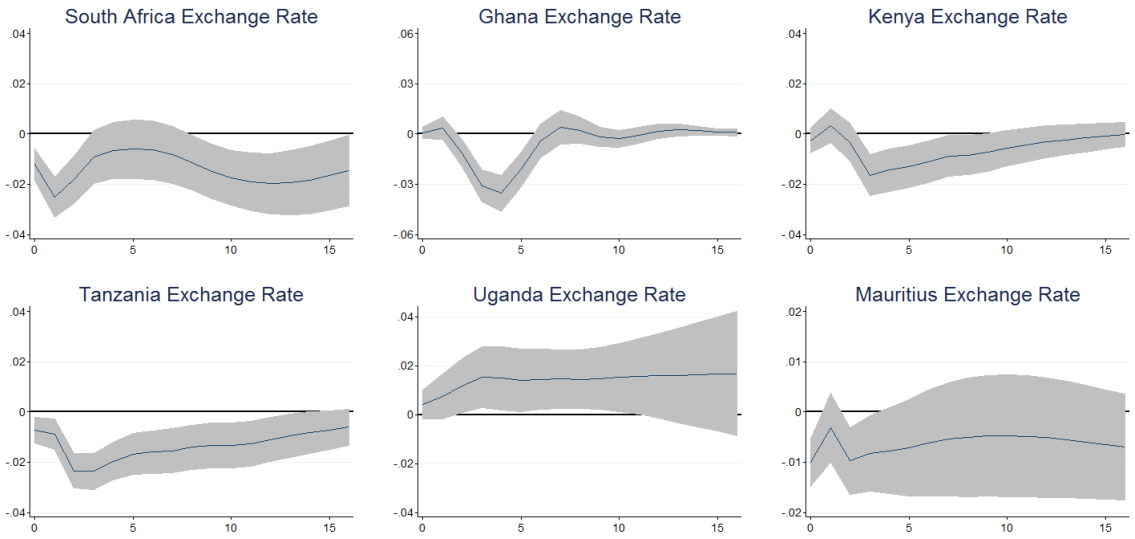

Figure 32: SSA Country Exchange Rate Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

Figure 33: SSA Country Exchange Rate Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

A.2 Macroeconomic Responses to US Monetary Policy Shock - Floating and Fixed Exchange Rate Countries.

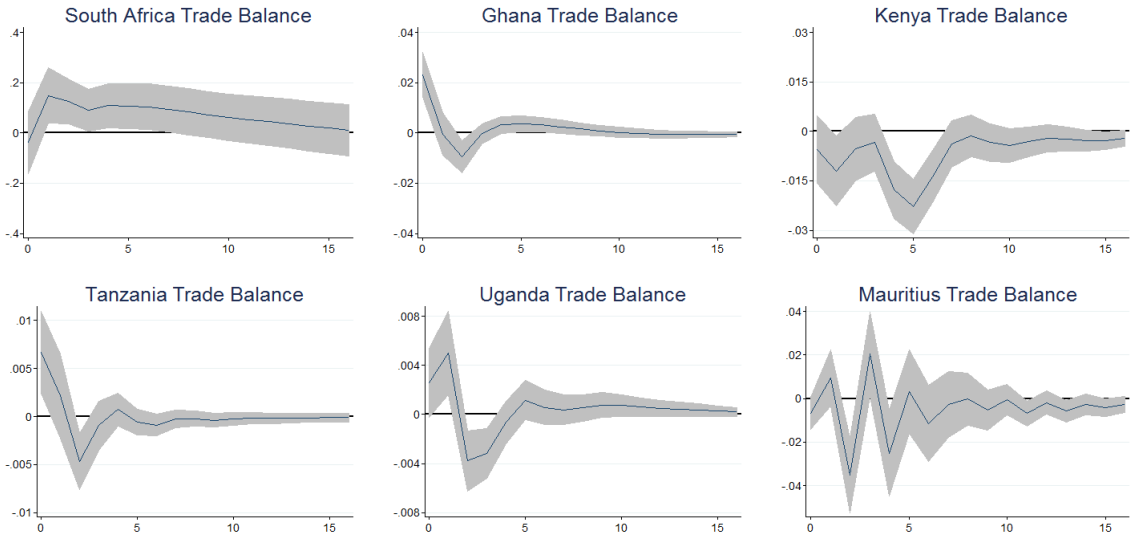

Figure 34: SSA Country Trade Balance Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

Figure 35: SSA Country Trade Balance Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

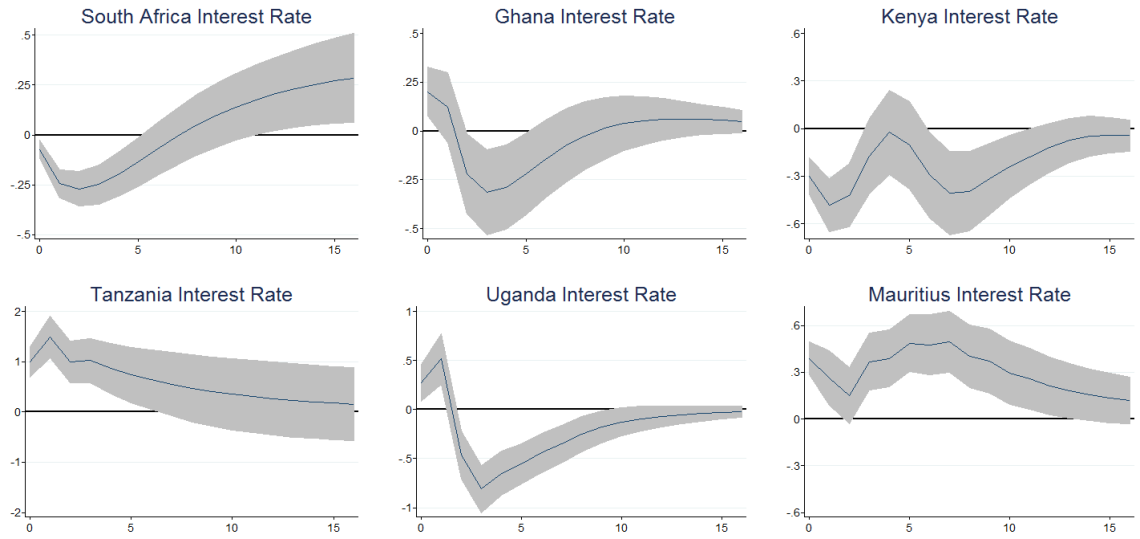

Figure 36: SSA Country Interest Rate Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

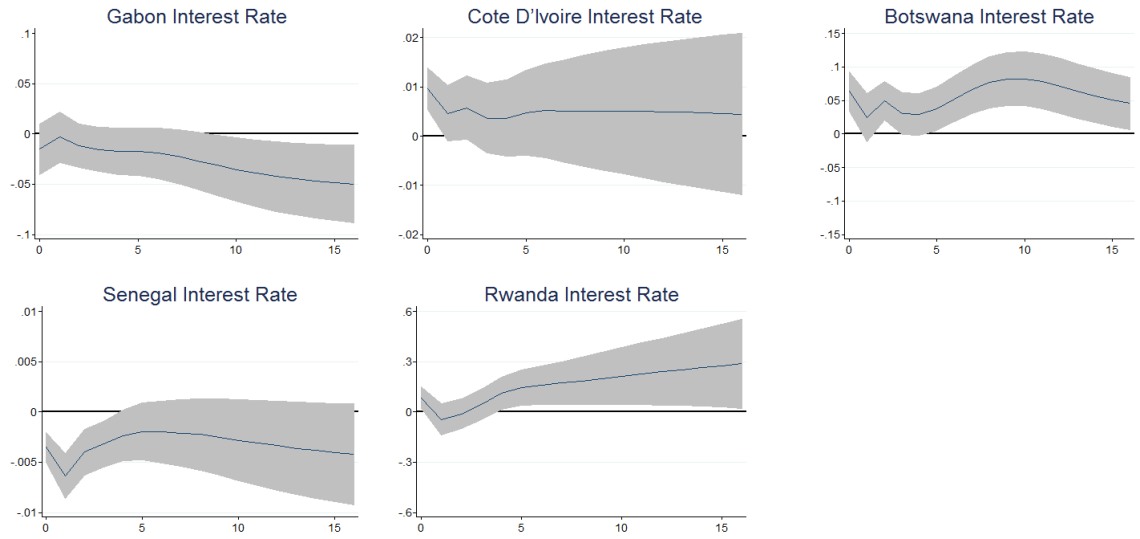

Figure 37: SSA Country Interest Rate Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

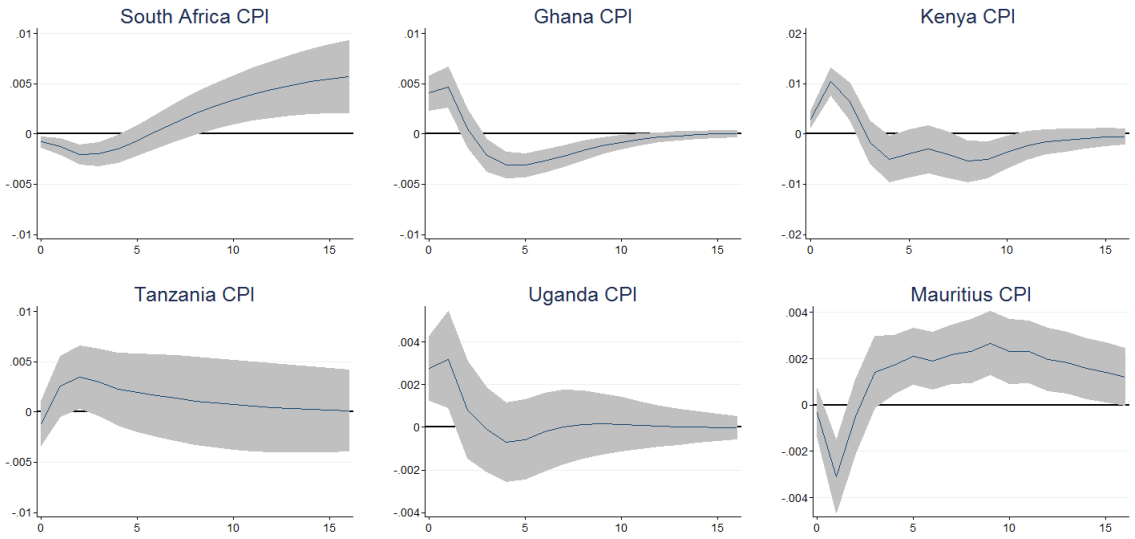

Figure 38: SSA Country CPI Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

Figure 39: SSA Country CPI Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

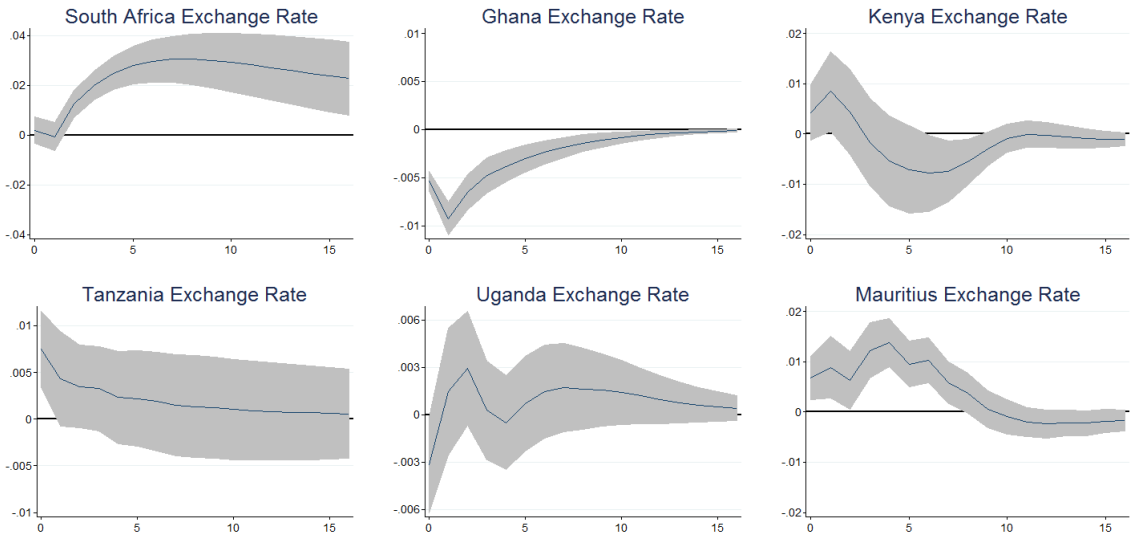

Figure 40: SSA Country Exchange Rate Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

Figure 41: SSA Country Exchange Rate Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

B Robustness Check Figures

B.1 Overall Trade Balance Robustness Check Figures

B.1.1 Macroeconomic Responses to EU Monetary Policy Shocks - Floating and Fixed Exchange Rate Countries

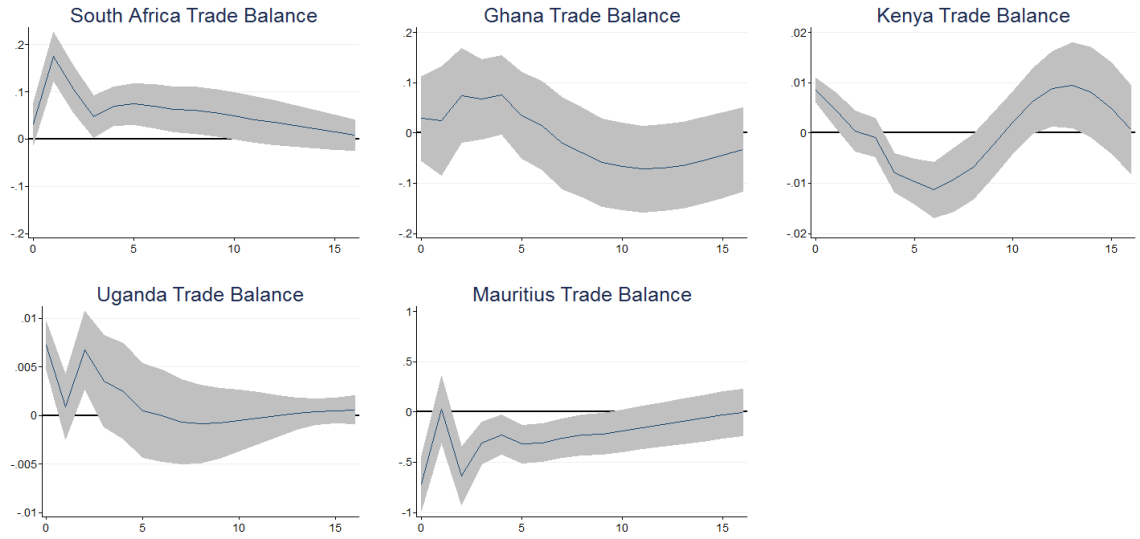

Figure 42: SSA Country Trade Balance Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

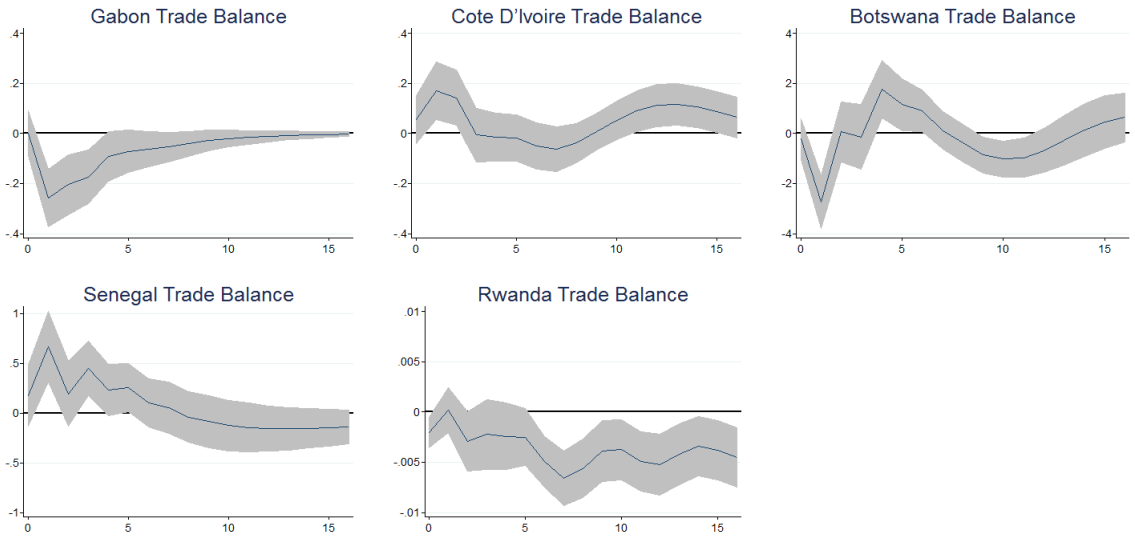

Figure 43: SSA Country Trade Balance Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

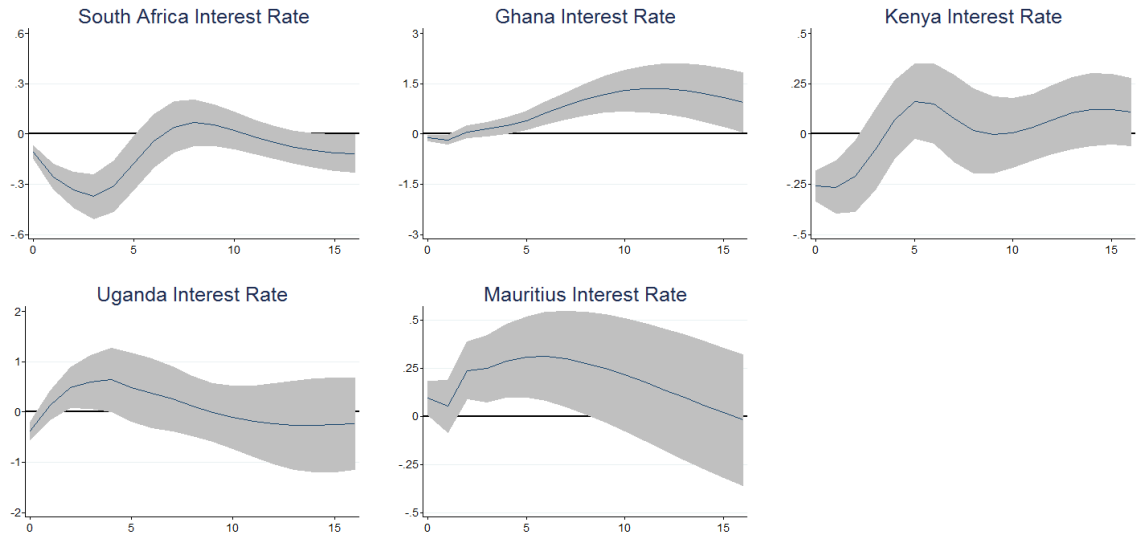

Figure 44: SSA Country Interest Rate Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

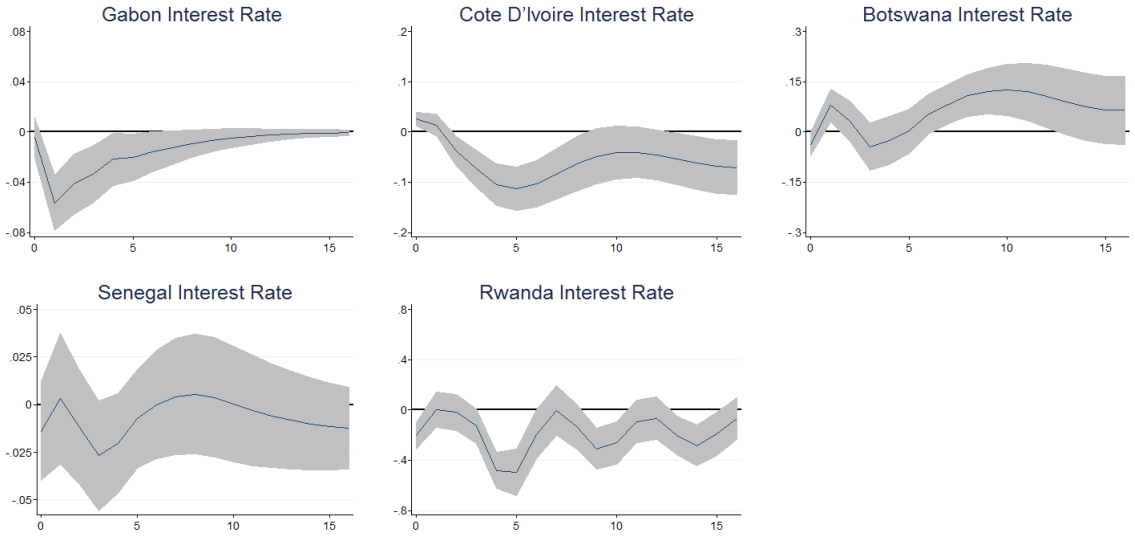

Figure 45: SSA Country Interest Rate Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

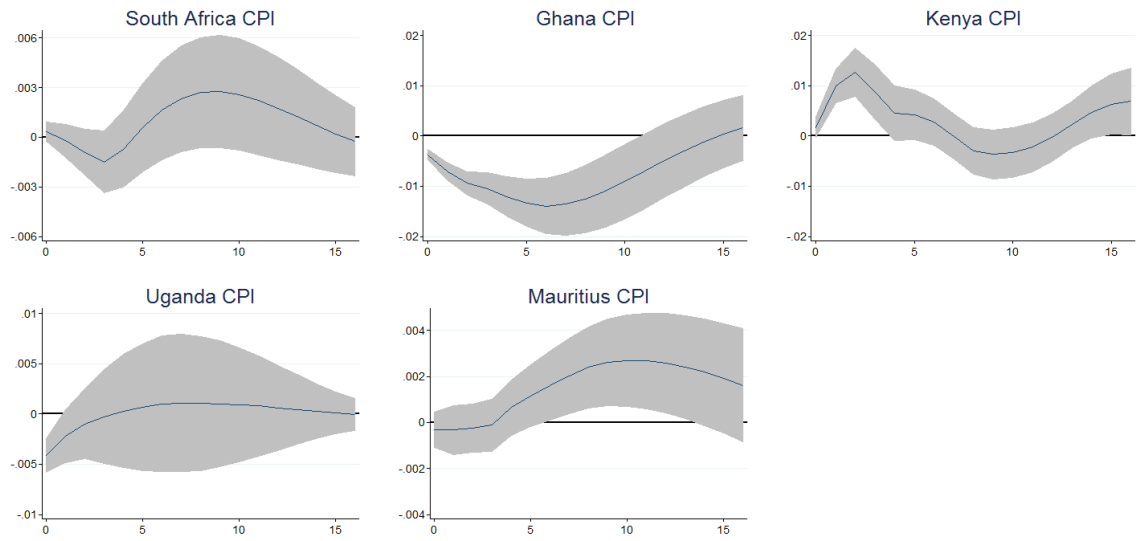

Figure 46: SSA Country CPI Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

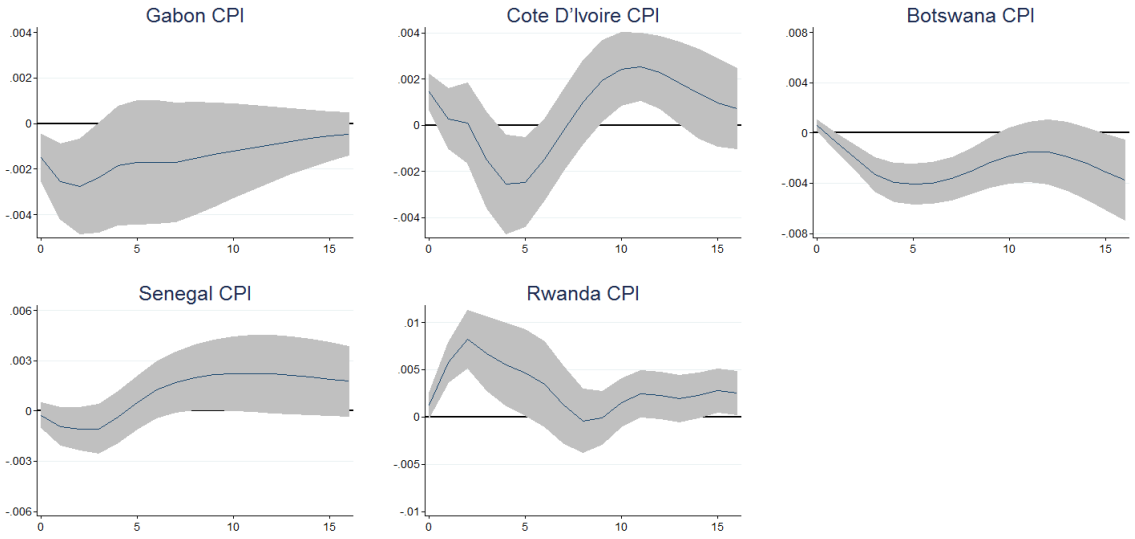

Figure 47: SSA Country CPI Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

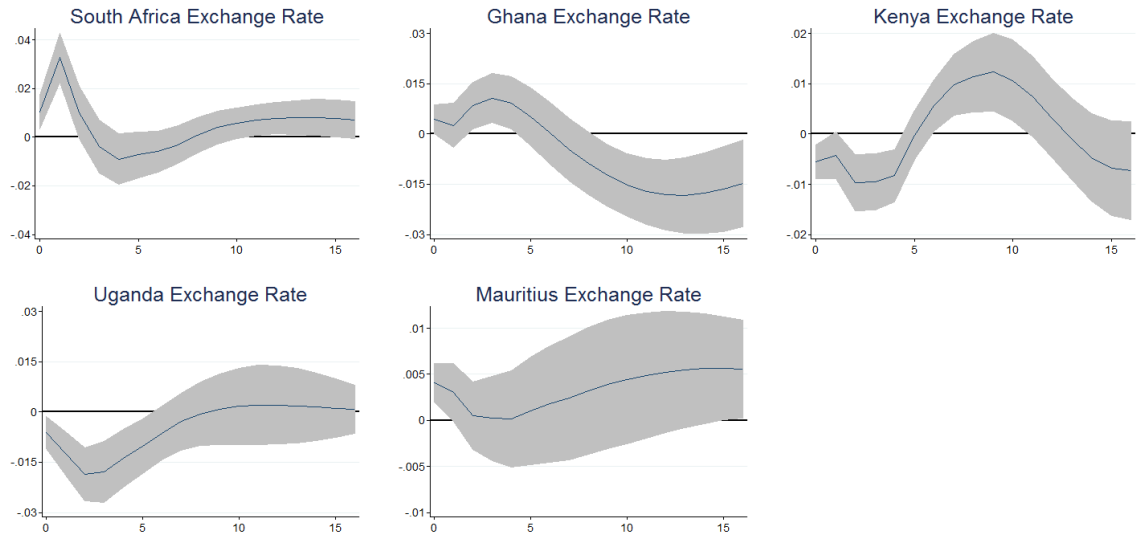

Figure 48: SSA Country Exchange Rate Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

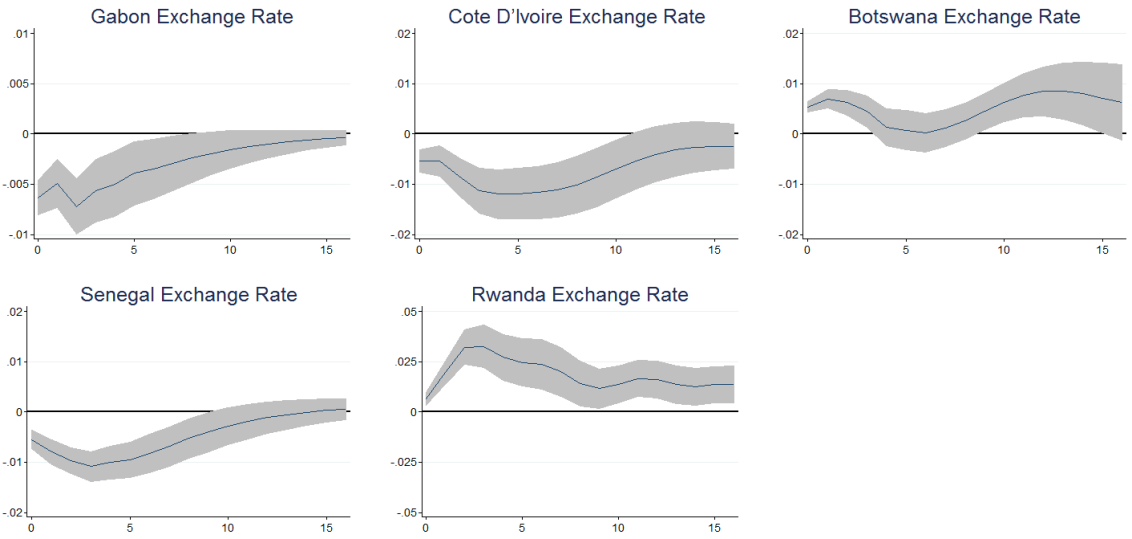

Figure 49: SSA Country Exchange Rate Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

B.1.2 Macroeconomic Responses to US Monetary Policy Shocks - Floating and Fixed Exchange Rate Countries

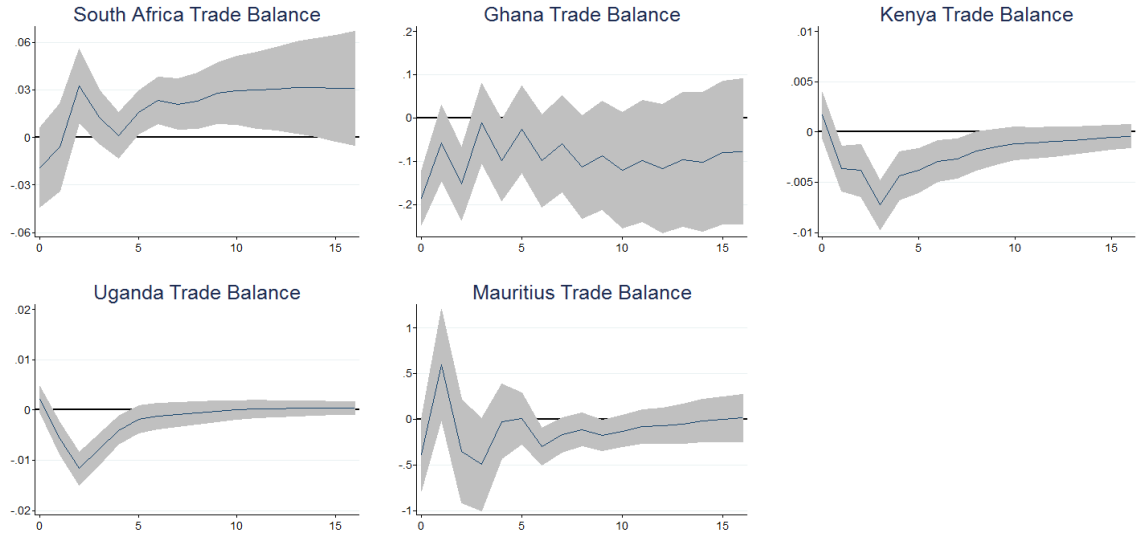

Figure 50: SSA Country Trade Balance Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

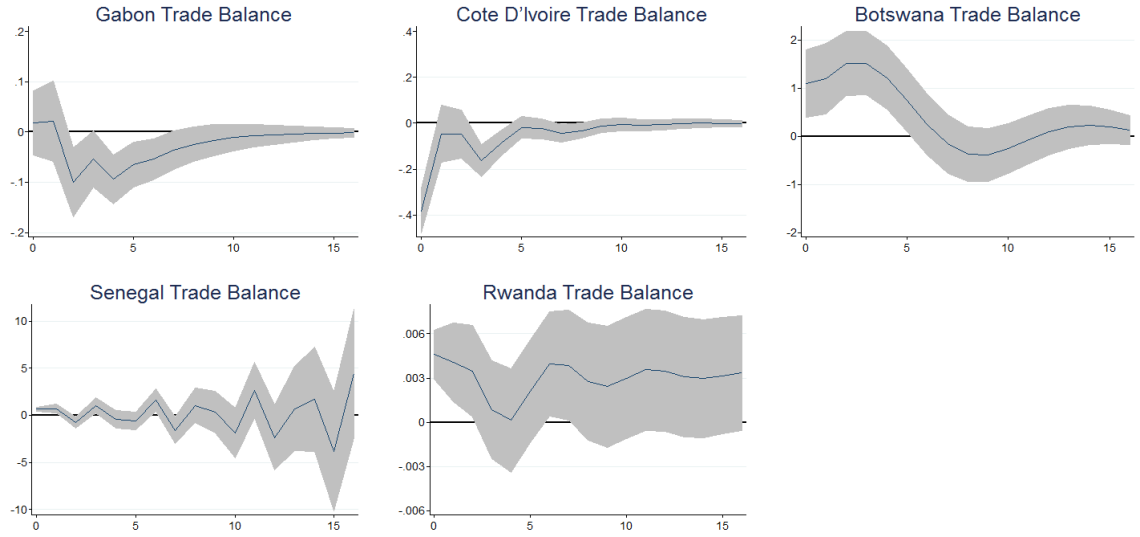

Figure 51: SSA Country Trade Balance Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

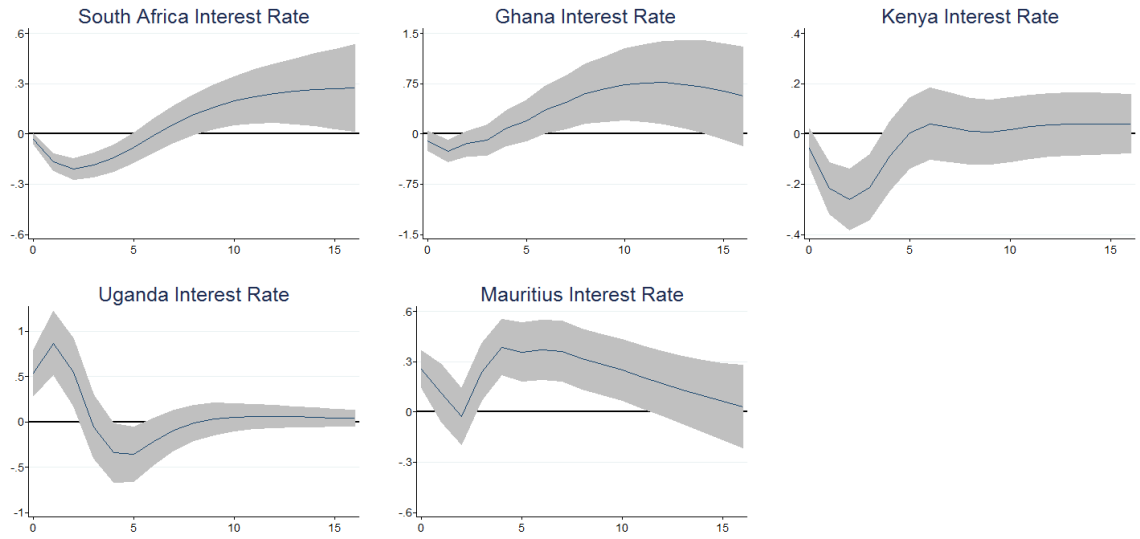

Figure 52: SSA Country Interest Rate Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

Figure 53: SSA Country Interest Rate Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

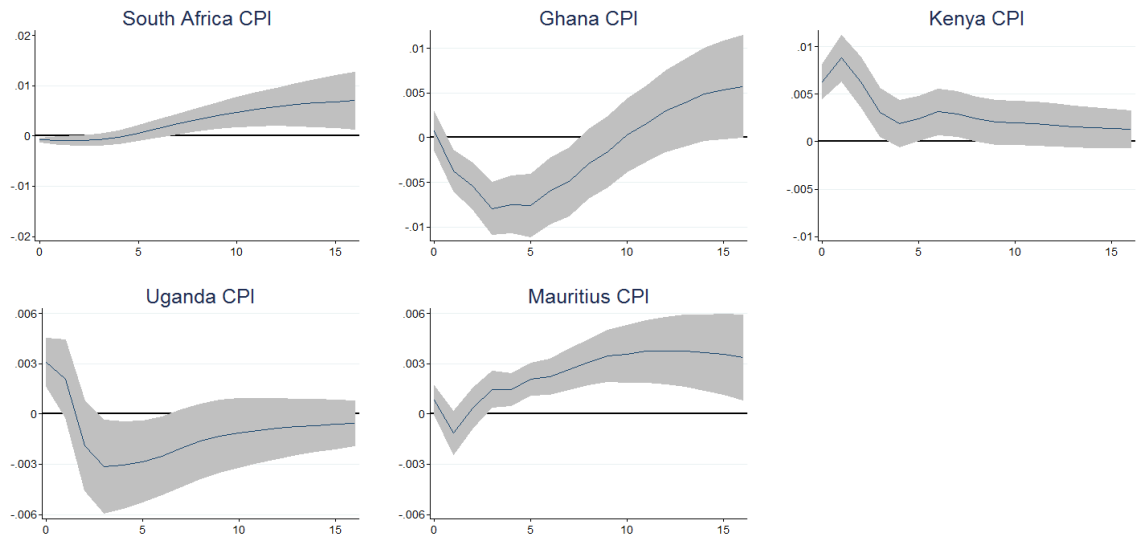

Figure 54: SSA Country CPI Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

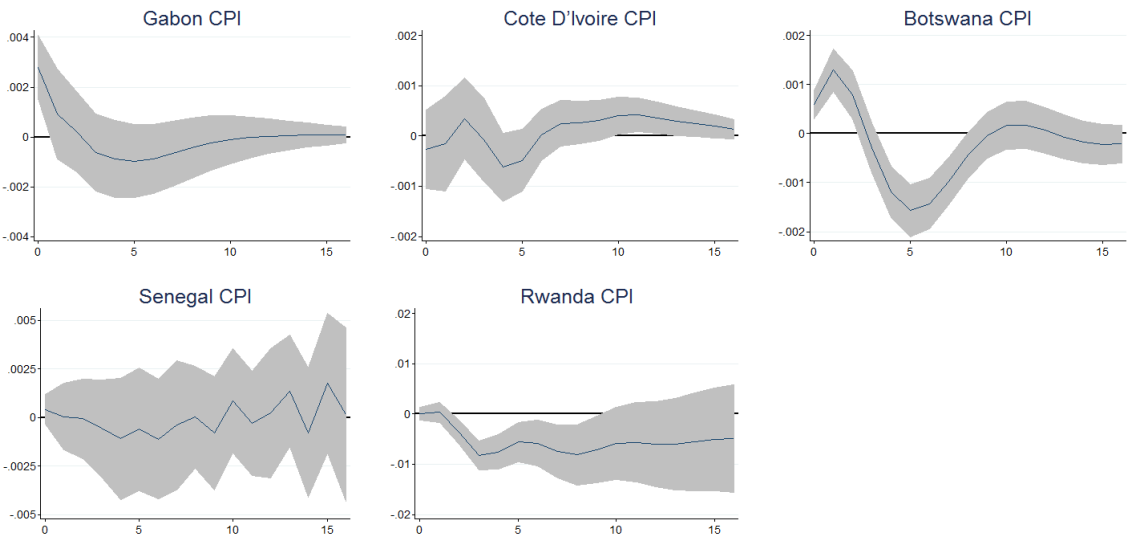

Figure 55: SSA Country CPI Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

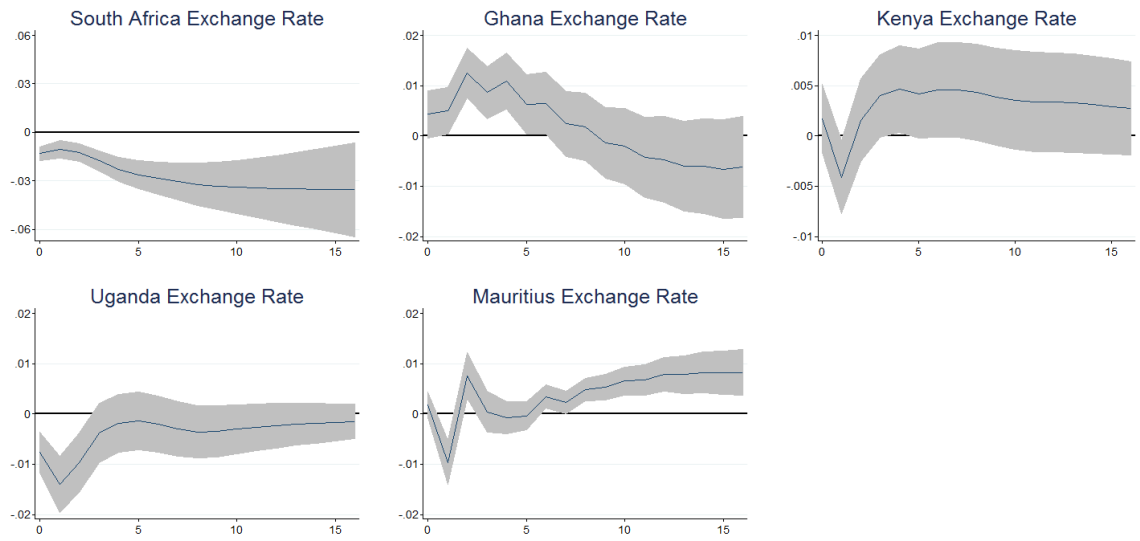

Figure 56: SSA Country Exchange Rate Response to US Monetary Policy Shock (Floating Exchange Rate Regime)

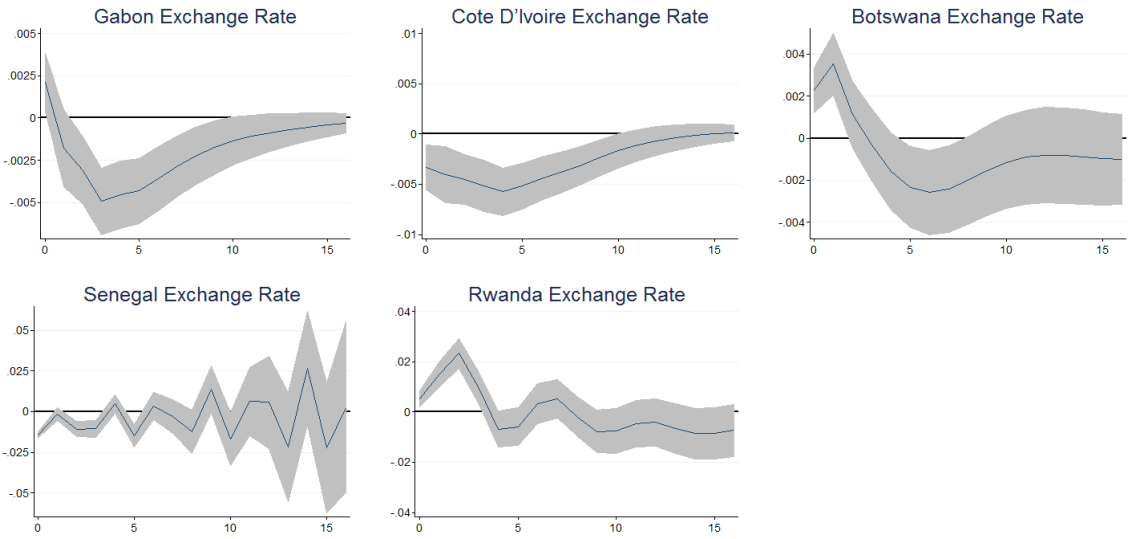

Figure 57: SSA Country Exchange Rate Response to US Monetary Policy Shock (Fixed Exchange Rate Regime)

B.2 Block-Block Robustness Check Figures

B.2.1 Macroeconomic Responses to EU Monetary Policy Shocks - Floating and Fixed Exchange Rate Countries

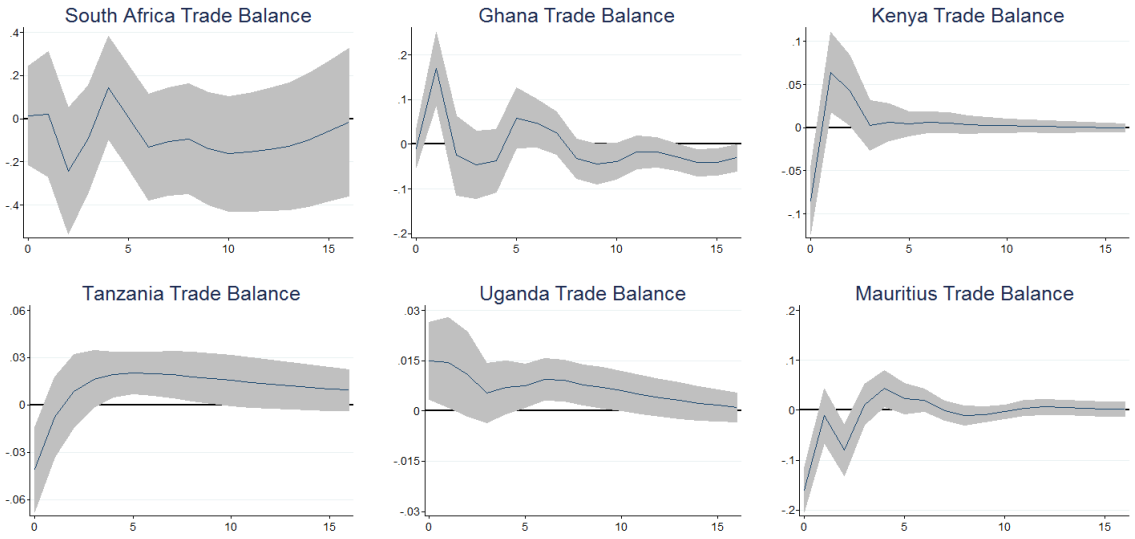

Figure 58: SSA Country Trade Balance Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

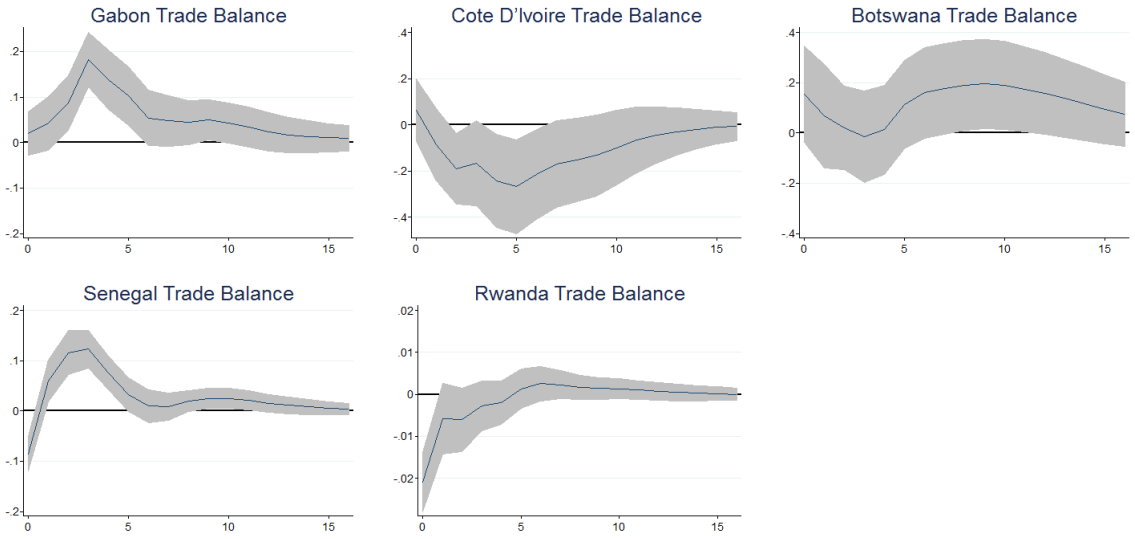

Figure 59: SSA Country Trade Balance Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

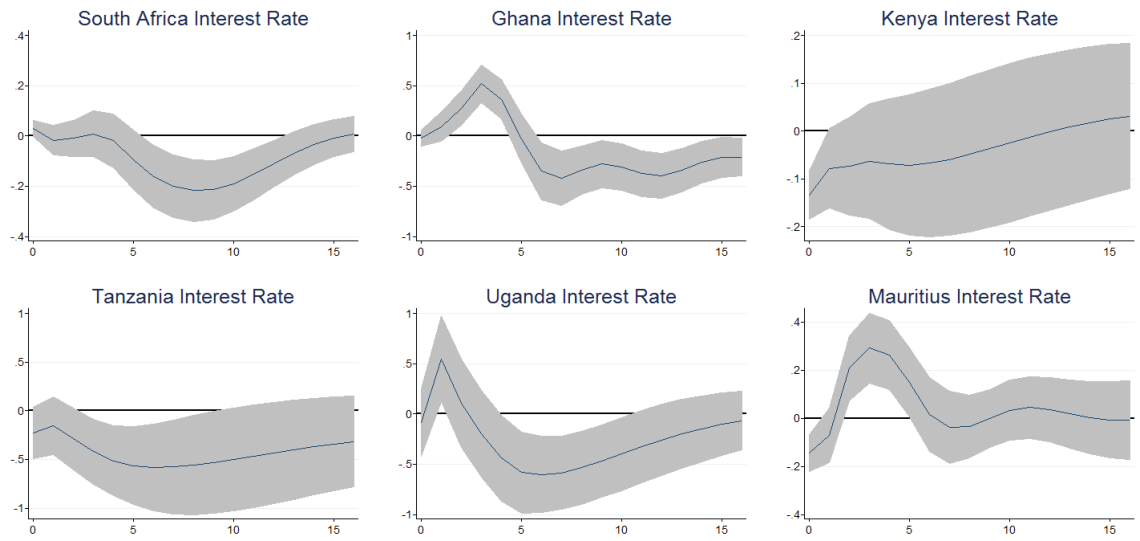

Figure 60: SSA Country Interest Rate Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

Figure 61: SSA Country Interest Rate Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

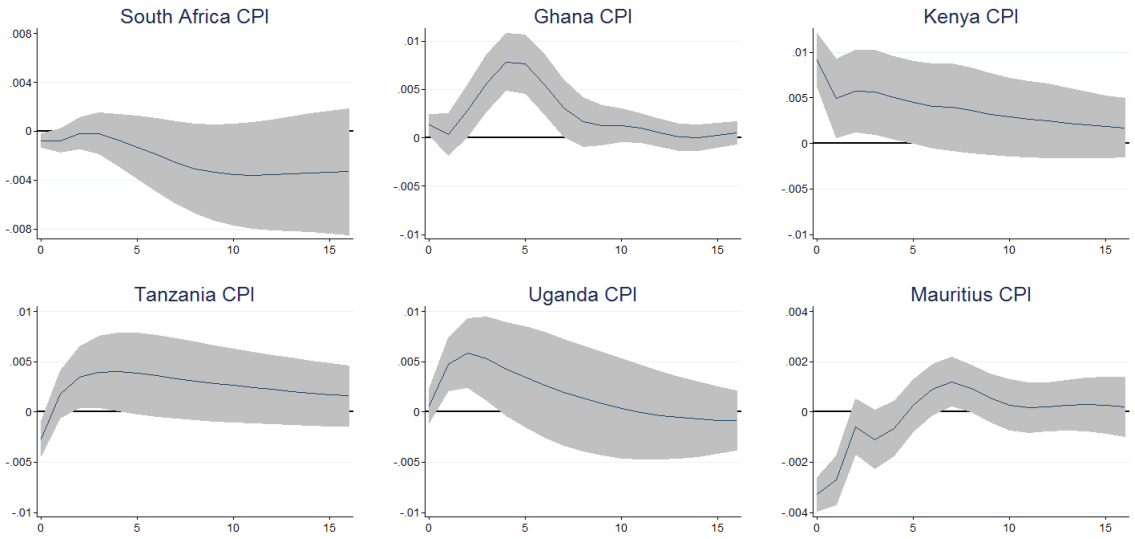

Figure 62: SSA Country CPI Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

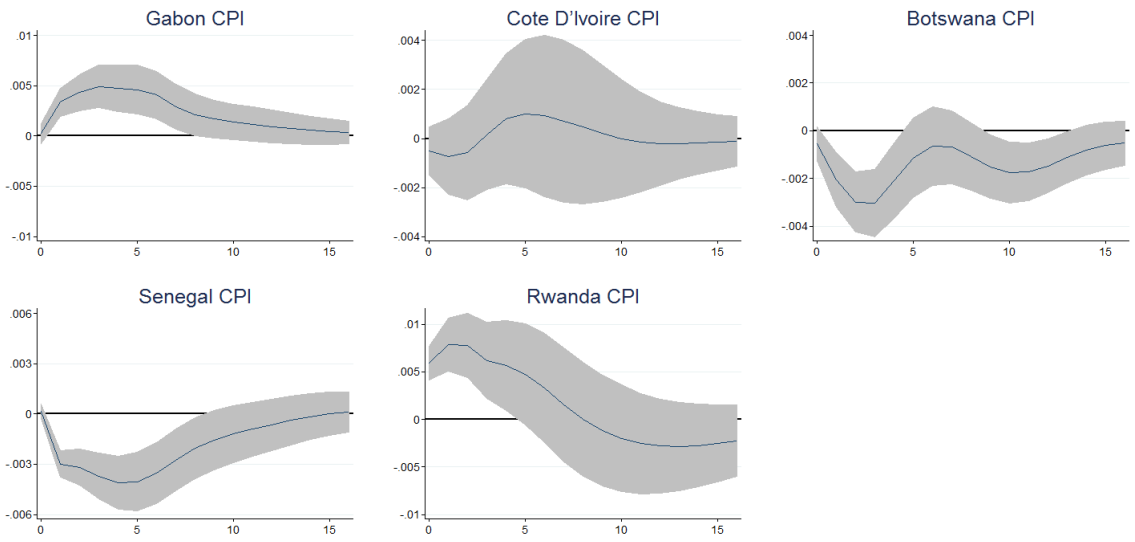

Figure 63: SSA Country CPI Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

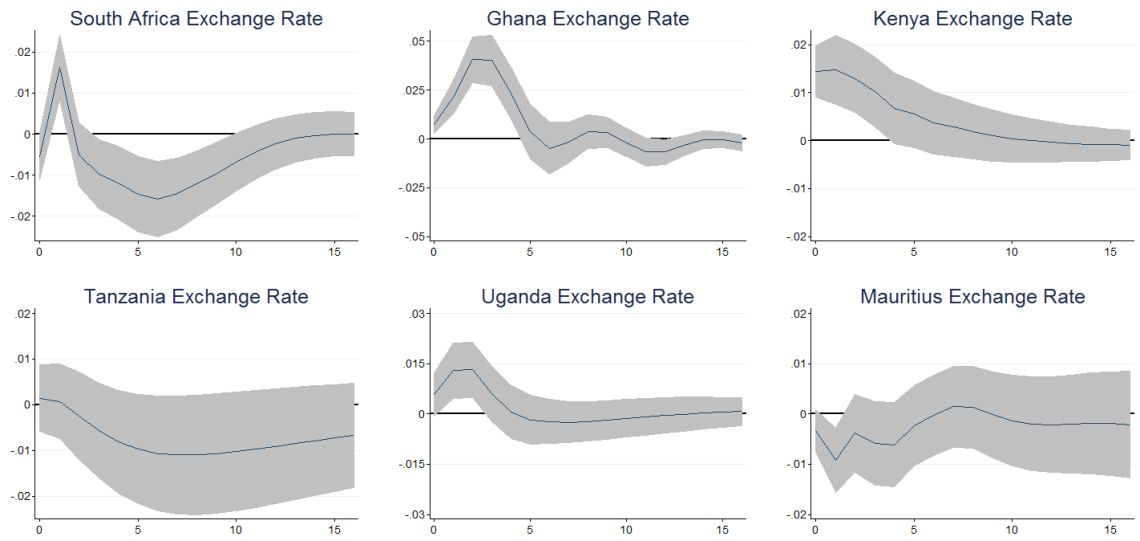

Figure 64: SSA Country Exchange Rate Response to EU Monetary Policy Shock (Floating Exchange Rate Regime)

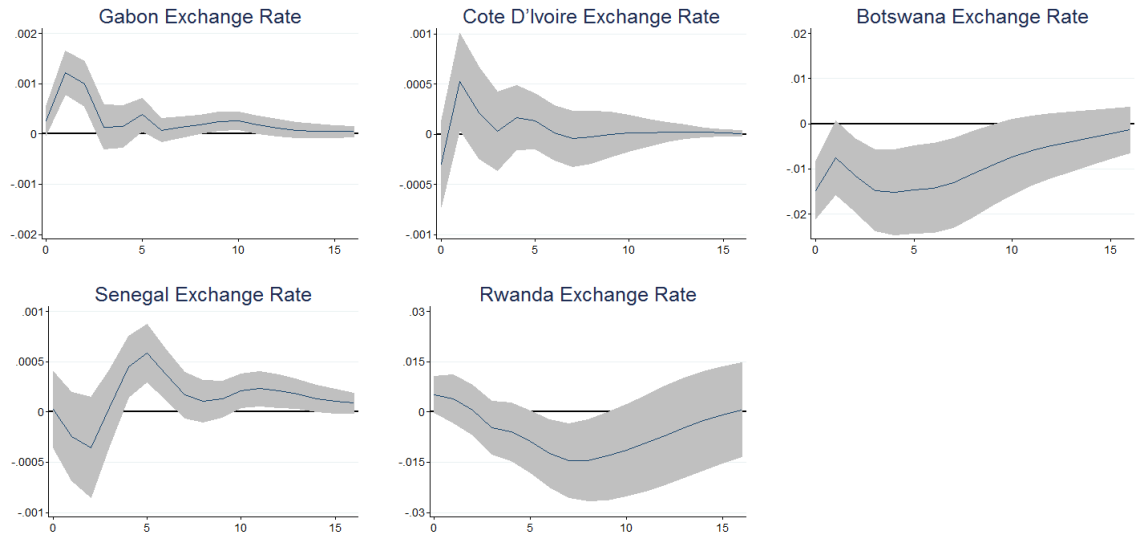

Figure 65: SSA Country Exchange Rate Response to EU Monetary Policy Shock (Fixed Exchange Rate Regime)

C Aid Figures

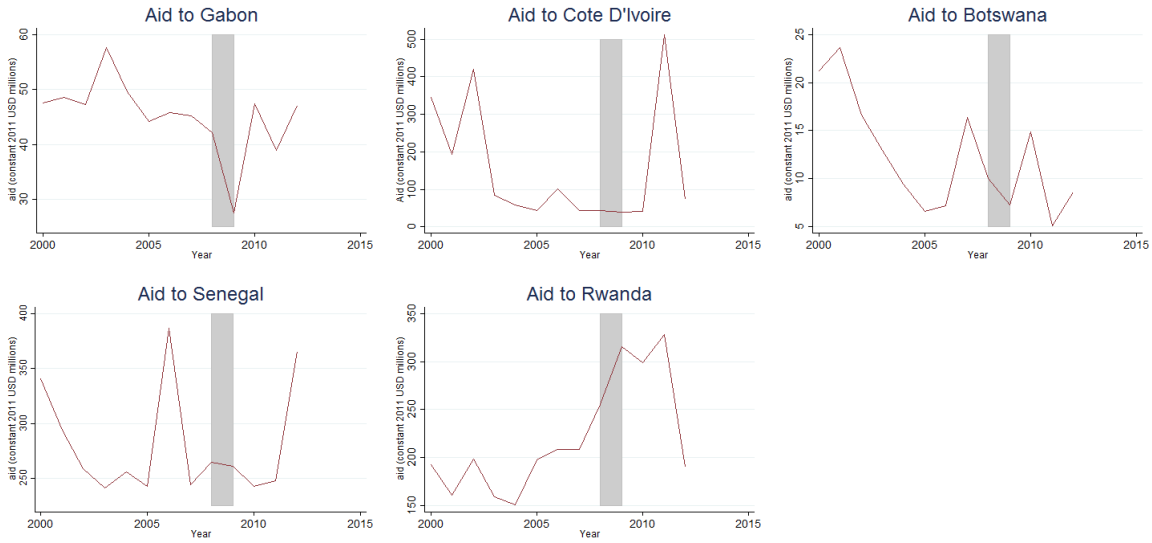

Figure 66: EU Aid to SSA - Fixed Exchange Rate Countries

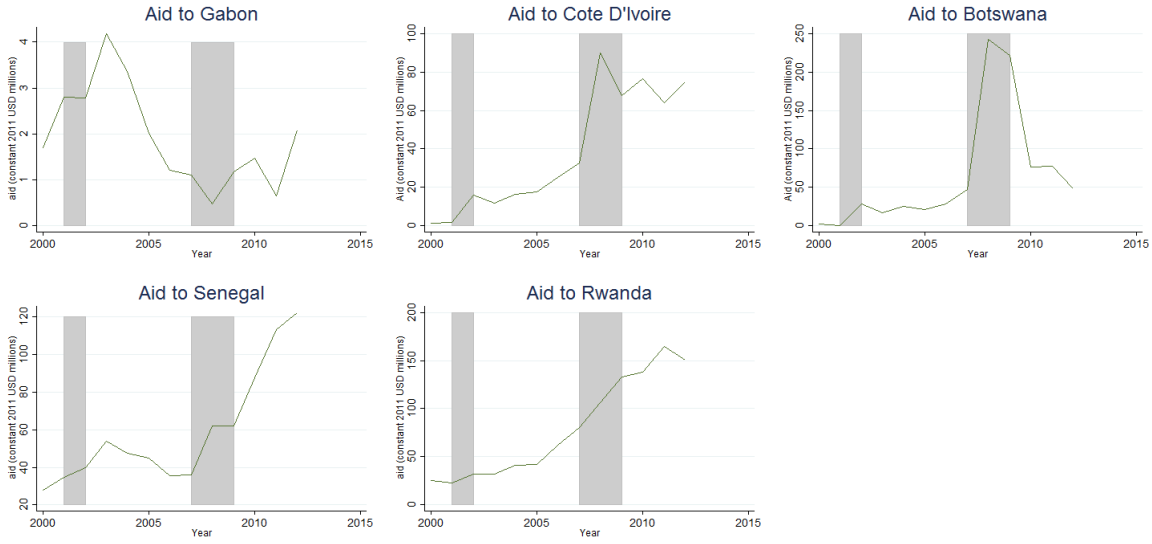

Figure 67: US Aid to SSA - Fixed Exchange Rate Countries

D Data

Most of the data, especially for the SSA countries comes from the IMF's International Financial Statistics ("IFS") database.

Creating a measure of real aggregate output in SSA countries is a difficult task given the lack of data availability and the reliability of the data that does exist. However, there are some SSA countries in which

quarterly data for real GDP is available, including South Africa, Mauritius, and Botswana. Furthermore, annual GDP data exists for Gabon, Cote d'Ivoire, and Senegal. I then use quarterly industrial production index ("IPI") data for these countries in order to interpolate the annual GDP data creating a proxy quarterly GDP dataset.[54] In addition, a paper by Opoku-Afari and Dixit (2012) creates quarterly GDP data for Kenya, Tanzania, Uganda, and Rwanda using high-frequency data to construct a comprehensive index of economic activity. Lastly, I use a real composite index of economic activity created by Ghana's central bank. This index is not interpolated due to the lack of annual GDP data during the middle years of the sample.

My primary specification first looks at the strength of the bilateral trade balance as a transmission mechanism for the foreign monetary policy shock. Bilateral trade balance data (exports and imports) is obtained from IFS. The data is taken from the perspective of the EU and US, and is all in USD.[55] Given the influence of large open economies such as the EU or US on the trade decisions of other countries, I also check to see whether world trade data changes any of the primary specification conclusions. Global exports, imports, and trade balance data also comes from IFS.

The domestic interest rate differs by country. All interest rates were gathered from IFS. They tend to be broken down in two categories: the central bank discount rate, and a money market rate. In industrial countries the rate generally used in the transmission of monetary policy shocks literature is some form of short-term rate (usually a money market rate) set directly or indirectly by the central bank, used by banks in interbank trading (e.g. FFR). In some countries (e.g. Canada) a target band is set with the interbank trading rate in the middle and the upper and lower parts equidistant from the middle. The upper band is the amount the central bank charges directly to the banks (the central bank discount rate). Depending on availability for the SSA countries I use either the money market rate or the central bank rate.[56] I do not use real interest rates in SSA countries because I am evaluating how a nominal interest rate shock from a foreign country affects an interest rate in the SSA countries and I want to compare similar items.[57]

Two different exchange rates are used. In the primary specification where the bilateral trade balance is analyzed, the nominal bilateral exchange rate (domestic currency per US dollar or Euro) is used. In the extension using global trade data, the real effective exchange rate ("REER") is used. Since trade is in real terms, exchange rate should usually be as well. However, since it is the nominal bilateral exchange rate that countries with pegs are looking at, and are adjusting to when they make nominal interest rate changes, this paper uses it when evaluating bilateral trade data. In the case of global trade, an effective exchange rate is necessary, and here it makes sense to use the real effective exchange rate as it works like a price on goods. Bilateral exchange rate date comes from IFS. The data comes in currency per USD so I also obtain the USD/Euro relationship from IFS and make the conversion for analyzing the EU shocks. The data for the

[54] I use the Denton least squares method for interpolation. Using IPI to interpolate GDP data has been performed in other papers including Owyang et al. (2013). The close relationship between IPI and GDP, as noted by Nilsson (1987) and others, has indicated an appropriateness to interpolating in this fashion.

[55] Trade balance data for the EU is for all European Union countries. Ideally only Euro Area countries would have been used, as is the case for all other variables, but this data was not available in aggregate and, given the changing nature of the Euro Area over time, constructing the data could have potentially lead to measurement error. Further, as the European Union acts as one trading block with a common external tariff, perhaps trade data on all European Union countries is more appropriate.

[56] I used money market rates where possible. If not I used central bank discount rates. Exception: Kenya where a lending rate is used as there is not enough data for central bank rates. During the time data is available for the central bank rate the correlation is high at approximately 0.65.

[57] Some economists, such as Saxegaard (2006) have argued that M0 (or some monetary aggregate) should be used as the instrument for monetary policy in SSA countries. Saxegaard (2006) argues that many SSA countries do not have an interbank market (or it is severely underdeveloped) and there is thus no interbank rate. Many of these countries look to target some form of monetary aggregate like M0. Research on the countries involved in this study seem to indicate a targeting of interest rates at a sufficient level to warrant their use over a monetary aggregate. Furthermore, as I am not creating a monetary policy variable with SSA interest rates, and am simply looking at the effect on interest rates, it becomes more appropriate to use these rates.

REER comes from a working paper, Darvas (2012a,b). The REER is CPI-based and relies on a wide range of trading partners.[58]

To account for foreign inflationary shocks, I include the world commodity price index from IFS which includes all primary commodities including fuel. In the SSA model I use a commodity price index without oil and an oil-specific index to separate out the effects. Including a foreign inflationary variable has been shown by Kim and Roubini (2000), among others, to prevent some puzzles from appearing in the results.

GDP, trade balance, exports, and imports are all in real terms.[59] All are deflated by the GDP deflator, where possible. If GDP deflator is not available then variables are deflated by CPI. All variables are in logarithms except for interest rates (in percent per annum terms) and trade balance. For global trade balance data I put it in terms of percent of GDP averaged over the sample.[60,61]

The foreign variables (i.e. EU and US variables) include real GDP, CPI, and appropriate interest rates. For the US, the real GDP is calculated using nominal GDP and the GDP deflator, both obtained from the St. Louis FED. US CPI is also obtained from the St. Louis FED. The interest rates for the US are the federal funds rate obtained from IFS and the federal funds futures rates at one to six-month horizons from Bloomberg. For the EU, the real GDP is also calculated using the nominal GDP and deflator, both of which come from IFS. EU CPI also comes from IFS. Lastly, the interest rates used for the EU is the three-month interbank rate, euribor, from IFS and the three-month euribor futures rate from Bloomberg. The US GDP, deflator, and CPI are all seasonally adjusted. The EU GDP is but the deflator and CPI do not appear to be. I compensate for non-seasonally adjusted variables here and in all other places by adding quarterly dummies.

Aid data comes from the OECD. This data is part of their Country Programmable Aid ("CPA") measures and represents aid that can be programmed by the donor at the level of the partner country. It uses exclusions to try and target aid that is actually intended for the people of the recipient country. The data is both bilateral from the donor, EU or US, to the recipient SSA country, or in total aid to the recipient SSA country.

Data is left in the currency it is found in as to not create potential measurement error in converting from one currency to another.[62]

There were not many gaps in the data but where there were, missing data was replaced with the time period before's data point.[63]

[58] The data in Darvas (2012a,b) is averaged over each month. In the case of REER I use the last month of the quarter to get the quarterly figure. This differs a bit from my use of end of period data for other stock variables, but should not change the results significantly.

[59] REER is already in real terms.

[60] I did not do this for bilateral trade since it is not in the same currency as GDP.

[61] For Ghana, Gabon, and Cote d'Ivoire the data for global trade is in US dollars so, as is the case for bilateral trade estimation, the data is not put in terms of percent of GDP averaged over the sample.

[62] Except for converting bilateral exchange rate from domestic currency per USD to domestic currency per Euro using the USD/Euro relationship.

[63] Exception: If countries were missing two data points in a row I replaced the first missing point with the period before and the second with the period after.

E Data Periods

Country	Period Under Analysis for EU Shock	Period Under Analysis for US Shock
South Africa	1999q1 - 2011q4	1992q1 - 2008q2
Ghana	2000q3 - 2010q3	2000q3 - 2008q2
Kenya	1999q1 - 2010q4	1992q1 - 2008q2
Tanzania	1999q1 - 2010q4	1992q1 - 2008q2
Uganda	1999q1 - 2010q4	1992q1 - 2008q2
Mauritius	2000q1 - 2011q4	2000q1 - 2008q2
Gabon	1999q1 - 2009q4	1992q1 - 2008q2
Cote d'Ivoire	1999q1 - 2010q4	1992q1 - 2008q2
Botswana	1999q1 - 2011q4	1994q1 - 2008q2
Senegal	1999q1 - 2010q4	1992q1 - 2008q2
Rwanda	1999q1 - 2010q4	1992q1 - 2008q2

Table 31: Period Under Analysis for Each Shock

F Exchange Rate Regimes

Country	Regime in 1992	Regime in 2011	Year of Switch (if any)
South Africa	Independent Float	Independent Float	No switch occurred
Ghana	Independent Float	Managed Float	Switch in 2001
Kenya	Hard Peg to Basket of Currencies	Managed Float	Switch in 1998
Tanzania	Crawling Peg	Managed Float	Switch to Independent Float in 1993 and remains for most of period eventually becoming Managed Float
Uganda	Independent Float	Managed Float	Independent Float for most of period eventually becoming Managed Float
Mauritius	Hard Peg to US Dollar	Managed Float	1994-1997 - Managed Float, 1998-2000 - Independent Float, 2001-2011 - Managed Float
Gabon	Hard Peg to French Franc	Hard Peg to Euro	Switch in 1999 after introduction of Euro
Cote d'Ivoire	Hard Peg to French Franc	Hard Peg to Euro	Switch in 1999 after introduction of Euro
Botswana	Hard Peg to Basket of Currencies	Crawling Peg Basket of Currencies	Switch in 2005
Senegal	Hard Peg to French Franc	Hard Peg to Euro	Switch in 1999 after introduction of Euro
Rwanda	Hard Peg	Crawling Peg	Hard Peg for most of period eventually becoming closer to Crawling Peg

Table 32: Exchange Rate Regimes During Sample Period

G Central Bank Mandates

Country	Primary Purpose*
South Africa	Price stability in the interest of balanced and sustainable economic growth
Ghana	Main aim of maintaining stable prices conducive to balanced and stable economic growth
Kenya	Central Bank has the responsibility of formulating monetary policy, promoting price stability, and issuing currency
Tanzania	Maintaining price stability, conducive to a balanced and sustainable growth of the national economy
Uganda	Foster price stability and a sound financial system
Mauritius	Stable price conditions if conducive to strong economic activity
Gabon	Monetary stability ensuring a stable inflation rate and sufficient monetary coverage
Cote d'Ivoire	Effective monetary policy at the heart of the West African Monetary Union
Botswana	Promote and maintain monetary stability in order to achieve sustainable growth
Senegal	Effective monetary policy at the heart of the West African Monetary Union
Rwanda	To ensure and maintain price stability

Table 33: Central Bank Mandates

*Definitions come from respective central bank websites.

H Capital Controls

This table gives a rating to a country based on its controls over movement of capital. There are two sub-sections, namely foreign ownership/investment restrictions and capital controls. The scores in these two sub-sections are then averaged. For foreign ownership/investment restrictions a higher score implies that foreign ownership of companies in your country is highly prevalent and regulations related to international capital flows are not restrictive. For capital controls, the higher the score the higher the percentage of capital controls not levied as a share of the total number of capital controls listed multiplied by 10. Overall, the higher the score the less capital controls are in place.[64] Germany and the US are put in as references.

[64]Data comes from The Fraser Institute

Countries	Freedom over the movement of capital	Exchange Rate Regime (SSA Countries)
Uganda	7.25	Float
Germany	7.09	N/A
US	6.89	N/A
Mauritius	6.78	Float
Botswana	6.28	Fixed
Kenya	5.10	Float
Ghana	4.38	Float
South Africa	3.89	Float
Rwanda	3.30	Fixed
Senegal	2.91	Fixed
Tanzania	2.74	Float
Cote d'Ivoire	1.49	Fixed
Gabon	0.28	Fixed

Table 34: Freedom of Capital

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