SADC Monetary Unification: An Empirical Investigation of Demand and Supply Shocks

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Abstract

The study investigates the suitability of the SADC countries for monetary integration by assessing the symmetry of shocks in the member states. The study makes use of the AD-AS framework to decompose output and price shocks into permanent and temporary shocks within a bivariate VAR system. The correlations of the underlying shocks and the speed of adjustment to shocks are compared across countries. The findings of the study do not give support to a region-wide monetary union within the SADC countries at present. However, the results suggest the existence of a distinct "core" group of countries comprising the SACU members that are characterized by relatively symmetric behaviour, and a "periphery" whose disturbances are idiosyncratic.

1. Introduction

In the current economic environment of highly mobile capital, the choice of a currency and exchange rate system by individual countries can affect the entire international financial system. In the event of financial collapse in a particular country, the ensuing crisis can have prolonged and severe effects on the international financial system. Literature suggests that one way to mitigate the prevalence and severity of financial crises is to reduce the number of risky currencies and exchange rates in a region by adopting a common currency (Alexander et al., 2004; Van der Haegen and Viñals, 2003; Mongelli, 2002; Wyplosz, 1997; Kenen, 1969; Mckinnon, 1963; Mundell, 1961). Monetary unification has especially been advocated for in developing and emerging-market countries with minor currencies, and which, cannot risk wide, long-lasting fluctuations in the exchange rate (Alexander et al., 2004; Wyplosz, 1997)[1].

The successful implementation of a currency union requires that, among other things, member states respond symmetrically to shocks or have alternative adjustment mechanisms in place to absorb the effects of the shocks. This is because membership of a currency union requires that countries surrender autonomy of their monetary and exchange rate policies to

[1] Monetary unification does not however prevent the occurrence of sovereign debt crises, where a profligate member country becomes so heavily indebted that it is unable to borrow or to roll over external debt (Alexander et al., 2004).

the union central bank. Should individual countries (or the union as a whole) be faced with negative external shocks, the central bank would implement common stabilization policies across the countries.

However, where the countries respond asymmetrically to shocks, the common policies would not correct for the effects of the shocks in all the countries. Consequently, the shocks may result in cyclical variation across the countries. In the event of financial collapse in a particular country, the ensuing crisis can have prolonged and severe effects on the union and the international financial system at large[2].

It is for this reason that the optimum currency area (OCA) theory prescribes pre-conditions, which when present among prospective union members, eliminate the need for exchange rate adjustments as an absorption mechanism in the face of shocks. The 'similarity in shocks and business cycles' criterion is described in literature as the "meta-property" as it captures the interaction between several OCA criteria (Mongelli, 2002). The property stipulates that countries exposed to similar shocks or possessing mechanisms for the absorption of asymmetric shocks may find it optimal to form a currency union. This implies that countries whose output and prices vary together are likely to experience the least costs of losing autonomy over their exchange rates.

It is in this light that the current study makes use of the aggregate demand-aggregate supply (AD-AS) framework to decompose output and price shocks in the SADC countries (which aim to establish a currency union in 2020 at the earliest) into permanent and transitory shocks. The premise of the analysis is that, if the incidence of supply and demand shocks and the speed with which individual economies adjust are similar across partner countries, then the countries are likely to experience the least costs of losing autonomy over their exchange rates (Mongelli, 2008; Trautwein, 2004; Bayoumi and Ostry, 1995; Bayoumi and Eichengreen, 1994).

The rest of the paper is organized as follows: Section 2 assesses the extent to which the SADC member states meet the OCA criteria. Section 3, present the methodology used in the

[2] This was observed recently with the Eurozone sovereign debt crisis that started in 2009.

analysis, while Section 4 discusses the estimation results. Lastly, Section 5 concludes the paper.

2. The OCA Characteristics of the SADC Countries

The SADC countries[3], like many other regional economic communities, aim to deepen economic integration among its member states- with the ultimate goal of establishing a monetary union with a common currency by 2020 at the earliest[4]. However, due to capacity constraints, the integration process has been slow. So far, the region has only managed to launch a free trade area, which was established in August 2008 (SADC, 2014). The customs union, which was originally set to be implemented in 2010, has not yet been established. Consequently, the launch of the common market (originally scheduled for 2015), the monetary union (originally scheduled for 2016), and the currency union have also been postponed.

The OCA criteria include the extent of free mobility of factors of production, the extent of trade openness, the level of trade interdependence in the region, the extent of diversification in the production structures of the economies, and similarity in shocks and business cycles. The criteria encompass the alternative adjustment mechanisms which make changes to the exchange rates between the national currencies unnecessary as an absorption mechanism when member nations are exposed to shocks. As a precursor to the analysis we thus, assess the extent to which the OCA properties hold in the SADC countries.

In assessing the mobility of factors of production[5], it is noted that of the SADC countries reporting data on capital movements to the SADC committee of central bankers, Botswana, Mauritius and Zambia have no restrictions on capital account transactions. Similarly, there is free capital mobility within the Common Monetary Area (CMA) (with the exception of investment or liquidity requirements prescribed for financial institutions). Furthermore, Namibia, South Africa and Swaziland have no restrictions on inward investment by non-

[3] Presently SADC comprises of fifteen countries, namely: Angola, Botswana, the Democratic Republic of Congo (DRC), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. Zimbabwe was also excluded from the analyses due to data inconsistencies during the period of economic crisis.

[4] The common currency was initially scheduled to be implemented by 2018 but the plan has been postponed until at least 2020.

[5] A high degree of capital mobility is especially encouraged in developing countries, where there are restrictions to the migration of labour.

residents, while they maintain controls on outward investment. Lesotho, on the other hand, maintains controls on both inward and outward investments.

On the other hand, all transfers in Angola, Malawi and Tanzania are subject to prior approval. Lastly, Mozambique maintains no restrictions on inward investment, while outward investment is regulated by law (CCBG, 2014). Table 1 shows that, overall, the economies of the SADC countries are small but highly open, which makes them good candidates for a common currency.

Table 1: SADC Trade Openness and Size of Economies (2013)

	Trade Openness*	Size of Economies**
Angola	125.59	0.41
Botswana	105.79	0.10
DRC	48.07	0.13
Lesotho	163.68	0.01
Madagascar	105.15	0.04
Malawi	98.87	0.03
Mauritius	124.29	0.06
Mozambique	83.60	0.08
Namibia	117.81	0.07
Seychelles	171.76	0.01
South Africa	56.78	2.17
Swaziland	112.66	0.02
Tanzania	89.51	0.17
Zambia	127.81	0.11

Source: Own calculations using data is from the World Bank database (2010).
Notes: i. *Openness is defined as the ratio (exports + imports)/ GDP.
ii. The size criterion is measured as the ratio of the respective SADC GDPs to that of the US.

Table 2 shows data on the composition of trade and on intra-regional trade flows for each of the SADC countries. The data indicates that there is minimal trade between the member states, with the exception of Botswana, Lesotho, Namibia, and Swaziland that import more than 70% of their total imports from within SADC. These countries are members of the Southern African Customs Union (SACU) together with South Africa and import most of their goods from the latter.

On the other hand, with the exception of Namibia and Swaziland, the member states export less than 50% of their products to the rest of the SADC countries. In addition, the data indicates that Angola, Madagascar, Mauritius, Seychelles, South Africa and Tanzania trade minimally with the rest of the SADC countries. Overall, the data indicates that there is an imbalance of intra-SADC trade flows. The generally low levels of intra-regional trade can be

attributed partly to the near homogenous nature of production in member states, which export predominantly primary and "first stop processing" goods and import manufactures.

3. Methodology

The aggregate demand- aggregate supply (AD-AS) framework has been used by a number of researchers to test for symmetry in the underlying structural shocks faced by potential monetary union members (see Buigut and Valev, 2006; 2005; Bayoumi and Eichengreen, 1994; 1992; Blanchard and Quah, 1989).

Assuming an infinite moving average representation of a vector of variables, $X_t = \left[\begin{smallmatrix}\Delta y_t \\ \Delta p_t\end{smallmatrix}\right]$, and an equal number of shocks, ε_t, the model can be expressed as follows:

$$X_t \equiv \begin{bmatrix}\Delta y_t \\ \Delta p_t\end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix}a_{11i} & a_{12i} \\ a_{21i} & a_{22i}\end{bmatrix} \begin{bmatrix}\varepsilon_{dt} \\ \varepsilon_{st}\end{bmatrix} = \sum_{i=0}^{\infty} L^i A_i \varepsilon_t \quad (1)$$

Where: Δy_t and Δp_t represent fluctuations in the log of output and prices, respectively. L is the lag operator, A_i represents the impulse response functions of the shocks of the elements of X, and ε_d, ε_s are independent supply and demand shocks, respectively.

The AD-AS framework assumes that a positive, permanent demand shock results in a temporary increase in output and a permanent rise in prices. On the other hand, the model assumes that a positive, permanent supply shock results in a permanent increase in output, which is accompanied by a reduction in prices. Hence, since output is expressed in first difference form in equation (1), this implies that the cumulative effect of demand shocks on the change in output must be zero. The following restriction is thus imposed:

$$\sum_{i=0}^{\infty} a_{11i} = 0 \quad (2)$$

The model defined in equations (1) and (2) can be estimated using a finite order VAR. Each element of vector $X_t$is regressed on lagged values of all the elements of X_t:

$$X_t = K + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + \cdots + \Phi_p X_{t-p} + e_t \quad (3)$$

Where: K is a vector of constants, the Φ_is are the estimated coefficients and e_t is a vector of residuals.

To obtain the demand and supply shocks, such that $e_t = A_0 \varepsilon_t$, four restrictions are imposed in order to define the four elements in A. The first two restrictions are simple normalizations

which define the variance of the shocks ε_{dt} and ε_{st} (which are usually set to unity). The third restriction assumes that the demand and supply shocks are orthogonal and hence, $E\ (\varepsilon_{dt}\varepsilon_{st}) = 0$. The last restriction is to assume that demand shocks have only temporary effects on output, as stated in equation (2). The four restrictions are stated below:

$$Var\left(e_{yt}\right) = a_{11}(0)^2 + a_{12}(0)^2 \quad (4)$$

$$Var\left(e_{pt}\right) = a_{21}(0)^2 + a_{22}(0)^2 \quad (5)$$

$$cov\left(e_{yt}e_{pt}\right) = E\left(e_{yt}e_{pt}\right) = a_{11}(0)a_{21}(0) + a_{12}(0)a_{22}(0) \quad (6)$$

$$\sum_{i=0}^{\infty}\begin{bmatrix} c_{11i} & c_{12i} \\ c_{21i} & c_{22i} \end{bmatrix}\begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} = \begin{bmatrix} 0 & * \\ * & * \end{bmatrix} \quad (7)$$

These restrictions allow the matrix A_0 to be uniquely defined and, hence, the demand and supply shocks to be identified.

3.1 Data

The data used in this study is quarterly data for different sample periods ranging from 1980-2013, depending on data availability. The data was obtained from the World Bank's World Development Indicators Database (2015). For each country, GDP growth and inflation are calculated as the first difference of the logarithm of real GDP and the implicit GDP deflator. The GDP deflator is used as a measure of prices because it reflects the price of output rather than the price of consumption (Bayoumi and Eichengreen, 1992).

Preliminary analyses are done using the raw data. Table 3 shows the standard deviations and correlation coefficients for the logarithm of GDP growth and inflation across the SADC countries. The correlations are measured with respect to South Africa, which is considered as the anchor country in the region since it has the largest economy and its central bank has a reputation for maintaining price stability.

The correlation coefficients indicate that output growth in Lesotho, Namibia, Swaziland, and Botswana (to a lesser extent), is highly correlated with growth in South Africa. This may be a reflection of the customs union among these countries. The rest of the countries display idiosyncratic behaviour. In particular, output growth in Madagascar is negatively correlated with growth in South Africa.

For inflation, Lesotho is the only SACU member whose correlation coefficient is highly correlated with that of South Africa. Mozambique, Tanzania and Zambia also have

correlation coefficients that are highly correlated with that of South Africa. In contrast, Botswana and Malawi have positive correlation coefficients that are less than 10% correlated with that of South Africa, while inflation in Seychelles is negatively correlated with inflation in South Africa.

Malawi, Mozambique and Zambia had standard deviations of output growth that were above 20%, while the rest of the countries (except Angola and the DRC) had standard deviations that were within a similar range (about 13%). These variations are however, much higher than those observed in the United States and the EU (Bayoumi and Eichengreen, 1992). Lastly, output and price fluctuations have generally been very high in Angola and the DRC- with standard deviations greater than 100% in each case. This is not surprising as these countries have experienced periods of conflict and economic instability, which resulted in declines in economic growth and hyperinflation during the crises.

Table 3: Standard Deviations and Correlation Coefficients for the SADC Countries: Logarithms of Raw Data

	Growth		Inflation	
	Std. Deviation	Correlation	Std. Deviation	Correlation
South Africa	0.13	1.00	0.03	1.00
Angola	1.19	0.16	1.14	*0.17
Botswana	0.10	*0.67	0.04	0.04
DRC	1.54	**0.20	1.48	*0.46
Lesotho	0.13	*0.87	0.04	*0.64
Madagascar	0.17	-0.07	0.08	**0.22
Malawi	0.23	0.10	0.13	0.09
Mauritius	0.07	*0.35	0.03	*0.51
Mozambique	0.21	**0.23	0.16	*0.69
Namibia	0.14	*0.89	0.04	**0.20
Seychelles	0.14	0.00	0.09	-0.16
Swaziland	0.13	*0.75	0.05	*0.36
Tanzania	0.12	**0.23	0.07	*0.62
Zambia	0.35	*0.43	0.27	*0.84

Note: *, ** and *** denote significance at the 1%, 5% and 10% level, respectively.

(ii) Since all variables are measured in log form, a standard deviation of 0.04 indicates a standard deviation of approximately 4%.

4 Empirical Results

In order to identify supply and demand disturbances, bivariate VARs were estimated for each country as described in Section 3. The choice of the lag length was based on the standard guideline used by most researchers that the lag length should be approximately $T^{1/3}$, where T is the number of usable observations (Enders, 2004).

Correlations of Underlying Supply and Demand Shocks

Table 4 shows the correlation coefficients measuring the correlations of the identified demand and supply shocks in South Africa with those in the other SADC countries[6]. Positive correlations are an indication of symmetric shocks, while negative correlations suggest asymmetry in shocks. Thus, the higher the correlation coefficients, the more symmetric the shocks and the more feasible monetary union is (Buigut and Valev, 2006; Bayoumi and Eichengreen, 1992).

Demand shocks in South Africa are highly correlated with those in Botswana, Lesotho, Namibia and Swaziland (the BLNS countries). This is to be expected given that, with the exception of Botswana, these countries are members of the Common Monetary Area (CMA). As per CMA arrangement, the South African Reserve Bank (SARB) is the only central bank that engages actively in discretionary monetary policy, while policies in the LNS countries are managed in line with the SARB policy. In the case of Botswana, the pula is linked informally to the South African Rand (ZAR) through a basket of currencies in which, since 1990, the latter weighs around 60 to 70%. The countries are therefore likely to experience similar monetary shocks.

Mauritius and Zambia also display positive, albeit smaller correlation coefficients with those of South Africa. On the other hand, the DRC, Madagascar, Malawi, Mozambique and Tanzania had negative correlation coefficients, which suggest asymmetry in shocks. Aside from the SACU countries, the DRC and Mozambique on the one hand, and Botswana and Mauritius, on the other hand, had cross-correlations above 0.5. The rest of the countries had disturbances that were loosely correlated.

The correlations further reflect the trade patterns within the region. There is high trade inter-dependence between South Africa and the BLNS countries emanating from the customs union among these countries. This is also seen in the cross-correlations between each of the SACU members, which are very high. In addition, more than 60% of the total imports of the BLNS countries are from within SADC[7], as observed in Table 2. The results suggest the existence of a distinct "core" group of countries comprising the SACU members that are

[6] The cross correlations of the underlying shocks among the SADC countries are reported in Tables 5 and 6.
[7] predominantly from South Africa

characterized by relatively symmetric behaviour, and a "periphery" whose disturbances are idiosyncratic.

The results for the supply disturbances are more difficult to characterize. South Africa supply shocks are positively correlated (and statistically significant) with those in Lesotho, Madagascar, Malawi, Namibia, Seychelles, and Zambia. However, with the exception of Lesotho, the correlation coefficients are relatively small.

Unlike demand shocks, supply shocks have permanent effects on output. Hence supply shocks experienced by any of the member states could potentially widen cyclical variations among the SADC countries. This is a cause for concern because effects of supply disturbances are more likely to be invariant to demand management policies (Buigut and Valev, 2005; Bayoumi and Eichengreen, 1994).

Table 4 Correlation Coefficients of Underlying Shocks

	Supply Shocks	Demand Shocks
South Africa	1.00	1.00
Angola	0.04	0.16
Botswana	0.06	*0.76
DRC	-0.04	-0.12
Lesotho	*0.55	*0.85
Madagascar	***0.19	-0.12
Malawi	*0.30	-0.06
Mauritius	-0.06	*0.27
Mozambique	-0.07	-0.16
Namibia	***0.17	*0.72
Seychelles	*0.29	0.17
Swaziland	-0.11	*0.80
Tanzania	0.06	-0.06
Zambia	**0.26	*0.31

Note: *, ** and *** denote significance at the 1%, 5% and 10% level, respectively.

Impulse Response and Variance Decomposition Analyses

In addition to measuring the correlation of shocks among the SADC countries, it is essential to estimate and compare the responses of the economies to shocks. This was achieved by analysing the impulse response functions obtained from the structural VARs. Two issues are of particular interest: the larger the size of the shock, the more disruptive its effects will be on the economy and, the more difficult it may be to maintain a fixed exchange rate. In addition, the slower the speed of adjustment, the larger will be the cost of maintaining a single

currency and, the more compelling will be the case for an autonomous economic policy response (Buigut and Valev, 2005; Bayoumi and Eichengreen, 1992).

Furthermore, it is important to ascertain which shocks are predominant in determining the fluctuations in output and prices in the member states. The forecast error variance decomposition analysis provides a breakdown of the contribution of each shock to the changes in each variable. This is important, because differences in the cause of variability in the countries could be indicative of underlying differences in the transmission mechanism and the policy strategies of the SADC countries. This in turn, hinders regional integration.

In the interest of brevity and for ease of comparison, the impulse responses are reported in a Table rather than drawing impulse response functions for the impact of each shock on each variable for each country. The impulse response functions are reported in Tables 8-11, while Table 7 shows the variance decomposition analysis of real output and price due to supply shocks.

The cumulative effect of demand shocks on prices is positive in the DRC, Madagascar, Mauritius, Namibia, Tanzania and Zambia, and negative for the rest of the countries. However, the magnitudes of the responses are very small (less than 15% for most of the countries). The response of price in Angola is initially high for the first five periods. Thereafter, the magnitude of the response declines to less than 15%. The variance decomposition analysis shows that demand shocks account for more than 90% of the variation in prices in Botswana, Lesotho, Malawi, Mauritius, South Africa, Seychelles, Swaziland and Tanzania.

On the other hand, the cumulative effect of supply shocks on prices is positive in all periods, for all the countries, with the exception of Malawi and Tanzania. For the latter, the responses are initially positive and then become negative in the fifth period. The DRC is the only country where supply shocks account for more than 90% of the fluctuations in prices.

The cumulative effects of output to a positive supply shock are negative for most of the SADC countries, except Botswana, Lesotho, Malawi, South Africa, Swaziland and Tanzania. On the other hand, the effects on output to a positive demand shock are generally small for

the SADC countries (less than 10%). The speed of adjustment to shocks also varies across countries.

The variance decomposition analysis shows that supply shocks account for the majority of the variation in output in Botswana, the DRC, Malawi, Mauritius, Mozambique, Namibia, Seychelles, Swaziland and Tanzania. Moreover, the impulse response analysis shows that the effects of supply shocks do not dissipate for most of the SADC countries. The effects of the shocks increase over longer horizons in most of the countries.

On the other hand, demand shocks account for a significant proportion of the variance in output (more than 40% on average) only in Angola, Lesotho, and South Africa.

Table 7: Variance Decomposition Analysis

	Proportion of Output Variations due to Demand Shocks					Proportion of Price Variations due to Demand Shocks				
Horizons	1	4	8	12	20	1	4	8	12	20
ANG	39.88	32.01	47.58	48.41	50.30	76.78	74.35	80.27	78.94	74.53
BOT	5.23	3.76	3.77	5.43	9.00	99.95	99.43	97.50	97.12	94.28
DRC	2.36	1.52	5.85	11.13	12.22	6.43	5.07	5.02	5.04	5.07
LES	43.28	38.79	45.04	45.94	48.18	81.25	83.00	82.71	81.84	80.62
MAD	15.61	8.05	9.68	11.63	11.88	16.07	22.86	25.85	28.63	28.81
MAL	0.14	1.41	1.89	3.35	4.22	95.23	94.50	63.60	52.30	52.07
MAU	4.15	6.95	8.43	9.33	12.15	93.93	93.87	94.84	93.38	93.27
MOZ	0.31	0.90	4.87	9.91	12.32	33.72	34.55	42.84	47.03	49.27
NAM	14.92	9.91	8.87	17.31	18.77	21.48	28.95	22.31	32.13	33.55
RSA	40.01	41.91	51.81	48.51	47.11	83.58	84.94	90.25	92.32	92.58
SEY	7.72	2.30	1.80	4.27	5.39	93.52	95.19	83.80	80.73	79.17
SWA	10.03	5.73	5.37	8.58	8.67	99.03	99.42	97.65	97.79	97.26
TAN	0.45	0.39	1.68	3.68	4.54	99.79	99.83	98.25	98.23	96.94
ZAM	1.66	1.22	7.86	12.32	12.18	39.80	44.27	43.80	42.36	43.07

Note: The proportion of forecast error variance due to supply shocks is found by simply subtracting from one.

5 Conclusion

The study tests the suitability of the SADC countries for monetary integration based on the OCA theory. In particular, the study investigates the extent of symmetry in the demand and supply shocks in the member states. Using, the AD-AS framework, the study decomposes output and price shocks into permanent and temporary shocks within a bivariate VAR system for the SADC countries. The data used in this study is quarterly data for different sample periods ranging from 1980-2013, depending on data availability.

The correlation coefficients of demand shocks show that demand shocks in South Africa are highly correlated with those in Botswana, Lesotho, Namibia and Swaziland. Mauritius and Zambia also had positive, albeit smaller correlation coefficients with those of South Africa. The latter two countries also had positive correlation coefficients between their respective output growths and that of South Africa. This suggests the existence of a distinct "core" group of countries comprising the SACU members that are characterized by relatively symmetric behaviour, and a "periphery" whose disturbances are idiosyncratic.

However, the study found that supply shocks do not contribute to fluctuations in output and prices in the same way across the SADC countries. Moreover, the impulse response analysis shows that the effects of supply shocks increase over longer horizons in most of the countries. This is a cause for concern as supply shocks have permanent effects on the economy and thus could potentially widen cyclical variations across the SADC countries. The results of the study do not give support to a region-wide monetary union within the SADC countries at present. The large idiosyncratic shocks are an indication that the member states are better off maintaining policy autonomy. The exchange rate is an important adjustment mechanism in these economies. At a future stage, the SADC states could perhaps consider approaching monetary integration through an extension of the CMA arrangement to initially include Botswana, Mauritius and Zambia.

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APPENDICES

Table 2: SADC Intra/Inter-Regional Trade (% total trade) & Composition of Trade (%), 2013*

	Trade Conducted With:								**Main Exports (X; as a share of total exports)**	**Main Imports (M; as a share of total imports)**
	SADC		**China**		**EU**		**USA**			
	X	**M**	**X**	**M**	**X**	**M**	**X**	**M**		
ANG	< 3	6.7	44.7	17.8	17	37.4	12.5	6.5	Mineral fuels, oils, etc. (97), ships, etc. (1.7)	Boilers, machinery, etc. (16.1), electrical, electronic equipment (7.7), vehicles (7.4), ships, etc. (6.8)
BOT	15.5	74	1.6	1.7	62.9	14	1.3	2.6	Pearls, precious stones, etc. (83.7), nickel & articles thereof (5.5), ores, etc. (1.7), meat (1.6)	Pearls, precious stones, etc. (27.7), mineral fuels, oils, etc. (17.3), boilers, machinery, etc. (7.9), vehicles (7.5)
DRC	24.7	44.2	36	14.1	20.3	21.3	1	2.5	Copper & articles thereof (46), mineral fuels, oils, etc. (19.7), other base metals (12.2)	Boilers, machinery, etc. (16.4), vehicles (9.2), electrical, electronic equipment (8.7)
LES	27.2	85.2	1.5	5.4	27.8	1	40.3	< 1	Apparel, etc. (45.8), pearls, precious stones, etc. (32.9), electrical, electronic equipment (7.7)	Mineral fuels, oils, etc. (16.7), electrical, electronic equipment (6), vehicles (5.8), boilers, machinery, etc. (5.2)
MAD	4.7	9	7.9	14.7	48.6	13.5	7.3	3.2	Apparel, etc. (21.39), nickel & articles thereof (19.63), coffee, tea, etc. (11.49)	Mineral fuels, oils, etc. (22.9), boilers, machinery, etc. (7.7), cereals (6.1), vehicles (5.1),
MAL	21.2	40.9	5.6	9.8	31	15.6	6.4	2.6	Tobacco & tobacco products (46.6), ores, etc. (11.26), sugar & related products (9.4)	Mineral fuels, oils, etc. (14.5), fertilizers (12.1), boilers, machinery, etc. (8.4), pharmaceutical products (7.6)
MAU	15.3	8.7	2.1	16.1	57.1	21.5	10.1	1.5	Apparel, etc. (32), meat, fish, etc. (16), sugar & related products (13.5)	Mineral fuels, oils, etc. (21.82), boilers, machinery, etc. (7.2), aquatic products (6.8)
MOZ	27.6	35.1	2.6	6.7	38.7	20.4	3.6	2	Mineral fuels, oils, etc. (33.5), aluminium & articles thereof (26.5), Tobacco & tobacco products (6.4)	Mineral fuels, oils, etc. (29.41), optical, photo & related apparatus (10.6), boilers, machinery, etc. (8.9), vehicles (8.3)
NAM	54.3	68.2	2.5	3.3	17.9	8.6	3.4	1.9	Pearls, precious stones, etc. (22.6), ores, etc. (15.3), ships, etc. (14.1), aquatic products (11.5)	vehicles (11.2), mineral fuels, oils, etc. (9.9), boilers, machinery, etc. (9.6)
SEY	9.7	10.5	0.1	4.8	66.5	52.1	1	1.5	Meat, fish, etc. (64.5), aquatic products (25.5), optical, photo & related apparatus (1.8)	Aquatic products (17.5), boilers, machinery, etc. (14.1), ships, etc. (8.5)
RSA	24.7	7.1	14.2	15.7	17.3	27.9	7.2	6.3	Pearls, precious stones, etc. (18.4), ores, etc. (14.3), mineral fuels, etc. (10.8), vehicles (8.7)	Mineral fuels, oils, etc. (21.54), boilers, machinery, etc. (14.4), electrical, electronic equipment (10.2)
SWA	63.2	89.6	5.4	1.4	14.3	1.8	2.9	1.3	Essential oils, perfumes, etc. (23.7), sugar & related products (23.4), miscellaneous chemical products (10.5)	Mineral fuels, oils, etc. (18.5), vehicles (7.9), boilers, machinery, etc. (6.5)
TAN	28.2	7.5	7.7	13	11.3	9.9	1.4	1.9	Pearls, precious stones, etc. (36.7), ores, etc. (9.1), coffee, tea, etc. (5.9)	Mineral fuels, oils, etc. (38.8), vehicles (9), boilers, machinery, etc. (6.8)
ZAM	29.4	52.1	21.5	9.9	3	11.5	0.1	2.4	Copper & articles thereof (64.1), chemical products (4.8), mineral fuels, oils, etc. (3.6), pearls, precious stones, etc. (3.1)	Boilers, machinery, etc. (17.9), ores, etc. (15.3), mineral fuels, oils, etc. (10.6)

Source: Own calculations using data from International Trade Centre (2014)
Notes: * Latest available data

Table 5: Correlations of Contemporaneous Supply Shocks

	ANG	BOT	DRC	LES	MAD	MAL	MAU	MOZ	NAM	RSA	SEY	SWA	TAN	ZAM
ANG	1.0 -----													
BOT	0.36 * (0.00)	1.0 -----												
DRC	0.07 (0.52)	0.04 (0.67)	1.0 -----											
LES	-0.10 (0.36)	-0.02 (0.83)	-0.22 **(0.03)	1.0 -----										
MAD	-0.04 (0.69)	-0.13 (0.20)	0.21 (0.04)	0.37 * (0.00)	1.0 -----									
MAL	0.49 * (0.00)	-0.04 (0.69)	0.02 (0.81)	0.04 (0.73)	0.25 **(0.02)	1.0 -----								
MAU	0.14 (0.19)	0.14 (0.18)	-0.35 * (0.00)	0.20 ** (0.05)	-0.02 (0.82)	0.05 (0.65)	1.0 -----							
MOZ	0.57 * (0.00)	0.15 (0.16)	0.40 * (0.00)	-0.07 (0.53)	0.14 (0.20)	0.23 ** (0.03)	0.03 (0.78)	1.0 -----						
NAM	0.06 (0.53)	-0.04 (0.71)	0.39 * (0.00)	-0.07 (0.48)	0.29 **(0.01)	0.09 (0.40)	0.03 (0.74)	0.23 **(0.02)	1.0 -----					
RSA	0.04 (0.67)	0.06 (0.55)	-0.04 (0.69)	0.55 *(0.00)	0.19 ***(0.07)	0.30 * (0.00)	-0.06 (0.58)	-0.07 (0.50)	0.17 (0.10)	1.0 -----				
SEY	-0.01 (0.90)	-0.26 ** (0.01)	-0.04 (0.68)	0.22 ** (0.04)	0.04 (0.70)	-0.22 ** (0.03)	0.07 (0.53)	-0.08 (0.47)	0.24 ** (0.02)	0.29 *(0.00)	1.0 -----			
SWA	0.03 (0.76)	-0.35 *(0.00)	-0.25 **(0.01)	-0.06 (0.55)	-0.10 (0.36)	0.16 (0.12)	0.26 **(0.01)	-0.23 **(0.03)	0.05 (0.65)	-0.11 (0.27)	0.11 (0.29)	1.0 -----		
TAN	-0.41 * (0.00)	-0.35 * (0.00)	0.06 (0.54)	0.17 (0.10)	0.28 ** (0.01)	-0.09 (0.38)	-0.09 (0.37)	-0.18 ***(0.08)	0.13 (0.23)	0.06 (0.54)	0.17 (0.11)	-0.04 (0.73)	1.0 -----	
ZAM	-0.06 (0.60)	0.19 ***(0.07)	0.38 * (0.00)	0.00 (0.96)	-0.29 * (0.00)	-0.12 (0.24)	-0.12 (0.25)	-0.04 (0.73)	0.15 (0.14)	0.26 ** (0.01)	0.06 (0.54)	-0.39 * (0.00)	-0.13 (0.22)	1.0 -----

Note: Probabilities are in parenthesis. *, ** and *** denote significance at the 1%, 5% and 10% level, respectively.

Table 6: Correlations of Contemporaneous Demand Shocks

	ANG	BOT	DRC	LES	MAD	MAL	MAU	MOZ	NAM	RSA	SEY	SWA	TAN	ZAM
ANG	1.0 -----													
BOT	0.14 (0.17)	1.0 -----												
DRC	0.14 (0.20)	-0.07 (0.48)	1.0 -----											
LES	0.13 (0.22)	0.72 * (0.00)	-0.13 (0.21)	1.0 -----										
MAD	-0.17 (0.11)	0.06 (0.56)	0.34 * (0.00)	0.13 (0.22)	1.0 -----									
MAL	-0.19 *** (0.07)	-0.03 (0.76)	0.35 * (0.00)	-0.16 (0.14)	0.30 * (0.00)	1.0 -----								
MAU	-0.13 (0.21)	0.55 * (0.00)	-0.15 (0.16)	0.34 * (0.00)	0.21 ** (0.04)	0.05 (0.61)	1.0 -----							
MOZ	0.23 ** (0.02)	-0.19 *** (0.06)	0.61 * (0.00)	-0.22 ** (0.03)	0.18 *** (0.09)	0.26 ** (0.01)	-0.09 (0.38)	1.0 -----						
NAM	-0.01 (0.89)	0.77 * (0.00)	-0.26 ** (0.01)	0.80 * (0.00)	0.02 (0.82)	-0.26 ** (0.01)	0.37 * (0.00)	-0.27 ** (0.01)	1.0 -----					
RSA	0.16 (0.12)	0.76 * (0.00)	-0.12 (0.24)	0.85 * (0.00)	-0.12 (0.24)	-0.06 (0.54)	0.27 ** (0.01)	-0.16 (0.12)	0.72 * (0.00)	1.0 -----				
SEY	0.06 (0.54)	0.36 * (0.00)	-0.01 (0.93)	0.09 (0.39)	-0.11 (0.31)	0.06 (0.54)	0.04 (0.68)	-0.24 ** (0.02)	0.17 (0.11)	0.17 (0.11)	1.0 -----			
SWA	0.14 (0.18)	0.80 * (0.00)	0.01 (0.91)	0.81 * (0.00)	0.09 (0.37)	-0.13 (0.21)	0.25 ** (0.02)	-0.03 (0.78)	0.84 * (0.00)	0.80 * (0.00)	0.08 (0.42)	1.0 -----		
TAN	-0.15 (0.17)	-0.11 (0.30)	0.21 ** (0.05)	-0.02 (0.87)	0.04 (0.67)	0.06 (0.57)	0.12 (0.24)	0.12 (0.25)	-0.06 (0.59)	-0.06 (0.55)	-0.09 (0.37)	-0.13 (0.23)	1.0 -----	
ZAM	0.32 * (0.00)	0.26 * *(0.01)	0.14 (0.18)	0.11 (0.31)	-0.08 (0.47)	0.04 (0.67)	0.08 (0.45)	0.05 (0.66)	0.03 (0.75)	0.31 * (0.00)	0.15 (0.15)	0.09 (0.37)	0.25 ** (0.01)	1.0 -----

Note: Probabilities are in parenthesis. *, ** and *** denote significance at the 1%, 5% and 10% level, respectively.

Table 8: Impulse Responses of Price to Demand Shocks

	Impulse Response of Price to a Positive Demand Shock																			
Horizons	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ANG	-0.165	-0.226	-0.273	-0.315	-0.186	-0.119	-0.055	0.004	0.014	0.037	0.056	0.081	0.052	0.012	-0.040	-0.109	-0.113	-0.111	-0.095	-0.065
BOT	-0.016	-0.038	-0.064	-0.092	-0.110	-0.121	-0.127	-0.126	-0.126	-0.124	-0.121	-0.118	-0.112	-0.107	-0.102	-0.097	-0.095	-0.094	-0.094	-0.095
DRC	0.072	0.099	0.122	0.140	0.090	0.069	0.051	0.037	0.048	0.048	0.046	0.038	0.043	0.051	0.063	0.082	0.072	0.066	0.057	0.044
LES	-0.015	-0.035	-0.060	-0.086	-0.100	-0.108	-0.109	-0.105	-0.104	-0.103	-0.103	-0.106	-0.107	-0.109	-0.112	-0.114	-0.118	-0.121	-0.123	-0.125
MAD	0.007	0.018	0.034	0.053	0.069	0.084	0.098	0.108	0.119	0.128	0.135	0.141	0.143	0.144	0.143	0.141	0.138	0.135	0.132	0.128
MAL	-0.027	-0.039	-0.049	-0.056	-0.041	-0.034	-0.027	-0.023	-0.025	-0.025	-0.023	-0.018	-0.016	-0.016	-0.018	-0.025	-0.026	-0.029	-0.029	-0.027
MAU	0.006	0.016	0.028	0.041	0.051	0.059	0.064	0.068	0.072	0.076	0.080	0.085	0.089	0.092	0.095	0.096	0.098	0.099	0.101	0.103
MOZ	-0.029	-0.043	-0.056	-0.069	-0.040	-0.025	-0.008	0.010	-0.010	-0.018	-0.027	-0.038	-0.023	-0.020	-0.018	-0.018	-0.032	-0.036	-0.036	-0.030
NAM	0.006	0.015	0.026	0.039	0.044	0.044	0.042	0.038	0.042	0.049	0.059	0.071	0.077	0.079	0.079	0.075	0.074	0.073	0.073	0.074
RSA	-0.005	-0.012	-0.021	-0.030	-0.038	-0.045	-0.052	-0.058	-0.065	-0.071	-0.077	-0.084	-0.089	-0.095	-0.100	-0.105	-0.110	-0.114	-0.119	-0.125
SEY	-0.026	-0.065	-0.109	-0.154	-0.178	-0.187	-0.182	-0.164	-0.150	-0.136	-0.124	-0.119	-0.109	-0.102	-0.096	-0.090	-0.092	-0.095	-0.102	-0.112
SWA	-0.016	-0.039	-0.062	-0.085	-0.090	-0.087	-0.079	-0.069	-0.072	-0.081	-0.093	-0.107	-0.108	-0.103	-0.096	-0.086	-0.086	-0.091	-0.099	-0.109
TAN	0.010	0.015	0.019	0.022	0.018	0.016	0.014	0.012	0.011	0.010	0.008	0.006	0.005	0.006	0.007	0.010	0.011	0.012	0.012	0.012
ZAM	0.02	0.03	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

Note: Multiply by 100 to get % change in variable.

Table 9: Impulse Responses of Price to Supply Shocks

	Impulse Response of Price to a Positive Supply Shock																			
Horizons	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ANG	0.091	0.133	0.169	0.196	0.195	0.220	0.251	0.296	0.329	0.339	0.334	0.310	0.269	0.232	0.191	0.142	0.127	0.117	0.124	0.158
BOT	0.000	0.001	0.003	0.006	0.010	0.014	0.017	0.021	0.024	0.025	0.026	0.024	0.021	0.017	0.013	0.008	0.004	0.002	0.000	0.000
DRC	0.274	0.413	0.540	0.667	0.488	0.394	0.287	0.163	0.216	0.212	0.214	0.217	0.168	0.176	0.206	0.277	0.349	0.379	0.381	0.329
LES	0.007	0.017	0.029	0.039	0.046	0.050	0.052	0.052	0.052	0.053	0.055	0.060	0.065	0.069	0.072	0.071	0.070	0.068	0.066	0.067
MAD	0.016	0.039	0.068	0.100	0.127	0.151	0.170	0.184	0.193	0.197	0.199	0.197	0.195	0.192	0.189	0.187	0.183	0.179	0.175	0.170
MAL	0.006	0.007	0.006	0.001	-0.020	-0.032	-0.041	-0.047	-0.032	-0.024	-0.015	-0.004	-0.009	-0.007	-0.006	-0.008	-0.004	-0.006	-0.009	-0.011
MAU	0.002	0.004	0.007	0.011	0.012	0.014	0.014	0.015	0.016	0.018	0.020	0.023	0.024	0.025	0.025	0.025	0.026	0.026	0.027	0.028
MOZ	0.041	0.061	0.078	0.095	0.068	0.053	0.037	0.019	0.027	0.028	0.030	0.036	0.031	0.032	0.035	0.037	0.046	0.049	0.050	0.050
NAM	0.011	0.026	0.044	0.063	0.079	0.092	0.102	0.108	0.110	0.109	0.106	0.101	0.099	0.096	0.095	0.095	0.094	0.093	0.093	0.092
RSA	0.002	0.005	0.009	0.013	0.014	0.015	0.014	0.013	0.012	0.013	0.014	0.015	0.016	0.018	0.019	0.021	0.023	0.024	0.025	0.026
SEY	0.007	0.015	0.024	0.035	0.047	0.062	0.080	0.099	0.116	0.128	0.134	0.134	0.130	0.124	0.117	0.111	0.105	0.098	0.092	0.086
SWA	0.002	0.004	0.005	0.006	0.009	0.012	0.015	0.019	0.020	0.022	0.023	0.023	0.025	0.027	0.029	0.031	0.031	0.031	0.030	0.028
TAN	0.000	0.000	0.000	0.000	-0.001	-0.002	-0.003	-0.003	-0.003	-0.003	-0.003	-0.002	-0.002	-0.001	0.000	0.001	0.001	0.001	0.000	0.000
ZAM	0.025	0.038	0.050	0.062	0.057	0.056	0.054	0.053	0.050	0.045	0.040	0.032	0.030	0.029	0.030	0.034	0.035	0.036	0.038	0.039

Table 10: Impulse Responses of Output to Demand Shocks

	Impulse Response of Output to a Positive Demand shock																			
Horizons	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ANG	0.105	0.138	0.161	0.182	0.096	0.049	0.005	-0.034	-0.064	-0.091	-0.114	-0.145	-0.102	-0.060	-0.007	0.065	0.058	0.055	0.038	0.007
BOT	0.009	0.020	0.031	0.042	0.049	0.054	0.055	0.054	0.051	0.045	0.036	0.023	0.010	-0.004	-0.016	-0.024	-0.029	-0.030	-0.028	-0.024
DRC	0.043	0.052	0.057	0.060	-0.026	-0.062	-0.091	-0.120	-0.033	0.009	0.051	0.099	0.047	0.029	0.006	-0.026	-0.002	-0.010	-0.018	-0.025
LES	0.027	0.037	0.044	0.049	0.030	0.019	0.009	0	-0.005	-0.011	-0.015	-0.019	-0.013	-0.006	0.003	0.014	0.016	0.016	0.014	0.008
MAD	0.023	0.053	0.078	0.094	0.092	0.078	0.059	0.041	0.024	0.011	-0.002	-0.014	-0.021	-0.026	-0.028	-0.025	-0.023	-0.019	-0.016	-0.015
MAL	0.002	0.008	0.020	0.039	0.051	0.058	0.058	0.045	0.034	0.019	0.003	-0.008	-0.020	-0.027	-0.028	-0.026	-0.017	-0.008	0.001	0.007
MAU	0.006	0.016	0.028	0.042	0.052	0.060	0.065	0.067	0.067	0.064	0.059	0.052	0.042	0.034	0.027	0.021	0.017	0.015	0.013	0.012
MOZ	0.006	0.010	0.016	0.023	0.002	-0.010	-0.024	-0.042	-0.016	-0.002	0.014	0.032	0.012	0.004	-0.004	-0.011	0.006	0.010	0.011	0.003
NAM	0.017	0.038	0.061	0.081	0.096	0.107	0.110	0.106	0.090	0.066	0.039	0.010	-0.008	-0.021	-0.026	-0.024	-0.024	-0.021	-0.019	-0.018
RSA	0.024	0.036	0.047	0.056	0.035	0.027	0.018	0.011	0.017	0.015	0.012	0.009	0.005	0.008	0.012	0.019	0.023	0.023	0.022	0.019
SEY	0.010	0.020	0.029	0.036	0.036	0.034	0.028	0.019	0.006	-0.008	-0.022	-0.033	-0.040	-0.041	-0.037	-0.029	-0.021	-0.011	-0.002	0.004
SWA	0.015	0.033	0.050	0.065	0.071	0.072	0.067	0.058	0.044	0.028	0.012	0	-0.006	-0.008	-0.006	-0.002	-0.001	-0.001	-0.002	-0.004
TAN	0.001	0.001	0.001	0	-0.003	-0.004	-0.005	-0.005	-0.002	-0.001	0.001	0.003	0.003	0.004	0.004	0.003	0.002	0.001	-0.001	-0.003
ZAM	0.009	0.012	0.014	0.015	-0.003	-0.013	-0.024	-0.037	-0.026	-0.019	-0.008	0.009	0.008	0.011	0.012	0.009	0.014	0.013	0.011	0.006

Table 11: Impulse Responses of Output to Supply Shocks

	Impulse Response of Output to a Positive Supply Shock																			
Horizons	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ANG	-0.128	-0.195	-0.256	-0.311	-0.280	-0.283	-0.287	-0.297	-0.342	-0.355	-0.357	-0.346	-0.288	-0.246	-0.202	-0.155	-0.160	-0.161	-0.174	-0.207
BOT	0.038	0.091	0.151	0.212	0.247	0.266	0.270	0.258	0.247	0.231	0.215	0.203	0.190	0.182	0.178	0.177	0.181	0.186	0.192	0.199
DRC	-0.276	-0.414	-0.539	-0.666	-0.477	-0.381	-0.273	-0.147	-0.219	-0.226	-0.240	-0.254	-0.186	-0.179	-0.192	-0.244	-0.326	-0.365	-0.381	-0.343
LES	0.031	0.045	0.057	0.068	0.050	0.042	0.035	0.029	0.032	0.030	0.027	0.023	0.024	0.029	0.036	0.046	0.048	0.049	0.047	0.043
MAD	-0.054	-0.132	-0.222	-0.319	-0.366	-0.387	-0.385	-0.360	-0.355	-0.351	-0.357	-0.373	-0.378	-0.384	-0.385	-0.380	-0.377	-0.372	-0.367	-0.363
MAL	0.062	0.151	0.260	0.377	0.453	0.505	0.533	0.535	0.538	0.535	0.529	0.526	0.515	0.504	0.492	0.477	0.468	0.463	0.464	0.472
MAU	-0.028	-0.067	-0.112	-0.157	-0.183	-0.197	-0.200	-0.192	-0.187	-0.179	-0.174	-0.172	-0.168	-0.166	-0.164	-0.162	-0.162	-0.162	-0.164	-0.166
MOZ	-0.102	-0.148	-0.189	-0.226	-0.158	-0.122	-0.084	-0.044	-0.056	-0.052	-0.052	-0.054	-0.051	-0.064	-0.082	-0.105	-0.123	-0.127	-0.123	-0.110
NAM	-0.041	-0.098	-0.166	-0.240	-0.294	-0.338	-0.366	-0.378	-0.383	-0.378	-0.369	-0.357	-0.346	-0.335	-0.327	-0.322	-0.317	-0.314	-0.312	-0.311
RSA	0.029	0.043	0.054	0.064	0.057	0.051	0.045	0.039	0.028	0.021	0.015	0.007	0.014	0.019	0.025	0.035	0.037	0.040	0.042	0.042
SEY	-0.034	-0.085	-0.151	-0.227	-0.294	-0.353	-0.399	-0.429	-0.450	-0.459	-0.460	-0.455	-0.443	-0.428	-0.411	-0.393	-0.376	-0.362	-0.351	-0.345
SWA	0.045	0.109	0.182	0.259	0.309	0.343	0.359	0.356	0.350	0.337	0.321	0.307	0.293	0.283	0.276	0.272	0.272	0.273	0.277	0.281
TAN	0.019	0.029	0.037	0.044	0.035	0.030	0.025	0.019	0.020	0.017	0.015	0.012	0.011	0.013	0.016	0.020	0.023	0.024	0.024	0.023
ZAM	-0.069	-0.103	-0.133	-0.160	-0.127	-0.110	-0.093	-0.077	-0.077	-0.067	-0.057	-0.041	-0.035	-0.038	-0.048	-0.066	-0.077	-0.084	-0.085	-0.082