Trade Intensity and Business Cycle Synchronicity in Africa

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Abstract

Business cycle synchronicity, which is the key requirement for sharing a common currency, is not particularly strong within the prospective African monetary unions. However, this parameter is not irrevocably fixed and may be endogeneous vis-à-vis the integration process. For example, trade may increase the similarity of economic disturbances. This paper tests such an effect among the 53 African countries from 1965 to 2004. The estimated results suggest that trade intensity increases the synchronization of business cycles in the African context. The magnitude of the 'endogeneity effect' is, however, smaller than similar estimates among industrial countries.

JEL codes: E3, F1, F3.

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1 Introduction

Having a single currency is an official policy objective of African states. Monetary unions are perceived by African policymakers as a possible way to attain political stability, sound macroeconomic policies, and sustained economic growth. In fact, it is well-established that monetary union arrangements enhance regional trade and provide more credible regional institutions (Alesina and Barro, 2002).

The suitability of monetary unions is usually analyzed through the theory of Optimum Currency Areas (OCA). The OCA theory outlines that the key requirement for suitable monetary unions is the symmetry of shocks *i.e.* shocks that affect countries similarly.[2] The similarity of shocks offsets the costs induced by the delegation of the monetary policy and the exchange rate policy to a regional central bank, which has a regional objective rather than a country-specific target. Empirically, there is evidence that most prospective African monetary unions do not have sufficient symmetry to meet this criterion (*e.g.* Fielding and Shields, 2001; Khamfula and Huizinga, 2004; Benassy-Queré and Coupet, 2005; Tsangarides and Qureshi,

[2] Other secondary criteria were also defined: the mobility of factors (labour and capital), the diversification of production, the similarity in inflation rates, the flexibility of wages and prices and the capacity for risk-sharing.

2006; Buigut and Valev, 2005; and Houssa, 2008).[3]

However it is possible that African states would satisfy the OCA criteria *ex post* rather than *ex ante*. There could be a certain dynamic process, *i.e.* first monetary union and then increased symmetry of shocks across countries. This is the proposition of Frankel and Rose (1997, 1998) for European countries. They suggested that the traditional OCA paradigm does not provide the full picture of asymmetric shocks within a monetary union since some parameters such as the trade integration and the business cycle synchronicity are not irrevocably fixed. On the one side, the synchronicity of business cycles creates appropriate conditions for monetary unions which, in turn, increase internal trade; and, on the other hand, the degree of trade integration may increase the synchronicity of business cycles. Frankel and Rose (1997, 1998) labelled this phenomenon the *'endogeneity of the OCA criteria'*.

The motivation for investigating the hypothesis of the endogeneity of the OCA criteria in the debate on African monetary unions is further reinforced by evidence that African monetary unions double their internal trade after controlling for the gravity variables (see *e.g.* Carrère, 2004; Masson and Pattillo, 2004 and Tsangarides *et al.*, 2006).[4] Given the fact that African

[3] Fielding and Shields (2001) use the technique of structural VAR (Vector Auto-Regressive) to analyze the correlation of output and price shocks within the CFA monetary unions. They find that price shocks are highly correlated whereas output shocks rarely co-moved. Houssa (2008) applies a Dynamic Structural Factor Model which solves some limits of the VAR methodology and finds similar conclusions for the West African countries. Using cluster analyses, Benassy-Queré and Coupet (2005) and Tsangarides and Qureshi (2006) also find that there is a significant lack of homogeneity within the West African states. Khamfula and Huizinga (2004) use a GARCH (Generalized Auto-Regressive Conditional Heteroskedasticity) model to assess the share of the variation in real exchange rates of each SADC country vis-à-vis South Africa that can be explained by the divergence in monetary and fiscal policies. Their results indicate low degrees of symmetry of the real exchange rate shocks across most of SADC countries. Finally, Buigut and Valev (2005) find that the supply and demand shocks estimated through the VAR method are asymmetric among the EAC (East African Community) countries.

[4] Masson and Pattillo (2004) find that, compared with the African states with sovereign monies, the volume of trade within African monetary unions is about three times higher. Carrère (2004) also estimates a similar effect for the WAEMU (West African Economic and Monetary Union) and for the CAEMC (Central African Economic and Monetary Community). Recently, Tsangarides *et al.* (2006) include in estimates pair fixed effects and find that the effect of African monetary unions on trade is still large, almost a doubling.

monetary unions increase trade integration, it is logical to study the existence of the 'endogeneity effect': is the impact of African monetary unions on trade enough to overturn the negative assessment of asymmetric shocks among African states? The 'endogeneity effect' would indicate the degree to which the costs induced by asymmetric shocks may be exaggerated for African countries.

This paper proposes an empirical evaluation of the 'endogeneity effect' among the 53 African states from 1965 to 2004. The results suggest that African internal trade increases the co-movement of African business cycles. However, the magnitude of the 'endogeneity effect' is smaller among African states than analogous estimates among countries belonging to the Organization for Economic Cooperation and Development (OECD).

The remainder of the paper is as follows. The second section presents the theoretical issues of the impact of the trade integration on the business cycle synchronization. Section 3 explains the empirical methodology. Section 4 interprets the econometric results and section 5 discusses the importance of the 'endogeneity effect' for future African monetary unions. The last section concludes and provides some policy recommendations.

2 Theoretical issues

The effect of trade integration on the business cycle synchronicity is ambiguous. It could be either positive or negative.

The European commission (1990) was a pioneer in introducing the suggestion that the OCA criteria may be endogenous vis-à-vis the integration process. Some parameters such as relative openness and the symmetry of economic shocks are not irrevocably fixed. The argument of the European commission (1990) was empirically tested by Frankel and Rose

(1997, 1998), Imbs (2004), Baxter and Kouparitsas (2005), Caldéron *et al*. (2007) and Inklaar *et al.* (2008). These authors find that trade intensity significantly increases business cycle synchronicity. Particularly, Caldéron *et al.* (2007) notice that the magnitude of the 'endogeneity effect' is smaller among developing countries than equivalent estimates among industrial countries. On the opposite side, Krugman (1993) proposes an alternative argument: specialization drives different industry-specific supply shocks and increases the magnitude of asymmetric shocks. In this context, trade is likely to increase the divergence of business cycles.

In order to shed light on the relationship between trade intensity and business cycle synchronicity, the growth rate of output of a given country is decomposed into the weighted average of sector-specific shocks, the average growth rate and the trend of output growth. The country produces N goods and each good corresponds to one industry. The real growth of the output of the domestic country is expressed as follows:

$$\Delta Y_t = \sum_{k=1}^{N} \alpha_k u_{kt} + v_t + g \qquad (1)$$

ΔY_t is the real growth rate of the output at a time t. u_{kt} represents the sector k specific deviation of the growth rate of output at a time t from the average growth rate in the country v_t, α_k is the share of sector k in the output ($\sum_{k=1}^{N} \alpha_k = 1$) and g is the trend of output growth. The equivalent decomposition for the foreign country is:

$$\Delta Y_t^* = \sum_{k=1}^{N} \alpha_k^* u_{kt} + v_t^* + g^* \qquad (2)$$

I assume that the sector-specific shocks (but not necessarily the sector-specific output shares) are common across countries. I also presume that the u_{kt} are independently distributed across sector and time. I further suppose that the v_t are independently distributed over time. The cross-country covariance of the output growth rates is given by:

$$\begin{aligned} Cov(\Delta Y_t, \Delta Y_t^*) &= Cov(\sum_{k=1}^{N} \alpha_k u_{kt}, \sum_{k=1}^{N} \alpha_k^* u_{kt}) + Cov(v_t, v_t^*) \\ &= \sum_{k=1}^{N} \alpha_k \alpha_k^* \sigma_k^2 + \sigma_{v,v^*} \end{aligned} \quad (3)$$

where σ_{v,v^*} is the covariance of the country-specific aggregate shocks and σ_k^2 is the sectoral variance of u_{kt}. The net effect of trade integration on the cross-country covariance of output growth depends on two factors: the degree of specialization (the effect on '$\sum_{k=1}^{N} \alpha_k \alpha_k^* \sigma_i^2$') and the spillover effect of aggregate shocks (the effect on 'σ_{v,v^*}').

If the production structures are different across countries, countries tend to produce and export the goods in which they have a comparative advantage. In this context, trade is mostly 'between' industries, *i.e.* it is an inter-industry trade. The correlation between the shares of sectors in the output α_k and α_k^* is likely to be negative and the quantity '$\sum_{k=1}^{N} \alpha_k \alpha_k^* \sigma_i^2$' falls. The difference in the specialization patterns induces different supply shocks and increases the magnitude of asymmetric shocks. Conversely if much of the bilateral trade is 'within' rather than 'between' industries, *i.e.* if it is intra-industry trade, the specialization effect becomes smaller. A smaller specialization increases the correlation between the shares of sectors in the output α_k and α_k^*. The quantity '$\sum_{k=1}^{N} \alpha_k \alpha_k^* \sigma_i^2$' then rises. The increase in trade integration would lead to greater business cycle synchronicity by inducing similar industrial shocks.

Trade integration that promotes intra-industry trade may offset the specialization effect.

Trade integration could affect the covariance of aggregate shocks that are specific to countries (σ_{v,v^*}) through the spillovers from demand shocks or supply shocks. According to the principle of the Keynesian multiplier, an expansion in one country can be transmitted to its trading partners through an increase in its imports. For example, following an expansion, an increase in public or private spending in one country tends to raise the demand for both the foreign and the domestic output. More generally, trade integration combined with the coordination of monetary policies or fiscal policies would positively increase σ_{v,v^*}. Trade intensity also has an impact on the covariance of the aggregate shocks through spillovers from supply shocks. For example, an increase in trade integration may induce a more rapid spread of the productivity shocks through a more rapid diffusion of the knowledge and technology and raises the quantity 'σ_{v,v^*}'.

The net effect of African trade on the business cycle synchronicity could be negative or positive. On the one hand, most African states are commodity or oil dependent. In this context, the production structures are likely to be dissimilar across the African countries. The difference in production structures implies that the specialization effect, *i.e.* the mechanism of comparative advantage, is expected. Therefore, much of the African trade is likely to be inter-industry rather than intra-industry. In this way, trade integration is associated with a divergence of business cycles. On the other hand, as mentioned above, the specialization effect is not the only channel through which trade affects the synchronicity of business cycles. Spillovers from aggregate shocks through trade may be important in Africa. For example, an increase in the output of one country could raise the demand for the output of other African states. The positive effect of trade through the spillovers of aggregate shocks could take place among African countries.

3 Empirical methodology

3.1 The data

The data section describes the calculation of the business cycle synchronicity and the trade intensity.

3.1.1 The calculation of business cycle synchronicity

The dependent variable is the degree of business cycle synchronization between countries i and j over a decade.

The business cycle is measured by the de-trended component of original series of economic activity. The economic activity is approximated by real GDP (Gross Domestic Product) growth. I use GDP because it is the most comprehensive measure of economic activity and it is generally available for African states. Some authors, like Frankel and Rose (1997, 1998), Darvas *et al.* (2005), and Inklaar *et al.* (2008), use alternative proxies of the economic activity such as the industrial production or the employment rate. Such data are not available for African countries.

In practice, I use the logarithm of the GDP in United States dollar for the year 2000 from the *World Development Indicators 2006* of the World Bank (see Appendix 1 for the description of the sources of all data used in this article). The cyclical component is computed with Baxter and King's (1999) band-pass linear filter (hereafter BK filter). Following Imbs (2004), Baxter and Kouparitsas (2005), Caldéron *et al.* (2007), and Inklaar *et al.* (2008), I suppose that the length of the business cycle is between 2 and 8 years. This length is close to the duration from 6 to 32 quarters (*i.e.* 1.5 to 8 year) as originally recommended by Baxter and

King (1999).

Other authors, like Frankel and Rose (1997, 1998), Rose and Engel (2002), and Darvas *et al.* (2005), have exploited the alternative filter of Hodrick and Prescott (1997). Hodrick and Prescott's filter (HP filter) is often criticized for two reasons. First, the HP filter is interpreted as a high-pass filter that removes fluctuations with a frequency of more than 8 years and includes those fluctuations in the trend. The second problem with the HP filter is uncertainty about the appropriate value of the smoothing parameter for annual data: Hodrick and Prescott (1997) originally propose 100, whereas Ravn and Uhlig (2002) recommend 6.25. The BK filter allows for these problems by combining a high-pass filter and a low-pass filter and by setting the length of cycle according to the assumptions of the authors. For these reasons, I prefer to focus on the BK filter, which was specifically designed for the analysis of the business cycle synchronicity, which is the focus of this paper. More decisively, most studies find qualitatively similar results for the different filtering methods (*e.g.* Frankel and Rose, 1997 and 1998, Caldéron *et al.*, 2007) and recent studies on business cycle synchronicity focus on the BK filter (*e.g.* Baxter and Kouparitsas, 2005; Caldéron *et al.*, 2007; Inklaar *et al.*, 2008).

Finally, I follow Frankel and Rose (1997, 1998) by computing, for each pair of countries, business cycle synchronicity as a simple coefficient of correlation of the business cycles of countries i and j over a decade. I denote the indicator of business cycle synchronicity by ρ_{ijt}.

3.1.2 The calculation of the trade intensity

The second variable of interest is trade intensity. The degree of trade intensity between countries i and j is computed as the amount of bilateral trade divided by the sum of the total trade or the sum of the output of countries i and j. The indicators of the trade intensity computed in this article are those used by Frankel and Rose (1997, 1998) and Baxter and Kouparitsas (2005). The trade intensities (TI1 and TI2) are computed as follows:

$$TI1_{ijt} = \frac{M_{ijt} + X_{ijt}}{(X_{it} + M_{it}) + (X_{jt} + M_{jt})} \text{ and } TI2_{ijt} = \frac{M_{ijt} + X_{ijt}}{Y_{it} + Y_{jt}}.$$

X_{ijt} is the nominal bilateral trade exports FOB (Free On Board) of country i to country j and M_{ijt} is the nominal bilateral trade imports CIF (Cost-Insurance-Freight) of country i from country j. Bilateral trade data come from the database *Direction of Trade* of the IMF. The official trade data are obtained from the compilation of formal trade and do not include informal trade which is certainly important among African states. Therefore, with the official data, the estimate of the impact of African trade intensity on African synchronicity may be underestimated. X_{it} (M_{it}) is the total nominal exports FOB (total nominal imports CIF) of the country i. Y_{it} is the nominal GDP of the country i. Total exports, total imports and nominal GDP are taken from *World Development Indicators 2006* of the World Bank. For each pair of countries, I compute a decade-average of trade indicators.

3.1.3 The dataset

The dataset contains at most 1378 pairs of countries over four decades (1965-1974, 1975-1984, 1985-1994 and 1995-2004). The choice of decades for the calculation of the synchronization and the trade intensity is motivated by the objective of discussing the validity of the results with the related literature on industrial countries, which also uses decades. In total, the dataset includes a maximum of 5512 observations. Unfortunately, because of the missing data, I conduct the analysis on an unbalanced panel.

I am able to compute business cycle synchronicity for 513 pairs of countries over the first decade, 651 over the second decade, 931 over the third decade, and 979 over the last decade. I have in total 3074 observations for business cycle synchronicity.

Similarly, I can calculate TI1 *i.e.* the trade between countries i and j divided by the sum of the total trade of the countries i and j (respectively TI2 *i.e.* the trade between countries i and j divided by the sum of the output of the countries i and j) for 21 (respectively 623) pairs of countries over the first decade, 727 (respectively 747) over the second decade, 969 (respectively 1014) over the third decade, and 770 (respectively 1018) over the last decade. I have in total 2487 observations for TI1 and 3074 for TI2.

Furthermore, for a benchmark purpose, I also estimate the impact of the trade intensity on the business cycle synchronicity for industrial countries. I use Inklaar *et al.*'s (2008) dataset. Their dataset covers the 21 OECD countries and the period from 1970 to 2003. They split their sample into three periods of equal length of 11 years: 1970-1981, 1981-1992 and 1992-2003.[5]

3.2 Econometric methodology

In order to test the impact of the trade integration on the business cycle synchronicity, the regression I estimate takes the form:

$$\rho_{ijt} = \alpha + \beta \cdot TI_{ijt} + \eta_{ijt} \qquad (4)$$

ρ_{ijt} is the correlation of business cycles between countries i and j during a decade t; TI_{ijt} is the trade intensity between countries i and j during period t and η_{ijt} is the classical error term; α

[5] The dataset of Inklaar *et al.* (2008) is publicly available at http: //www.rug.nl/staff/r.c.inklaar/research. The OECD states are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and United States. Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain are members of EMU.

and β are the coefficients to be estimated. The sign of the β-coefficient indicates the existence of the phenomenon of endogeneity: a positive β means that the convergence effect dominates, whereas a negative β implies that the divergence effect dominates. The size of the β-coefficient indicates to what extent the hypothesis of the phenomenon of endogeneity is economically meaningful for African states.

A simple way to estimate α and β is the technique of Ordinary Least Squares (OLS). However, OLS may be inappropriate because of the endogeneity of the trade intensity. First, countries showing business cycle synchronicity are likely to trade more (or less) during common expansions (or common recessions). Moreover, monetary union membership simultaneously increases trade and the coordination of macroeconomic policies. As a result, a positive effect of trade intensity on synchronicity may be due to the participation into a monetary union: this is well-known as the simultaneity bias.

The technique of Instrumental Variables (IV) could address these limits. Following Frankel and Rose (1997, 1998), the instruments for trade intensity in this article are the basic variables of the gravity model (the logarithm of the distance between the main cities of the countries within the pair), a dummy variable set to one if the countries within the pair have a common border, and a dummy set to one if the countries within the pair have a common language spoken by at least 9 % of population.

I also include in the estimates dummies for the decades 1975-1984, 1985-1994 and 1995-2004 because the synchronicity of the African business cycles might vary from one decade to another for reasons that have nothing to do with the trade intensity, and this could be affecting the results.

I finally correct the potential heteroscedasticity with the pair-clustering method. The clustering method assumes that the observations for a pair of countries are not independent over decades. For example, the observation of a pair during the first decade may affect either (or both) of its observations during the second and the third decade. Unfortunately, because of the missing observations, I cannot correct the covariance matrices for the spatial dependencies. In fact, the observation of the pair of countries A and B may also depend on the observation of the pair of countries B and C.

4 Empirical results

This section presents the empirical assessment of the impact of the trade intensity on the correlation of business cycles of African countries.

4.1 Descriptive statistics

Table 1 presents descriptive statistics (the averages and the standard deviations) of the preferred indicators of business cycle synchronicity and trade intensity.

Firstly, on average, business cycle synchronicity and trade intensity are smaller in Africa than those reported for the OECD countries. In column [1], I present statistics of business cycle synchronicity. The average of the correlation of business cycles is 0.0436 from 1965 to 2004. The comparison with industrial countries is striking. From 1970 to 2003, the average of business cycle synchronicity is 9 times higher for the OECD members (0.4012) and 13 times higher for EMU members (0.5554). In columns [2] and [3], the average in the African sample is 0.0006 for TI1 (*i.e.* bilateral trade divided by the sum of the total trade of countries in the pair) and 0.0003 for TI2 (*i.e.* bilateral trade divided by the sum of the output of countries in the pair). Trade intensities are much higher among industrial countries: the average of TI1 is

0.0166 in the OECD sample (0.0204 in the EMU sample) and of TI2 is 5.6297 among the OECD members (8.3131 among the EMU members).

Secondly, in the African sample, the averages of trade intensities and the average of business cycle synchronicity are much higher within monetary unions.[6] The averages of TI1 and TI2 are respectively 0.0027 and 0.018. Similarly, the average of the coefficient of correlation of the business cycles within monetary unions is 0.0728 against 0.0436 in the African sample. I further perform within the African sample, a t-test of means-difference for the group of countries belonging to a monetary union (see Table 1). I assume for the test that the variances are unequal. I find that African monetary unions are only different in terms of trade integration.

Summary statistics reveal that the trade integration is deeper within African monetary unions whereas the difference in terms of business cycle synchronicity is not well-established.

[6] African monetary unions are in this paper WAEMU (West African Economic and Monetary Union) and CAEMC (Central Africa Economic and Monetary Community).

Table 1: Summary statistics (trade intensity and business cycle synchronicity)

	[1]	[2]	[3]
	ρ	TI1	TI2
AFRICA	0.0436	0.0006	0.0003
	(0.2830)	(0.0021)	(0.0012)
	N=3074	N=2487	N=3402
MONETARY UNION	0.0728	0.0027***	0.0018***
	(0.2999)	(0.0037)	(0.0028)
WAEMU	0.0624	0.0033***	0.0021***
	(0.3102)	(0.0039)	(0.0026)
CAEMC	0.0814	0.0016**	0.0010***
	(0.2791)	(0.0028)	(0.0013)
OECD	0.4012	0.0166	5.6297
	(0.3490)	(0.0261)	(8.4642)
	N=472	N=630	N=630
EMU	0.5554	0.0204	8.3131
	(0.2847)	(0.0264)	(11.7786)

Notes: ρ=correlation of the GDP cycles, BP (2, 8); TI1=bilateral trade divided by the sum of the total trade of countries in the pair; TI2=bilateral trade divided by the sum of the output of countries in the pair. N=Number of observations. Clustered robust standard errors in parentheses. *** and ** if the t-test of means-difference within the African sample (under the hypothesis that the variances are unequal) is significant at 1 % and 10 %.

4.2 Baseline results

Table 2 presents the baseline estimates from equation (4). In panel B, the first stage of the IV estimates. All instruments are highly significant in explaining trade intensities. The logarithm of distance has a negative and significant impact on trade intensities whereas contiguity and common language foster trade integration (the reader should notice that the estimated coefficient of common language is not significant for the OECD countries). The partial R^2 of the excluded instruments is between 0.2154 and 0.2489 for African countries and between 0.3414 and 0.6175 for the OECD countries. Moreover, the F-stats of the first stage are significant at 1 %.

The OLS and the IV results indicate that trade intensity has a positive and significant effect (at least at 5 %) on business cycle synchronicity. The trade-intensity coefficients are larger when trade intensity is instrumented.

I also find that in the African sample, contrary to Frankel and Rose (1997, 1998) and Inklaar *et al.* (2008), the TI-coefficients are higher and more significant when bilateral trade is divided by output. Because OLS is inappropriate, I only interpret results from the IV estimates. The IV coefficient is 12.6787 with TI1 (*i.e.* bilateral trade divided by the sum of the total trade of countries in the pair) and 28.2499 with TI2 (*i.e.* bilateral trade divided by the sum of the output of countries in the pair).

A more convenient way to interpret these results is the use of the standardized coefficients as is usually done in studies on the determinants of business cycle synchronicity (*e.g.* Frankel and Rose, 1997 and 1998; Caldéron *et al.*, 2007 and Inklaar *et al.*, 2008). The standardized coefficients are what the regression coefficients would be if the model were fitted to standardized data, that is, if from each observation the sample mean was subtracted and divided by the sample standard deviation (hereafter SD). The standardized coefficients are interpreted as the increase in the synchronization of output cycles resulting from an increase of one SD in the indicator of trade intensity.

The reported standardized coefficients from the IV results are 0.0924 with TI1 and 0.1119 with TI2. An increase of one SD in TI1 would increase the correlation of output cycles by 0.0924 (in Table 1 the SD TI1 in the African sample is 0.0021). For instance, an increase of one SD in TI1 corresponds to the gap of trade integration between the pair Niger-Ghana (without a monetary union arrangement) and Niger-Côte d'Ivoire (with a monetary union arrangement) over the decade 1995-2004.[7] By the same token, a rise of one SD in TI2 (in Table 1 the SD of TI2 in the African sample is 0.0012) would increase the coefficient of correlation of business cycles by 0.1119. An increase of one SD in TI2 is the gap of trade integration between the pair Senegal-Nigeria (without a monetary union arrangement) and Senegal-Côte d'Ivoire (with a monetary union arrangement) over the decade 1995-2004.[8]

In an African sample, business cycle synchronicity, the key criterion for optimal currency area, appears to be positively affected by trade integration. The effect of trade intensity on business cycle synchronicity is positive and significant among African countries.

[7] TI1 between Niger and Ghana is 0.0020 against 0.0041 between Niger and Côte d'Ivoire.

[8] TI2 between Senegal and Nigeria is 0.0032 against 0.0043 between Senegal and Côte d'Ivoire.

Table 2: Baseline results (trade intensity and business cycle synchronicity)

Panel A: IV results								
Dependent variable: ρ	African sample (1965-2004)				OECD (1970-2003)			
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
TI1	7.6865**	12.6787**			2.5253***	6.1165***		
	(3.7445)	(6.1916)			(0.7412)	(1.5212)		
	[0.0560]	[0.0924]			[0.2057]	[0.4982]		
TI2			15.2661***	28.2499***			0.0104***	0.0157***
			(4.2109)	(9.6366)			(0.0019)	(0.0025)
			[0.0605]	[0.1119]			[0.2549]	[0.3843]
Panel B: First stage of IV estimate								
Logarithm of distance		-0.00055***		-0.00033***		-0.0040***		-2.7799***
		(0.00011)		(0.000079)		(0.0012)		(0.3633)
Common border		0.00259***		0.0011095***		0.0363***		12.4825***
		(0.00055)		(0.0002444)		(0.0081)		(2.5216)
Common language		0.00042***		0.0002208***		0.0165		4.2725
		(0.00012)		(0.0000589)		(0.0105)		(2.6100)
F-stat		18.94***		20.52***		12.50***		39.74***
Partial R^2		0.2489		0.2154		0.3414		0.6175
Number of pairs	928	928	979	979	210	210	210	210
Observations	2238	2238	3049	3049	472	472	472	472

Notes: OLS=ordinary least squares, IV=instrumental variables, ρ=correlation of the GDP cycles, BP (2, 8); TI1=bilateral trade divided by the sum of the total trade of countries in the pair; TI2=bilateral trade divided by the sum of the output of countries in the pair. F-stat is statistic of a F-test on the included instruments. All regressions include an intercept and decade-specific dummies (1975-1994, 1985-1994 and 1995-2004) and are corrected for heteroskedasticity. Clustered robust standard errors in parentheses. Standardized coefficients in brackets. * significant at 10 %, ** significant at 5 % and *** significant at 1 %.

4.3 Other determinants of business cycle synchronicity

According to the previous literature, there are several candidates other than trade intensity in the determination of the degree of business cycle synchronicity: monetary union membership (Rose and Engel, 2002), the extent of total trade of the pair of countries (Baxter and Kouparitsas, 2005), specialization patterns (Imbs, 2004) and the similarity of domestic policies (Darvas *et al.*, 2005). In order to check the relevance of these variables for the 'endogeneity effect' among African states, I estimate the following equation:

$$\rho_{ijt} = \alpha' + \beta' \cdot TI_{ijt} + \gamma' \cdot Z_{ijt} + \eta_{ijt} \qquad (5)$$

where Z_{ijt} denotes the other determinants of business cycle synchronicity. It includes a dummy set to one if the countries in the pair belong to a monetary union, an indicator of the extent of total trade TT_{ijt}, an indicator of industrial specialization S_{ijt} (I use the Grubel-Lloyd index ITT_{ijt} as an alternative indicator of specialization), and a measure of the similarity of fiscal stances (coefficient of correlation) as a proxy of policy coordination. TT_{ijt} is defined as $TT_{ijt} = \frac{X_{it} + M_{it} + X_{jt} + M_{jt}}{Y_{it} + Y_{jt}}$. X_{it}, M_{it}, and Y_{it} are defined as in section 3.1. I calculate for each pair of countries, a decade-average of TT_{ijt}. S_{ijt} is computed as $S_{ijt} = \frac{1}{T}\sum_{t}^{T}\sum_{n}^{N}\left|s_{nit} - s_{njt}\right|$, s_{ni} denotes the GDP share of a sector n in a country i. S_{ij} is the average of the differences of the economic structures between countries i and j over the decade t. From the *Development Indicators 2007* of the World Bank, I use the shares of agriculture, industry, and services in value added as proxies of sectors shares. S_{ij} reaches its maximal value when the two countries have no sector in common. ITT_{ijt} is defined by $IIT_{ijt} = 1 - \frac{\sum_{k=1}^{N} \left| X_{ijkt} - M_{ijkt} \right|}{\sum_{k=1}^{N} (X_{ijkt} + M_{ijkt})}$. IIT_{ijt} measures the share of intra-industry trade. X_{ijkt} denotes the exports of an industry k from a country i to a country j, M_{ijkt} is the imports of an industry k of a country i from a country j. I use bilateral trade data by industry according to the 3-digit level of ISIC (International Standard Classification) revision 3 from the *World trade data by commodity (COMTRADE)* of the United Nations. An index value of 0 indicates that there is exclusively inter-industry trade (*i.e.* complete specialization) whereas a value of 1 designates exclusively intra-industry trade.

I now discuss the IV estimates in Table 3. The effect of trade intensity on the business cycle synchronicity is still positive and significant at 10 %. The estimated coefficients of the monetary union, the degree of total trade, the specialization of production structure, and the specialization of trade and fiscal coordination are not significant (the exception is the estimated coefficient of total trade which is significant at least at 10 % when it is combined with the indicator of the specialization of the production structure). The standardized coefficients indicate that an increase of one SD in TI1 (respectively TI2) is associated with an increase in the co-movement of business cycles between 0.0927 and 0.1401 (respectively 0.0924 and 0.1350). The 'endogeneity effect' is robust to the control of other determinants of business cycle synchronicity.

Table 3: Augmented model (trade intensity and business cycle synchronicity)

Dependent variable: ρ

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	OLS	OLS	IV	IV	OLS	OLS	IV	IV
TI1	5.4617	9.2313***	11.1355*	14.0100**				
	(4.3533)	(2.6000)	(6.7460)	(6.9241)				
	[0.0455]	[0.0923]	[0.0927]	[0.1401]				
TI2					14.3869**	16.0916***	19.7451*	22.3757*
					(5.7276)	(4.7906)	(11.9127)	(11.9849)
					[0.0673]	[0.0971]	[0.0924]	[0.1350]
Monetary union	0.0389	0.0209	0.0233	0.0081	0.0295	0.0184	0.0205	0.0080
	(0.0360)	(0.0336)	(0.0396)	(0.0374)	(0.0352)	(0.0339)	(0.0404)	(0.0381)
Total trade	-0.0741**	-0.0267	-0.0706*	-0.0231	-0.0767**	-0.0348	-0.0768**	-0.0352
	(0.0366)	(0.0486)	(0.0372)	(0.0484)	(0.0366)	(0.0486)	(0.0366)	(0.0484)
Production specialization	-0.0272		-0.0267		-0.0212		-0.0196	
	(0.0365)		(0.0373)		(0.0362)		(0.0364)	
Trade specialization		-0.0365		-0.0258		-0.0361		-0.0279
		(0.0522)		(0.0541)		(0.0522)		(0.0543)
Correlation of fiscal stances	-0.0109	-0.0059	-0.0113	-0.0065	-0.0101	-0.0043	-0.0103	-0.0046
	(0.0244)	(0.0295)	(0.0244)	(0.0295)	(0.0243)	(0.0295)	(0.0243)	(0.0294)
Observations	1435	797	1435	797	1440	798	1440	798

Notes: OLS= ordinary least squares, IV= instrumental variables, ρ= correlation of the GDP cycles, BP (2, 8); TI1=bilateral trade divided by the sum of the total trade of countries in the pair; TI2=bilateral trade divided by the sum of the output of countries in the pair. All regressions include an intercept and decade-specific dummies (1975-1994, 1985-1994 and 1995-2004) and are corrected for heteroskedasticity. Clustered robust standard errors in parentheses. Standardized coefficients in brackets. * significant at 10 %, ** significant at 5 % and *** significant at 1 %.

4.4 The channel of aggregate shocks: supply or demand shocks?

Most studies focus on the filtering technique to identify the business cycles. This filtering approach does not allow one to distinguish the shocks from the reactions to shocks, or the demand shocks from the supply shocks.

Blanchard and Quah (1989) propose a bivariate structural Vector Auto Regressive (VAR) procedure in order to separate the shocks from the responses and the demand shocks from the supply shocks. The structural VAR decomposition has the advantage of providing shocks that have a clear economic interpretation. It also allows for testing the effect of trade integration on the business cycle synchronicity through the spillovers channels.

Blanchard and Quah (1989) define shocks as the linear combinations of the residuals from a bivariate VAR representation of the real output growth rate and the inflation rate. By construction, the demand shock has only a transitory impact on the level of output, while the supply shock might have a long-term impact on the level of output. For each country, I use the logarithm of real GDP and the logarithm of CPI (Consumer Price Index) as variables of the VAR model. I uniformly set one lag for the VAR.[9] Formally, the representation of the estimated VAR is:

$$\begin{aligned} \Delta y_{it} &= \varphi_{01} + \varphi_{11}\Delta y_{it-1} + \varphi_{12}\Delta p_{it-1} + e_t^y \\ \Delta p_{it} &= \varphi_{02} + \varphi_{21}\Delta y_{it-1} + \varphi_{22}\Delta p_{it-1} + e_t^p \end{aligned} \qquad (6)$$

where Δy_{it} and Δp_{it} are respectively the output growth rate (the first-differences of the

[9] I initially chose 2 lags but the sample size felt drastically because of the missing data. A convenient way to get reliable results was setting 1 for lag.

logarithm of real GDP) and the inflation rate (the first-differences of the logarithm of CPI) of a country i at year t. e_t^y and e_t^p are the white-noise shocks and are serially uncorrelated. These disturbances are not structural and just represent the unexplained part in the output growth and in the inflation movement. The structural shocks are interpreted as the supply and demand shocks and are computed from the following system:

$$\begin{aligned} e_t^y &= C_{11}\varepsilon_t^D + C_{12}\varepsilon_t^S \\ e_t^p &= C_{21}\varepsilon_t^D + C_{22}\varepsilon_t^S \end{aligned} \qquad (7)$$

ε_t^D and e_t^S are respectively the structural demand and supply shocks. The system (7) states that the unexplained components in the movements of output growth and inflation are linear combinations of the structural demand and supply shocks.

In matrix form, $e_t = C\varepsilon_t$ with $C = \begin{bmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{bmatrix}$. ε_t is obtained by inverting the matrix C and multiplying by e_t: $\varepsilon_t = C^{-1}e_t$. The recovering of the coefficients of the matrix C requires four restrictions. Three restrictions are drawn from the system (7) with the normalization conditions [$\text{Var}(\varepsilon_t^y) = 1$, $\text{Var}(\varepsilon_t^p) = 1$ and $\text{Cov}(\varepsilon_t^y, \varepsilon_t^p) = 0$]: (i) $C_{11}^2 + C_{12}^2 = \text{Var}(e_t^y)$, (ii) $C_{21}^2 + C_{22}^2 = \text{Var}(e_t^y)$ and (iii) $C_{11}C_{12} + C_{12}C_{22} = \text{Cov}(e_t^y, e_t^p)$. The fourth restriction states that the demand shocks ε_t^D have no long-term impact on the level of output.[10] After recovering the demand and supply shocks, I compute for each pair of countries the synchronization of the supply and demand shocks.

I re-estimate the equation (4) for each measurement of synchronicity (synchronicity of

[10] I omit the mathematical expression of this restriction (see Blanchard and Quah 1989, Fielding and Shields 2001 for further details).

demand shocks and synchronicity of supply shocks). Reported results in Table 4 suggest that the effect of trade intensity on business cycle co-movement is a “demand” phenomenon. An increase of one SD in TI1 (*i.e.* bilateral trade divided by the sum of the total trade of countries in the pair) leads to an increase in the synchronization of demand shocks by 0.2422. By the same token, an increase of one SD in TI2 (*i.e.* bilateral trade divided by the sum of the output of countries in the pair) raises the synchronization of demand shocks by 0.2442. This result implies that African countries are likely to satisfy *ex post* the criterion of symmetrical shocks for monetary unions to some extent on the demand side, rather than on the supply side, as the trade integration deepens. However, to be convincing and conclusive, the result needs further sensitivity checks and a comparison with the related literature. I turn to these issues in the following sections.

Table 4: Supply and demand shocks (trade intensity and business cycle synchronicity)

Dependent variable	Correlation of supply shocks		Correlation of demand shocks	
	[1]	[2]	[3]	[4]
	OLS	IV	OLS	IV
TI1	4.6372	3.9938	14.8697**	33.8151***
	(3.1655)	(6.6211)	(5.8857)	(9.5429)
	[0.0377]	[0.0324]	[0.1065]	[0.2422]
	N=1222	N=1222	N=1222	N=1222
TI2	11.5206**	10.3550	23.5530***	59.0807***
	(5.6667)	(10.6940)	(7.0264)	(15.5869)
	[0.0543]	[0.0488]	[0.0973]	[0.2442]
	N=1455	N=1455	N=1455	N=1455

Notes: OLS= ordinary least squares, IV= instrumental variables, TI1=bilateral trade divided by the sum of the total trade of countries in the pair; TI2=bilateral trade divided by the sum of the output of countries in the pair. N=number of observations. All regressions include an intercept and decade-specific dummies (1975-1994, 1985-1994 and 1995-2004) and are corrected for heteroskedasticity. Clustered robust standard errors in parentheses. Standardized coefficients in brackets. * significant at 10 %, ** significant at 5 % and *** significant at 1 %.

4.5 Sensitivity analysis

Here I explore the sensitivity of the results. I successively change the estimation technique, the indicators of trade intensity and the indicators of synchronicity.

First, I explore the sensitivity of the positive impact of trade intensity on business cycle synchronicity. In Table 5, the impact is robust to: (i) the change of instruments[11]; (ii) the use of the Generalized Method of Moments estimator 'system'; (iii) the use of the quantile regression estimator; and (iv) the introduction of country fixed effects.

[11] The additional instrumental variables are a dummy set to 1 if the countries in the pair had the common colonizer, a dummy set to 1 if at least one country in the pair is landlocked, a dummy set to 1 if at least one country in the pair is an island, the logarithm of the area of the country i, the logarithm of the area of the country j, the logarithm of the population of the country i and the logarithm of the population of the country j.

Second, I change the calculation of trade intensity. In Table 6, the positive effect of trade intensity on the business cycle synchronicity is robust to: (i) the use of the logarithm of the trade intensity; (ii) the use of the minimum of the total trade and the minimum of the output of the countries in the pair and; (iii) the use of a composite index of the different trade intensities.[12]

The last sensitivity check tests the indicator of synchronicity. In Table 7, the positive effect of trade intensity on business cycle synchronicity is robust to: (i) the reduction of the maximal length of the business cycle from 8 to 4 years[13]; (ii) the use of Fisher's z-transformation which ensures the normality of the error terms;[14] and (iii) the use of the logarithm of CPI as an alternative proxy of the economic situation.

None of the various robustness checks alters the basic finding that African trade intensity is positively associated with an increase in the synchronization of business cycles.

[12] I combine four proxies of trade intensity (bilateral trade divided by the sum of total trade, bilateral trade divided by the minimum of total trade, bilateral trade divided by the sum of the output, and bilateral trade divided by the minimum of the total trade) into a single measure using the principal component analysis.

[13] For example, Rand and Tarp (2002) estimate the duration of cycles for 6 African countries from 1980 to 1999. They get durations around 3 years for South Africa (2.95) and Malawi (3), 2 for Zimbabwe (2.6), Côte d'Ivoire (2.43) and Nigeria (2.38) and finally less than 2 for Morocco (1.93).

[14] If the variable y is a z-transformation of Fisher of the variable x, then $y = \frac{1}{2}\ln(\frac{1+x}{1-x})$.

Table 5: Alternative econometric estimations (trade intensity and business cycle synchronicity)

Dependent variable: ρ		
	TI1	TI2
	[1]	[2]
IV, more instruments (a)	14.8207**	32.0627***
	(5.9112)	(9.2872)
'System' GMM (b)	12.4936***	11.3612*
	(3.7793)	(6.2933)
Country Fixed Effects	3.9466*	8.2306**
	(2.2837)	(4.1426)
Quantile regression (1st quartile)	10.8992**	15.9060**
	(4.5618)	(6.6627)
Quantile regression (2nd quartile)	7.9126**	15.2709***
	(3.6647)	(4.9321)
Quantile regression (3rd quartile)	8.1631*	15.7992**
	(4.2118)	(6.4133)

Notes: ρ= correlation of the GDP cycles, BP (2, 8); TI1= bilateral trade divided by the sum of the total trade of countries in the pair; TI2= bilateral trade divided by the sum of the output of countries in the pair. All regressions include an intercept and decade-specific dummies (1975-1994, 1985-1994 and 1995-2004) and are corrected for heteroskedasticity. Clustered robust standard errors in parentheses.

(a) The instruments are the logarithm of distance, a dummy set to 1 if the countries in the pair had a common border, a dummy set to 1 if the countries in the pair had a common ethnic language, a dummy set to 1 if the countries in the pair had a common colonizer, a dummy set to 1 if at least one country in the pair is landlocked, a dummy set to 1 if at least one country in the pair is an island, the logarithm of the area of the country i, the logarithm of the area of the country j, the logarithm of the population of the country i and the logarithm of the population of the country j.

(b) 'System' GMM= trade intensity is instrumented by at least its one lag value in the 'first differences' equation and by the first difference in the 'levels' equation.

* significant at 10 %, ** significant at 5 % and *** significant at 1 %.

Table 6: Alternative trade intensity indicators (trade intensity and business cycle synchronicity)

Dependent variable: ρ		
	OLS	IV
	[1]	[2]
Logarithm of TI1	0.0041*	0.0078*
	(0.0023)	(0.0044)
Logarithm of TI2	0.0044**	0.0087**
	(0.0019)	(0.0036)
Bilateral Trade/Minimum Trade	0.7083	2.4962**
	(0.4536)	(1.1722)
Bilateral Trade/Minimum Output	0.6410	4.5039***
	(0.5588)	(1.5830)
Trade intensity, PCA (a)	0.0150**	0.0278**
	(0.0068)	(0.0133)

Notes: OLS: ordinary least squares, IV: instrumental variables, ρ: correlation of the GDP cycles, BP (2, 8); TI1: bilateral trade divided by the sum of the total trade of countries in the pair; TI2: bilateral trade divided by the sum of the output of countries in the pair. All regressions include an intercept and decade-specific dummies (1975-1994, 1985-1994 and 1995-2004) and are corrected for heteroskedasticity. Clustered robust standard errors in parentheses. * significant at 10 %, ** significant at 5 % and *** significant at 1 %. (a) Trade intensity, PCA is a composite index (principal component analysis) of bilateral trade divided by the sum of the total trade, the bilateral trade divided by the minimum of the total trade, the bilateral trade divided by the sum of the output, and the bilateral trade divided by the minimum of the total trade.

Table 7: Alternative business cycle synchronicity indicators (trade intensity and business cycle synchronicity)

Regressor	TI1		TI2	
	OLS	IV	OLS	IV
Dependent variable				
Output cycles, BP (2,4)	6.2065*	14.1101**	9.7947*	26.2411**
	(3.2190)	(6.3450)	(5.2160)	(11.1176)
Fisher's z-transformation	8.1955**	13.3685**	16.0936***	30.1100***
	(3.9921)	(6.7398)	(4.5689)	(10.4999)
Prices cycles, BP (2, 8)	17.6108***	47.3032***	27.4600***	78.8748***
	(5.2356)	(10.5218)	(5.9026)	(15.3011)

Notes: OLS= ordinary least squares, IV= instrumental variables, TI1: the bilateral trade divided by the sum of the total trade of countries in the pair; TI2: the bilateral trade divided by the sum of the output of countries in the pair. All regressions include an intercept and decade-specific dummies (1975-1994, 1985-1994 and 1995-2004) and are corrected for heteroskedasticity. Clustered robust standard errors in parentheses. * significant at 10 %, ** significant at 5 % and *** significant at 1 %.

5 Discussion of the 'endogeneity effect'

The analysis is consistent with the proposition of Frankel and Rose (1997, 1998). As for industrial countries, trade integration fosters business cycle synchronicity in Africa. The result is further consistent with Caldéron *et al.*'s (2007) conclusion suggesting that the positive effect of trade intensity on the business cycle synchronicity also takes place among developing countries. As a result, African states could have sufficient synchronicity to satisfy the OCA criterion *ex post* rather than *ex ante*. This finding supports the intuition of the dynamic process. The fact that Africa does not actually comply with the OCA criterion of synchronicity of shocks should not block the political decision for monetary unions in Africa as it could create more symmetrical shocks.

However, the right policy issue for African monetary integration is not only the existence of the phenomenon of endogeneity; it is also how important the phenomenon is. I discuss the importance of the phenomenon of endogeneity in Africa by comparing the results with similar estimates for the OECD countries. In columns [5-8] of Table 2, I present the baseline estimates for the OECD countries. The standardized coefficients for the OECD estimated with the instrumental variables (IV) are higher than those reported for African countries. An increase of one SD would raise the correlation of the GDP cycles by 0.50 with TI1 (5.5 times larger than the African estimate) and 0.38 with TI2 (3.5 times larger than the African estimate).[15] The smaller standardized effects of trade intensity on the business cycle synchronization for Africa compared to the OECD are mainly explained by the much smaller standard deviations of trade intensity and business cycles synchronicity. In table 1, the standard deviation of the variable TI1 (*i.e.* bilateral trade divided by the sum of the total trade of countries in the pair) for the OECD is almost 12 times larger than the African figure and 7053 times larger with TI2 (*i.e.* bilateral trade divided by the sum of the output of the countries in the pair). These smaller standard deviations then lower the standardized effects.

The effect of trade integration is smaller in Africa. For example, a doubling of trade intensity would, on average, increase the correlation of business cycles by 0.0076 (with TI1, *i.e.* the bilateral trade is divided by the sum of the total trade of countries in the pair) or by 0.0085 (with TI2, *i.e.* the bilateral trade is divided by the sum of the output of countries in the pair). On average, this roughly means an increase of the African business cycle synchronicity from 0.04 to 0.05.[16]

In the light of the above-mentioned debate, the combination of the smaller averages of the

[15] The standardized coefficients are 0.09 with TI1 and 0.11 with TI2. Then 0.50/0.09=5.5 and 0.38/0.11=3.5.

[16] On average TI1 is 0.0006 and TI2 is 0.0003 (see columns [2] and [3] of Table 3). The IV estimated coefficients are 12.6787 with TI1 (significant at 5%) and 28.2499 with TI2 (significant at 1%). The marginal increase in business cycle synchronicity is 0.0076=12.6787*0.0006 with TI1 and 0.0085=28.2499*0.0003.

trade intensity and business cycle synchronicity in Africa (compared with the OECD figures in Table 1) and the lesser magnitude of the ‘endogeneity effect’ would not drastically change the pattern of asymmetric shocks among African states. A relevant solution for the future African monetary unions is the establishment of institutions and mechanisms that are able to cope with the asymmetric shocks.

6 Conclusion

This paper contributes to the literature on Africa monetary unions. An argument often used in the debate states that the fact that Africa does not comply with the OCA criterion of synchronicity should not actually block the political decision for monetary unions among African states as it could create more symmetrical shocks. In order to shed light on the debate, I have empirically assessed the effect of trade intensity on the business cycle synchronicity for the 53 African countries from 1965 to 2004. The main results are the following: (i) trade integration among African countries increases the synchronization of their business cycles. The effect is robust to various controls and several sensitivity checks. (ii) The effect of trade intensity on the synchronicity is mainly found on the demand side. African countries are likely to satisfy *ex post* the criterion of symmetrical shocks for monetary unions to some extent on the demand side rather than the supply side as the trade integration deepens. (iii) The magnitude of the ‘endogeneity effect’ is smaller among African countries. Compared with the figures reported for African states, the increase in synchronicity following an increase of one standard deviation in trade integration is 3.5 to 5.5 times higher in the OECD sample. In addition, it would be difficult to expect a radical change in the patterns of the asymmetric shocks through the ‘endogeneity effect’ of trade, given the smaller magnitude of trade integration and business cycle co-movement among African countries.

Another relevant solution for future African monetary unions is the establishment of institutions and mechanisms that are able to cope with the asymmetric shocks. The symmetry of shocks is not a necessary condition for sharing a common monetary policy. A monetary union could be optimal if output stabilization mechanisms are in place to deal with asymmetric shocks (*e.g.* Asdrubali *et al.,* 1996, Sorensen and Yosha, 1998). This was the focus of Mundell (Mundell, 1961), who introduced the concept of OCA. He discussed the role of the mobility of factors (mainly labour mobility) and the flexibility of prices as a stabilization mechanism in monetary unions. The question of risk-sharing among African states is not much addressed in the literature and is certainly an interesting and relevant future research topic.

Furthermore, the empirical results of the paper certainly underestimate the 'endogeneity effect' because the official trade data recorded by IMF (the main source in this paper) do not include informal trade which is certainly important in Africa. Monetary union reduces transaction costs both for formal and informal trade. The positive impact of the trade intensity on the business cycle synchronicity could be higher in the African context.

The conclusion of the paper is twofold: first the argument that African monetary unions could be self-validating is applicable in the debate; second the argument cannot overturn the negative assessment of asymmetric shocks in future African monetary unions because the magnitude of the 'endogeneity effect' of trade is quite small.

Appendix 1: List of countries in the sample

53 countries: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo Republic, Côte d'Ivoire, Djibouti, Democratic Republic of Congo, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sao Tome and Principe, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

Appendix 2: Data sources

• Bilateral exports and imports of goods and services in current USD	Direction of Trade, IMF 2006
• A dummy set to 1 if the two countries in the pair had a same colonizer for a relatively long period of time and with a substantial participation in the governance of the colonized country. • A dummy set to 1 if the two countries in the pair are contiguous • Area (Country's area in km2) • Distance is calculated following the great circle formula, which uses latitudes and longitudes of the most important cities/agglomerations (in terms of population). • Landlocked: Dummy variable set to 1 for landlocked countries. • A dummy set to 1 if the two countries in the pair share a language spoken by at least 9 % of the population in both countries.	From CEPII website, http://www.cepii.fr/francgraph/bdd/distances.htm
• OECD dataset	From Robert Inklaar, Richard Jong-A-Pin, Jakob de Haan (2008), the dataset is publicly available at the following http://www.rug.nl/staff/r.c.inklaar/research
• Monetary union membership	Own compilation
• Primary fiscal deficit or surplus (in % of GDP)	World Bank African Database 2006

• Exports and Imports of goods and services (BoP) in current USD • Consumer price index, basis 100 in 2000 • GDP in constant 2000 USD • GDP in current USD • Population • Share of Agriculture share in the GDP • Share of Industry share in the GDP • Share of Service share in the GDP	World Development Indicators 2007
• Bilateral trade by commodity	World Integrated Trade Solution, The COMTRADE database maintained by the United Nations Statistics Division

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