American trade policy towards Sub Saharan Africa — a meta analysis of AGOA

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30. July 2011

American Trade Policy Towards Sub Saharan Africa–A Meta Analysis of *AGOA*

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Draft: July 30, 2011

Abstract: Twelve econometric studies investigating the impact of *agoa* presented in this paper have reported 174 different estimates. In testing for publication bias and whether there is a genuine empirical impact of *agoa* we resort to a meta-analysis. The meta-analysis provides us with a formal means of testing for publication bias and an empirical effect. The result shows significant publication bias in the selected studies. However, in a few cases the test for a genuine effect is passed successfully. The results of the meta-analysis indicates that *agoa* increased the trade of beneficiaries by 13.2%.

Keywords: Trade preference regimes, African Growth and Opportunity Act (AGOA), Publication bias, Meta-Regression Analysis, Funnel plot, Study effect
Journal of Economic Literature Classification: F10, F13

[1] Paper prepared for presentation at the fifth MAER-NET colloquium in Cambridge, September 16 – 18, 2011.

1 Introduction

There have been several studies on the impact of the African Growth and Opportunity Act (*agoa*) of the USA on Sub-Saharan African (SSA) countries. The estimates reported in these studies vary widely and differ in terms of econometric methodology applied as well as the level of aggregation of the dependent variable (exports and/or imports). A convenient way of summarising the coefficients reported in selected studies is by pursuing a meta regression analysis (MRA). This is pursued in this paper using some of the recent advances in MRA. A recent systematic review by Condon and Stern (2011) summarising the findings of twenty-one econometric and non-econometric *agoa* studies show that (1) exports from SSA have increased since the inception of *agoa* and (2) Apparel is significantly correlated with higher exports. This paper seeks to go beyond Condon and Stern's systematic review by performing a meta regression analysis (MRA) on studies that estimate the impact of *agoa* on SSA countries.

The main contribution of this paper is extending the work of Condon and Stern (2011) to incorporate a quantitative summary of the *agoa* literature. To the best of the knowledge of the author, this is the first attempt to investigate the *agoa* literature (and to some extent, trade preference literature) using a *MRA* approach. Hence our contribution in this area. MRA has now become a popular way of summarising quantitative analysis (Borenstein, et al., 2009, Stanley, 2005). There has been a phenomenal growth in its application in several areas of economics (for example, Cipollina and Salvatici, 2010, Doucouliagos and Stanley, 2005, 2008, Feld and Heckemeyer, 2011, Rose and Stanley, 2005, among others). In this paper, our focus is on the application of MRA towards assessing publication bias in the *agoa* literature. The closest study to analysing trade preferences is Cipollina and Salvatici (2010). They apply *MRA* to the study of several reciprocal trade agreements that have been ratified by the World Trade Organisation (WTO).

Several studies exist analysing the *agoa* preferences of the USA towards SSA countries. In spite of these studies there are only few that make use of econometric methods to estimate the effects of *agoa* and this limits the number of studies we can include in our MRA. However, the individual studies do report several coefficients, thereby increasing our sample size. The results of the *agoa* studies have been mixed—reporting varying estimates of the impact of the preference. In terms of methodology, several econometric approaches have been undertaken. In the EU preference literature, gravity models applying *Heckman selection* and *Poisson* models tend to be very popular. However, in the *agoa* literature gravity modelling is less popular. Much of the analysis are based on estimating import demand equations with one study (Seyoum, 2007) applying *arima* time series models. We do investigate whether these various specifications do affect the impact measured.

The choice of studies is based on whether their emphasis is on estimating the *agoa* impact as well as whether they employ econometric techniques in measuring the impact of *agoa*. A large number of *agoa* studies employ non econometric techniques in studying *agoa*. However, this does not limit the studies available for performing the MRA—12 studies are used in this paper. These studies report multiple estimated coefficients varying from 1 to as many as 32 estimates and the reported impacts also vary widely. The multiple estimates reported by the studies creates problems for estimation. One way around this problem is estimating random effects and fixed effect models to control for the within and between variation (Cipollina and Salvatici, 2010). The fixed effects model uses the within variation while the random effects model uses a combination of the between and within study variation. This is useful in reducing the impact of the resulting heterogeneity as a result of pooling various estimates. There are other approaches to get around this problem, such as multilevel modelling—estimates are taken to be hierarchically ordered as estimates are nested within individual studies (for example, Konstantopoulos, 2011). These are explored in the analysis presented in the paper.

One of the objectives of the paper is to summarise the *agoa* impact reported in the selected studies. Also, to investigate publication bias and to see if the effect is as large as reported in a couple of studies (for instance, Collier and Venables, 2007, Nouve and Staatz, 2003). Moreover, we are also interested in whether there is a genuine or authentic effect based on the studies selected. Additionally, does the impact depend on the composition of countries? That is, are the studies focussing on only *agoa* beneficiaries, the ones reporting larger coefficients compared to studies incorporating other non *agoa* countries. Finally, a number of studies on *agoa* have underscored the importance of apparel and textiles and reported strong impacts for *agoa* beneficiaries. Using study specific variables we test whether the impact varies across product groups.

The rest of the paper is organised as follows. Section 2 introduces the data, methodology and estimation framework used in the meta-analysis. Section 3 presents a visual guide to identifying publication bias as well as some stylised facts of the data. The next section discusses the results while the final section, section 5 concludes the paper.

2 Data and Methodology

Search strategy

To build the database for the *meta-analysis*, a search was carried out at various periods between January and June 2011. The search strategy involved querying google search, Munich personal repec archive (*MPRA*), google scholar, econlit, scopus, wiley journals and jstor databases. The following key words "*agoa* trade agreement", "economic impact of agoa trade preferences ", "African growth and opportunity act" and "*agoa* trade preferences" were used in finding the studies for the meta analysis. A couple of studies were also obtained from the references of the selected studies. The search led to 30 studies, however these were reduced to twelve studies. Three reasons for this include: (a) some studies were working paper versions of the published studies (all six published papers for example), (b) some studies had been published under two or more different titles but contained the same results (examples include, Collier and Venables, 2007, Frazer and Van Biesebreock, 2010, Nouve and Staatz, 2003, Tadesse and Fayissa, 2008), and (c) some studies even though were analysis of *agoa* either did not include regression analysis or looked at other aspects of *agoa*. For example, Olarreaga and Özden (2005) focussed on estimating the tariff rent in *agoa* apparel while Edwards and Lawrence (2010) were interested in the impact on prices. On the contrary, Brenton and Hoppe (2006), Lall (2005), Mattoo, et al (2003) and Páez et al (2010) were not econometric studies. This leaves us with a sample of twelve studies consisting of 174 estimates. Of the twelve, six are published studies.

Funnel and Galbraith plots

In investigating publication bias several authors have suggested the inspection of funnel graphs which plot the inverse of the standard error against the effect size (partial correlation or coefficient) (Borenstein, et al., 2009, Stanley, 2005, 2008, Stanley and Doucouliagos, 2010, Stanley, et al., 2008, Sterne, 2001). There have been modifications and some studies show other types of funnel graphs. There is also the Galbraith plot which shows the relationship between the t-statistic and the inverse of the standard error. When these graphs show symmetry then it implies the absence of publication bias. However, when there are more points to one side of the mean effect (or zero) then it is an indication of publication bias (Borenstein, et al., 2009, Sterne, 2001). Borenstein, et al. (2009), Stanley (2005, 2008), Stanley, et al. (2008), Sterne (2001) have emphasised the need to carry out formal testing of publication bias since the visual inspection of the graphs can be subjective. The formal testing is discussed in the *MRA* models below.

Fixed effect vs. Random effects models

Two major approaches exist for summarising the study effects reported in each study to obtain a pooled estimate. The *random effect models (REM)* and *fixed effect models (FEM)* are the main approaches. The *FEM* assumes all studies have the same effect size (μ) and that any departure from the observed effect are purely due to random errors (e_i) (Borenstein, et al., 2009). On the contrary, the *REM* assumes that the effect size varies across studies and are randomly distributed within each study (Borenstein, et al., 2009). The pooled estimates provided by these models are simply the weighted means of the observed study effects (in our case, the weighted means of the reported coefficients) (Borenstein, et al., 2009). In the *FEM* model, the summary effect is given by a weighted average of the study effect sizes and the weights are the inverse of the variance of the coefficients reported in each study (Equations (1) – (3)). The weights calculated in the *FEM* model penalises smaller studies while giving more weight to larger studies (Borenstein, et al., 2009). The *REM* on the other hand, does not penalise smaller studies and incorporates all studies without having any particular study strongly influencing the summary estimate (Borenstein, et al., 2009). Equations (3) – (7) represent the *REM*. The *REM* uses a moments based estimator in calculating the weights for θ^{REM} this is known as the DerSimonian and Laird method (Borenstein, et al., 2009). The Q calculated in Equation (6) can also be taken as a test for the presence of homogeneity between studies distributed as χ^2 with $k-1$ degrees of freedom (Borenstein, et al., 2009, Feld and Heckemeyer, 2011) in addition to the I^2 discussed below.

$$\theta^{FEM} = \mu + e_i \tag{1}$$

$$\theta^{FEM} = \frac{\sum_{i=1}^{k} W_i b_i}{\sum_{i=1}^{k} W_i} \tag{2}$$

$$W_i = \frac{1}{V_{b_i}}$$

$$\theta^{REM} = \mu_i + e_i \tag{3}$$

$$\theta^{REM} = \frac{\sum_{i=1}^{k} W_i^{REM} b_i}{\sum_{i=1}^{k} W_i^{REM}} \tag{4}$$

$$W_i^{REM} = \frac{1}{V_{b_i}^{REM}} \; ; \; V_{b_i}^{REM} = V_{b_i} + T^2$$

$$T^2 = \frac{Q - df}{C} \tag{5}$$

$$Q = \sum_{i=1}^{k} b_i^2 - \frac{\left(\sum_{i=1}^{k} W_i b_i\right)^2}{\sum_{i=1}^{k} W_i} \tag{6}$$

$$C = \sum_{i=1}^{k} W_i - \frac{\sum_{i=1}^{k} W_i^2}{\sum_{i=1}^{k} W_i} \tag{7}$$

Where, V_{b_i} is the variance of b_i, W_i are the weights assigned to each study, b_i are the observed effect size in the studies selected, and θ^{FEM}, θ^{REM} are the *FEM* and *REM* pooled estimates of the various effect sizes respectively, $df = k-1$ and k is the number of studies. The variances of the pooled estimates are $V_\theta^{FEM} = \frac{1}{\sum_{i=1}^{k} W_i}$ and $V_\theta^{REM} = \frac{1}{\sum_{i=1}^{k} W_i^{REM}}$ respectively. The standard error is then the square root of the variance. The confidence intervals for both models are then given by $CI = \theta + 1.96 \times \sqrt{V_\theta}$. The weights for the *REM* are differentiated by the superscript *REM*.

There is consensus in the literature that the *REM* is a preferred estimator when coefficient estimates are heterogeneous. The *FEM* performs poorly in the presence of heterogeneity. However, in the absence of heterogeneity the *FEM* can be used to obtain unbiased estimates of the summary study effect (Borenstein, et al., 2009). Furthermore, Borenstein, et al. (2009) points out that the *FEM* can be performed on two or more studies unlike the *REM* which requires a decent sample size. In the presence of heterogeneity, it is useful to investigate the sources of the heterogeneity. In this paper, we pursue this by estimating our *REM* model by study as well as using an *MRA* to investigate the sources of heterogeneity. We are able to carry out tests of heterogeneity using the I^2 statistic ($I^2 = \left(\frac{Q-df}{Q}\right) \times 100$). This allows us to decide on the type of modelling to carry out. Borenstein, et al. (2009) citing Higgins et al (2003) suggest that values of 25%, 50% and 75% can be considered as low, medium and high heterogeneity respectively. An I^2 value of 0% implies that there is no real variation in the studies while a value of 100% indicates high heterogeneity and real variation among coefficients reported by the individual studies.

Meta-regression model

In carrying out the *MRA*, we need to emphasis that when there are several coefficients involved one needs to be careful in the choice of *MRA* to apply. Questions of which coefficient to choose to represent each study becomes difficult to answer. Secondly, the presence of more than one coefficient per study also poses problems. Some authors get around this problem by selecting particular estimates or using the mean, mode or other value of the study effects. In this paper, we choose to include all estimates and due to that we also pursue a multi-level *MRA* to account for the multiple coefficients per study to check the accuracy of our pooled *MRAs*. The *MRA* takes the following form

$$\frac{b_{ij}}{Se_{ij}} \equiv t_{ij} = \beta_0 + \beta_1 \left(\frac{1}{Se_{ij}}\right) + \nu \tag{8}$$

$$t_{ij} = \beta_0 + \beta_1 \left(\frac{1}{Se_{ij}}\right) + \sum_{k=1}^{K} \frac{\gamma_k Z_{ijk}}{Se_{ij}} + \nu \tag{9}$$

$$t_{ij} = \alpha_0 + \alpha_1 \left(\frac{1}{Se_{ij}}\right) + \sum_{k=1}^{K} \frac{\zeta_k Z_{jk}}{Se_{ij}} + \mu_{0j} + e_{ij} \tag{10}$$

$$var(e_{ij}) = \sigma_e^2 \ ; \ var(\mu_{0j}) = \sigma_{\mu 0}^2 \ ; \ e_{ij} \sim iid(0, \sigma_e^2); \ \mu_{0j} \sim iid(0, \sigma_{\mu_0}^2)$$

Where b_{ij} is the i^{th} coefficient from the j^{th} study, t_{ij} is the reported t-statistic of the i^{th} estimate in the j^{th} study, Se_{ij} is the reported standard error, Z_{ijk} measures characteristics in each study—those that explain the differences between studies as well as certain features of each particular study, ν is the disturbance term, μ_{0j} is study level random intercept and e_{ij} is the error term. Estimation is carried out using *weighted least squares* (WLS).

Equations (8) and (9) will be estimated by WLS while Equation (10) is a multi-level equation with studies at level 2 and coefficient estimates at level 1. For Equation (10), α_0 is assumed to be the same for each study. The study level component (μ_{0j}) represents the departure of the j^{th} study's intercept from the overall population intercept (α_0). The first two coefficients are the fixed part of the model and the last two terms provide us with the random variation (Goldstein, 1998). The variance partition component (VPC) can be calculated as

$$VPC = \frac{\hat{\sigma^2_{\mu 0}}}{\hat{\sigma^2_e} + \hat{\sigma^2_{\mu 0}}}$$

This indicates the percentage of the variance that can be attributed to differences between studies.

Meta-Significance Testing

Stanley (2008) and Stanley (2005) note that a logarithmic relationship exists between the t-statistic and the degress of freedom. A positive relationship between the two provides a confirmation of the empirical effect (Stanley, 2005, 2008). A variation of Equation (8) is to use the natural log of the reported degrees of freedom in each study, that is

$$\ln |t_{ij}| = \delta_0 + \delta_1 \ln(df_{ij})$$

Other versions also employ either the square root of the degrees of freedom ($\sqrt{df}$) or the natural log of the sample size ($\ln N$) in place of $\ln(df)$ (examples of empirical work in this area include, Doucouliagos and Stanley, 2005, 2008, Rose and Stanley, 2005, Stanley, 2005, 2008, Stanley, et al., 2008). This is the *meta-significance testing (MST)* approach and is explored in the present analysis to ensure the robustness of our results. In the *MST*, $\delta_1 \neq 0$ indicates the presence of a genuine effect. Stanley (2005, 2008) note that an effect exists when $\delta_1 = \frac{1}{2}$. In the log-linearised model shown above rejecting $\delta_1 \leq 0$ indicates the existence of an empirical effect (Stanley, 2005, Stanley, et al., 2008). According to Stanley (2005) the estimates in the *MST* regression can be affected by publication selection. However, publication bias is proportional to the inverse of the square root of the sample size ($n^{-\frac{1}{2}}$) in the presence of publication selection (Stanley, 2005). Publication selection reduces the positive coefficient on the log of degrees of freedom thereby resulting in a coefficient that is less than half (Stanley, 2005).

Yet another way of testing for a genuine empirical effect is to shrink the coefficients to zero by correcting for publication bias (Stanley, 2005). Then a regression of the corrected t-statistics on precision should yield an answer to whether there are is any genuine empirical effect.

$$|t_{ij}| = \varphi_0 + \varphi_1 \left(\frac{1}{Se_{ij}}\right) + \xi$$

$$corrected\ - t_{ij} = \phi \left(\frac{1}{Se_{ij}}\right) + \varepsilon$$

In *MST*, the alternate hypothesis (H_1) $\delta_1 > 0$ implies a genuine empirical effect. Similarly, $\varphi > 0$ and $\phi \neq 0$ indicates publication bias and a genuine empirical effect respectively. In the joint *PET/MST* $\beta_1 \neq 0$ (in Equation (8) – (9) and $\alpha_1 \neq 0$ in Equation (10)) and $\delta_1 > 0$ indicates a genuine empirical effect (Stanley, 2005).

Finally, following Stanley (2005) and Stanley, et al. (2008) we carry out a t-test of β_0 in Equation (8) and (9) to test for publication bias (*funnel asymetry test (FAT)* and a test of $\beta_1 = 0$ which provides the *precision-effect test (PET)*. This is similarly done for α_0 and α_1 to test for *FAT* and *PET* respectively. Stanley (2005) also notes that a useful strategy is to carry out joint *PET/MST* testing to identify genuine effects in the presence of publication bias. This is also carried out in the results section. Controls included in Equation (9) and (10) allow us to check whether the reported estimates in the studies are strongly influenced by study characteristics.

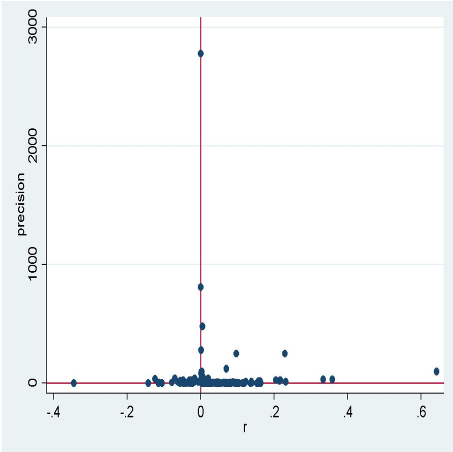
3 Stylised facts about data

Figures (1) – (5) show various features of the underlying data for the meta analysis. Figure (1) and (2) show various funnel plots to provide a visual aid in identifying any publication bias present in the meta analysis. The Sub-figure (a) plots the precision of the estimated *agoa* effect against a partial correlation of the *agoa* coefficient. Here all estimates are included. However, the remaining 3 sub-figures exclude 6 large estimated coefficients reported in one of the studies. These coefficients are larger than 300 while the remaining coefficients used in the plots are less than 4, hence their exclusion in this case. Panel (b) shows a funnel plot with the missing estimates to the left of the mean included. Figure (1) and (2) indicate that publication bias is plausible. There are more positive effects than negative effects as shown by the vertical line at the mean of zero. Borenstein, et al. (2009) note that the interpretation of the funnel plot can be subjective and there is the need for other tests to be carried out (also, Stanley, 2005, 2008, Stanley, et al., 2008).

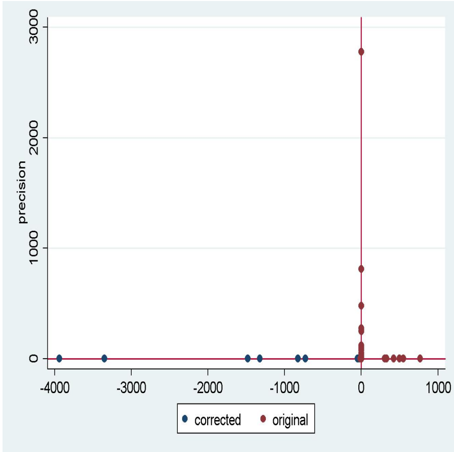
Following Stanley (2005, 2008) and Stanley, et al. (2008) we carry out formal tests of publication bias in addition to the funnel plots shown in this section. Figure (5) also depict funnel plots. The difference here is that, the number of years of data available after the passage of *agoa* is varied. The figure indicates that among the studies chosen, publication bias tends to increase as more data becomes available. This might not be indicative of publication bias but an indication of the fact that with the passage of time more and more countries adopt *agoa* and increase their exports to the US under the program. If that is the case, then more positive coefficients would be expected as displayed in the various sub-figures of Figure (5). Sub-figure (g) shows that studies with 8 years of *post-agoa* data only reported positive coefficients without any negative coefficients in their analysis.

We include two Galbraith plots in Figure (3). A considerable number of coefficients obtain t-statistics greater than 2 in absolute value. Two lines of fit are also included in the diagram. The green line indicates the fit for unpublished studies while the thick red line indicates the fitted values for the published studies. The large reported estimates were present in one unpublished study hence, the line of fit becomes very steep in the second panel. Panel (a) excludes the six large estimates whiles Panel (b) includes them. Both figures are consistent with the funnel plots shown earlier. Finally, Figure (4) plots the coefficients (and T-stats) reported against the number of *post-agoa* years of data available as well as the number of years after *agoa*, the paper was written. A quadratic fit is added in each sub-figure. The figures indicate a slight *U-shaped* relationship. In the initial years after *agoa*, large coefficients and highly significant results were reported. However, this tended to reduce till 6 years after *agoa* when larger and more significant coefficients were reported again. Thus with the passage of time smaller coefficients are reported while larger t-statistics are reported. This is similar to the findings of Stanley, et al. (2008) for the relationship between t-statistics and unemployment. Although, they show an inverted-U shaped quadratic fit[1] they also find larger absolute t-statistics reported with the passage of time.

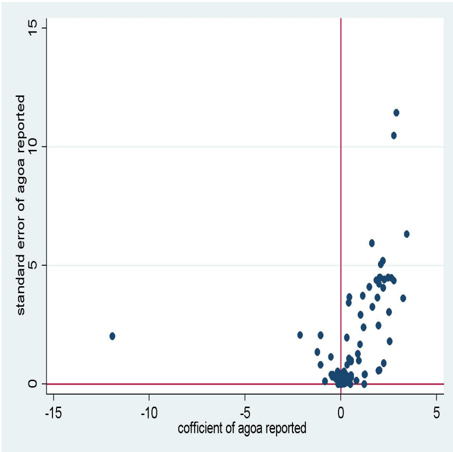
[1]Their t-statistics are all negative compared to ours that are mostly positive. Thus considering absolute values we both display a similar trend. To establish this result further, we would require more annual data on published studies *post-agoa*



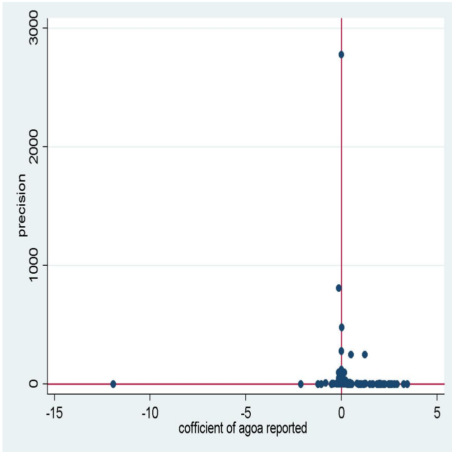
(a) Precision vs. correlation (all studies)



(b) precision vs. corrected coefficients



(c) Standard error vs. coefficient (excluding 6 large values)



(d) Precision vs. coefficient (excluding 6 large values

Figure 1: Funnel plots of agoa impact

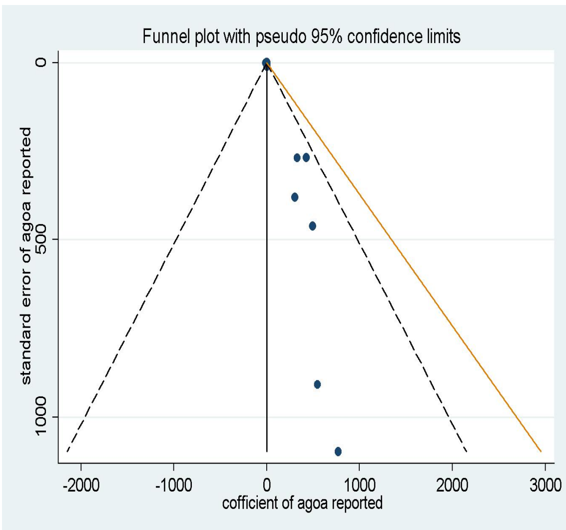
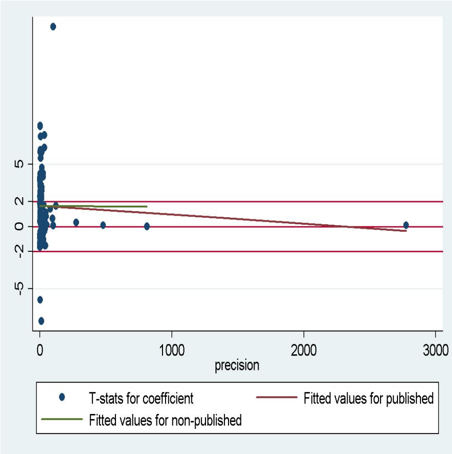
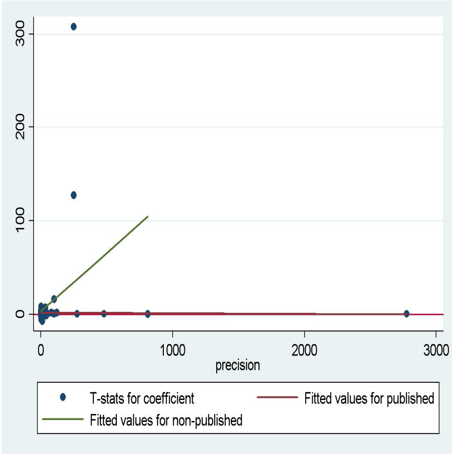


Figure 2: Standard error vs. coefficient based on Egger, et al. (1997) methodology

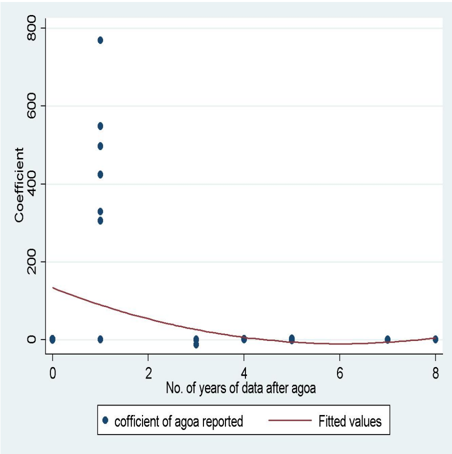


(a) precision vs. T-stats (6 large estimates excluded)

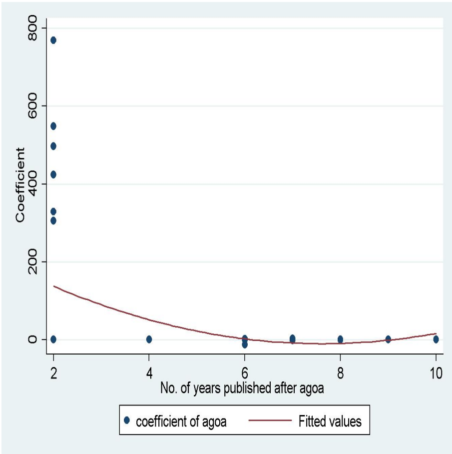


(b) precision vs. T-stats (all estimates included)

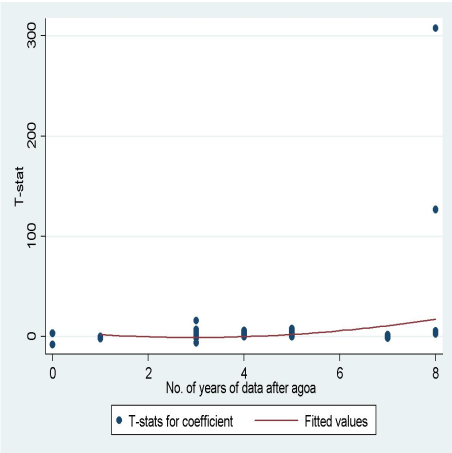
Figure 3: Galbraith plots of agoa impact



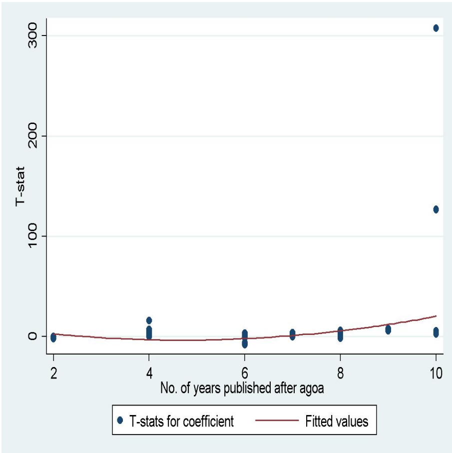
(a) coefficient vs. no. of years of data post agoa



(b) cofficient vs. no. of years published post agoa

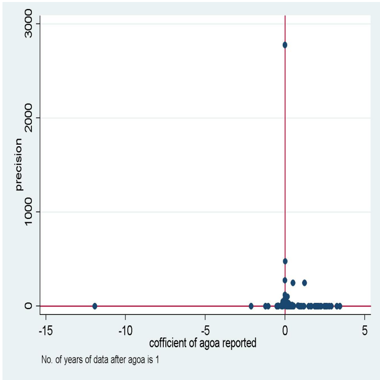


(c) t-statistics vs. no. of years of data post agoa

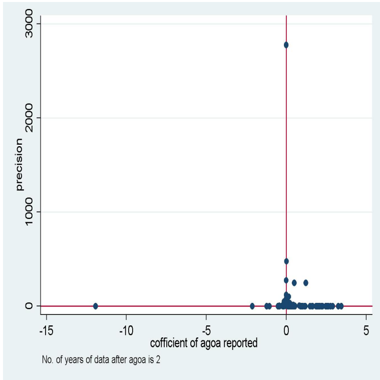


(d) t-statistics vs. no. of years published post agoa

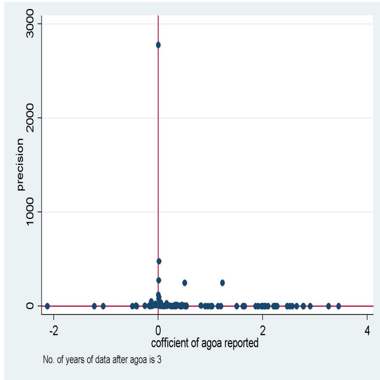
Figure 4: Relationship between years after agoa and coefficient/T-stat



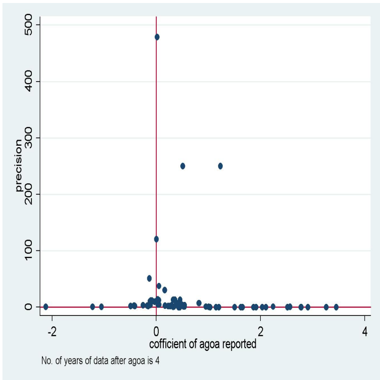
(a) 2 or more years after agoa



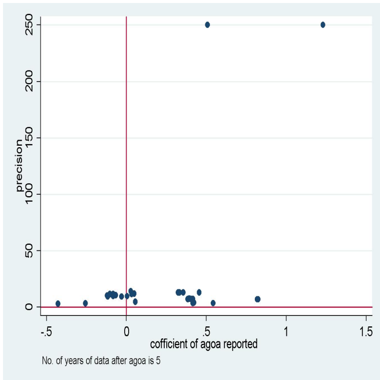
(b) 3 or more years after agoa



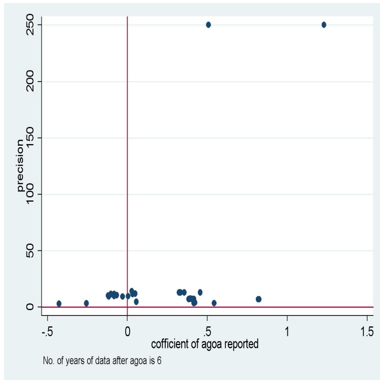
(c) 4 or more years after agoa



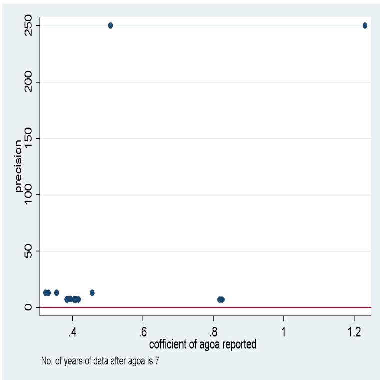
(d) 5 or more years after agoa



(e) 6 or more years after agoa



(f) 7 years after agoa



(g) 8 years after agoa

Figure 5: Precision vs. coefficient based on number of years after agoa

4 Results

Random Effects Meta-Analysis

In the analysis presented we excluded Mueller (2008) since it reported one coefficient and its inclusion did affect results of the various MRAs. In addition, the coefficients from the first table of Tadesse, et al (2008) were included in the analysis. The remaining tables in their paper reported similar (and in many case the same) coefficients in Tadesse and Fayissa (2008). In two studies (Nouve and Staatz, 2003, Seyoum, 2007) probability values were reported instead of t-statistics or standard errors. Hence, the inverse of the t-distribution was used to recover the t-statistics—the distribution of these imputed statistics are presented with the summary statistics reported in Table (1) in the appendix.

The summary statistics and the studies used in the meta analysis are presented in the appendix (Tables (1) –(2)). The results of the random effects meta analysis are presented in the appendix also. Figure (1) presents a visual representation of the summary meta analysis by study. The length of the diamonds in the graph represent the confidence intervals of the pooled study effects of each study. Three studies have a negative pooled estimate (Cooke, 2009, Nouve and Staatz, 2003, Seyoum, 2007). Of the three studies only Nouve and Staatz (2003) reports a significant pooled estimate. The remaining pooled coefficients are positive and three of these are significant. Table (3a) in the appendix presents the underlying data for the forest plot discussed above. Table (3b) presents the tests of heterogeneity. Five of the studies display high levels of heterogeneity reporting I^2 values of 69.7% – 99.9%. Five out of the remaining six studies have an I^2 value of zero indicating that there is no real variance between their coefficients. The pooled estimate of all studies of 0.124 is significant and also displays high heterogeneity ($I^2 = 99.9\%$). Thus, the pooled *agoa* impact is 13.2% ($(\exp^{0.124} - 1) \times 100$). Table (3c) reports the z – values and their respective probability values for tests of significance of the pooled estimates.

Due to the heterogeneity present in the studies (Table (3b)), pooled estimates from the *FEM* would be biased and hence its results are not reported in the appendix. However, for comparative purposes the estimate of the *FEM* was 0.007 (0.7%) which is much less than the 13.2% estimate reported by the *REM*. The results shown in the appendix excluded one study (Mueller, 2008)—the inclusion of this study reduces the pooled effect to 0.121 (12.9%)[2]. On the contrary, excluding the six large coefficients (305.1 – 769.5) reported in Nouve and Staatz (2003) did nothing to alter the results presented in the appendix—the pooled effects remained the same.

Meta-Significance Tests

We present the *MST* results (tests of genuine empirical effect) in Table (1). Results in columns (1), (3) and (4) point to the presence of a genuine empirical effect. The regressors—the log of degrees of freedom, sample size and square root of degrees of freedom are all significant at the 1% level of significance in each of the 3 columns respectively. However, columns (2) and (5) find no effects. The square root of degrees of freedom and precision are insignificant also in the remaining columns. In column (5) we followed Stanley (2008) by shrinking the t-statistic value to zero and using it as the dependent variable. All three estimates of the genuine effect are greater than zero and less than half in columns (1) and (3) of the table. A t-test of $\alpha_1 = \frac{1}{2}$ is rejected in all three cases (with t values of 12.41, 12.40 and 2302 respectively) with the result—$\alpha_1 < \frac{1}{2}$.

[2]In the *FEM* model the pooled estimate was 0.006 after including Mueller (2008) indicating a marginal decrease of 0.001.

Table 1: MST—Test of Authentic effect

	(1) log of T-stat	(2) T-stat	(3) log of T-stat	(4) log of T-stat	(5) Corrected T-stat
log of degrees of freedom	0.175^{***}				
	(0.026)				
degrees of freedom (square root)		0.013		0.001^{***}	
		(0.008)		(0.000)	
N (in logs)			0.176^{***}		
			(0.026)		
precision					-0.010
					(0.013)
Constant	-1.059^{***}	1.400^{*}	-1.078^{***}	0.066	
	(0.224)	(0.549)	(0.227)	(0.092)	
Observations	172	173	172	172	173
R^2	0.218	0.061	0.220	0.227	0.008
F-test	45.10	2.362	45.57	30.28	0.515

Robust Standard errors in parentheses, Absolute values of T-stat used
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Pooled Meta-Regression Analysis

In Table (2), our initial *FAT/PET* results are presented using a random effects model. Precision is insignificant in all three columns of the table, indicating the absence of a genuine effect. The constant (β_0) in Equation (8) is significant at 5% in column (2) indicating the presence of publication bias. In the remaining two columns the *FAT* is not passed. This is not however, indicative of the absence of publication bias, given that the funnel plots are consistent with the result from column (2). We believe it is the nesting of several coefficients per study which is driving this. In terms of the remaining variables in columns (2) and (3), it is observed that the number of explanatory variables, annual data and logged dependent variable contribute to higher t-statistic values, all things equal. On the contrary, holding all other variables constant, the number of countries, cross-sectional data, robust standard errors, product fixed effects, GMM and Heckman/Tobit type estimators relative to other estimators reduce the reported t-statistics. These are all in line with expectations—for example robust standard errors tend to reduce the bias in reported t-statistics, while increasing the number of countries (increases the sample size) and dilutes the effect of the reported *agoa* coefficient. Nevertheless, product fixed effects, GMM and Heckman/Tobit estimators tend to reduce the bias in OLS coefficients. Further analysis to investigate the publication bias and the evidence of a genuine effect are presented in the remaining tables to enable us reach a more definitive conclusion on the presence of publication bias and genuine effects.

Table 2: Random effects meta-regression results

	(1)	(2)	(3)
	T-stat	T-stat	T-stat
precision	0.00443	4.276	0.366
	(0.009)	(3.055)	(0.687)
no. of explanatory variables		0.0417^{***}	0.0416^{***}
		(0.001)	(0.001)
N (in logs)		-0.00369	-0.000990
		(0.016)	(0.015)
no. of years (logs)		-0.289	-0.702
		(1.056)	(0.444)
no. of countries (logs)		-0.0613^{*}	-0.0552^{*}
		(0.028)	(0.026)
annual = 1		-4.897	1.614^{**}
		(3.858)	(0.510)
published = 1		2.326	0.00784
		(3.427)	(0.023)
country effects = 1		2.493^{*}	-0.0776
		(1.145)	(0.308)
time effects = 1		0.0140	-0.0267
		(0.135)	(0.124)
cross section = 1		1.311	-2.309^{**}
		(17.103)	(0.864)
other preferences included = 1		-0.290	0.110
		(15.539)	(0.163)
gravity regression = 1		8.338^{+}	-0.583^{**}
		(4.250)	(0.178)
robust s.e. = 1		-0.143^{**}	-0.160^{***}
		(0.046)	(0.043)
product effects = 1		-2.893^{*}	0.0964
		(1.193)	(0.125)
logged dep. var. = 1		-0.211	0.244^{*}
		(0.590)	(0.111)
product group = "All/Total"		-0.0560	
		(0.191)	
product group = "Apparel & Textiles"		-0.0584	
		(0.128)	
product group = "Agriculture"		0.0650	
		(0.074)	
regions included = AGOA countries		-3.870	
		(15.307)	
regions included = AGOA + N. Africa		-8.448	
		(7.026)	
definition of dep. var. = Exports		-0.277	
		(15.264)	
definition of dep. var. = Imports		2.871	
		(15.228)	
time frequency = Monthly		-5.060	
		(3.842)	
econometric method = GMM		-2.620^{*}	
		(1.319)	
econometric method = Heckman/Tobit		-8.678^{**}	
		(2.952)	
level of aggregation = Aggregate		0.0950	
		(0.113)	
level of aggregation = Less Aggregate		-2.223	
		(3.424)	
single country analysis			1.015^{**}
			(0.336)
Constant	2.769	-0.707^{*}	-0.392
	(2.135)	(0.356)	(0.313)
Observations	173	173	173
$\tau^2 = 0$ constant only model	730.5	6550.9	730.5
τ^2 estimate	733.9	7.923	7.215
LR test of $\tau^2 = 0$	1.31107e+10		320466.4
degrees of freedom	171	150	156

Standard errors in parentheses, All explanatory variables are divided by the standard error
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

On the contrary, Table (3) which presents the WLS results based on a fixed effects format indicates strongly the presence of publication bias and also the presence of a genuine empirical effect. Column (1) reports the basic *MRA* of Equation (8). The remaining columns include moderator variables. These are varied between the columns. The final two columns, however, use the variance (σ^2) of the reported coefficients as the weights. In all seven columns, precision and the constant are significant indicating the presence of genuine effects and publication bias respectively. With the exception of precision in column (4) and the constant in column (3) (5% and 10% significance levels respectively) all remaining coefficients are significant at the 1% level. In two cases, the constant is positive (first two columns). Precision is also negative in two cases (columns (2) and (4)). In the simple *MRA* of Equation (8), precision and the constant appear positive in all tables presented in the main section except column (6) of Table (3) which reports a negative constant term. Thereby indicating a positive genuine empirical effect of the *agoa* literature. However, including moderator variables has caused changes in the signs of our constant term in some cases.

The number of explanatory variables in a study is positive and significant at the 1% level in all four columns it appears. The *agoa* dummy (columns (3), (5) and (7)), Africa and North Africa relative to the world (columns (4) and (5)), selection correction (columns (3), (5) and (7)), country fixed effects (columns (3) and (7)) and cross-sectional data (columns (3) and (7)) are all significant at the 5% level and contribute to a decrease in the reported t-statistics, all things equal. On the contrary, product fixed effects (columns (3) and (7)), other preferences (columns (3) and (7)), logged dependent variable (columns (3) and (7)), agricultural dummy (columns (4) and (5)), sample size (columns (2) and (7)), single country analysis (columns (3) and (7)) and published studies (columns (5) and (7) are also significant at the 5% level but have a positive association with the reported t-statistics. All things equal, these variables lead to larger t-statistics.

Aggregated data (columns (4) and (5)) on the other hand is positive and significant at the 10% level implying that, holding all things equal, more aggregated definitions of exports/imports lead to larger t-statistics relative to highly disaggregated data. Of the remaining coefficients annual data relative to monthly data is positive and significant in column (4) while monthly data relative to quarterly data (column (5)) and Heckman/Tobit estimators (column (4)) relative to other estimators are negatively related to the reported t-statistics. A few of the significant coefficients are observed to reverse their signs as more moderator variables are included in the regression. Examples include, the coefficients of robust standard errors (negative in columns (3) and (5), positive in column (7)), gravity estimators (negative in columns (3) and (7), positive in column (5)), annual data relative to other formats (positive in (3) and (7), negative in column (5)), number of years (positive in column (2), negative in columns (3) and (7)) and number of countries (negative in columns (3)–(5), and (7) and positive in column (2)).

Table 3: Weighted Least Squares meta regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	T-stat	T-stat	T-stat	T-stat	T-stat	T-stat	T-stat
Constant	2.693***	1.932***	-0.253*	-0.572***	-0.406***	-28.82***	-0.360***
	(0.077)	(0.079)	(0.101)	(0.097)	(0.109)	(0.001)	(0.006)
no. of explanatory variables		0.0422***	0.0416***	0.0416***	0.0416***		0.0425***
		(0.000)	(0.000)	(0.000)	(0.000)		(0.000)
N (in logs)		0.0175***	0.000443	0.00515	-0.00195		-0.0162***
		(0.000)	(0.006)	(0.005)	(0.006)		(0.000)
No. of years used (log)		0.0448***	-0.392*	0.0198	-0.269		-0.378***
		(0.002)	(0.166)	(0.086)	(0.375)		(0.025)
No. of countries (log)		0.384***	-0.0535***	-0.0642***	-0.0561***		-0.0285***
		(0.003)	(0.010)	(0.010)	(0.010)		(0.000)
annual = 1			1.241***		-2.880*		1.092***
			(0.190)		(1.214)		(0.031)
selection correction = 1			-0.190***		-0.189***		-0.252***
			(0.049)		(0.049)		(0.004)
published = 1			0.0106		2.287*		0.0117***
			(0.009)		(0.977)		(0.000)
country effects = 1			-0.283*		0.384		-0.235***
			(0.115)		(0.560)		(0.016)
time effects = 1			0.00382		0.0105		-0.00122
			(0.046)		(0.048)		(0.004)
cross section = 1			-2.256***		-4.005		-2.485***
			(0.320)		(4.257)		(0.044)
other preferences included = 1			0.200***		0.699		0.151***
			(0.061)		(3.553)		(0.010)
gravity regression = 1			-0.466***		4.300**		-0.379***
			(0.066)		(1.514)		(0.011)
agoa dummy = 1			-2.707***		-2.196***		-2.673***
			(0.262)		(0.422)		(0.103)
robust s.e. = 1			-0.144***		-0.139***		0.00619***
			(0.016)		(0.017)		(0.001)
product effects = 1			0.153**		-0.864		0.391***
			(0.047)		(0.570)		(0.005)
single country analysis = 1			0.834***				0.972***
			(0.125)				(0.015)
logged dep. var. = 1			0.288***		-0.116		0.331***
			(0.041)		(0.208)		(0.005)
product group = "All/Total"				-0.00637	-0.0311		
				(0.056)	(0.068)		
product group = "Apparel & Textiles"				-0.0369	-0.0436		
				(0.045)	(0.045)		
product group = "Agriculture"				0.0609*	0.0550*		
				(0.026)	(0.026)		
regions included = AGOA countries				-0.0514	-2.874		
				(0.068)	(3.493)		
regions included = AGOA + N. Africa				-0.287***	-6.300**		
				(0.069)	(2.054)		
definition of dep. var. = Exports				-0.214	0.696		
				(0.264)	(3.502)		
definition of dep. var. = Imports				0.156	1.813		
				(0.245)	(3.455)		
time frequency = Annual				0.488**			
				(0.157)			
time frequency = Monthly				-0.0248	-2.959*		
				(0.134)	(1.208)		
econometric method = GMM				-0.00367	-0.657		
				(0.057)	(0.607)		
econometric method = Heckman/Tobit				-0.873***	-2.552		
				(0.121)	(1.567)		
level of aggregation = Aggregate				0.0686^{+}	0.0712^{+}		
				(0.039)	(0.040)		
level of aggregation = Less Aggregate				0.0779*	-2.206*		
				(0.040)	(0.976)		
Precision	0.00449***	-2.228***	2.584***	-0.258^{+}	4.384***	0.0128***	2.489***
	(0.000)	(0.009)	(0.342)	(0.149)	(1.056)	(0.000)	(0.107)
Observations	173	173	173	173	173	173	173
goodness of fit–χ^2	120496.0	7710.6	862.6	1074.5	836.8	1.31107e+10	316374.3
model χ^2	1217.4	114002.8	120850.8	120639.0	120876.6	600194512.9	1.37106e+10

Standard errors in parentheses. All explanatory variables divided by standard error. The last two columns use the square of the standard error as weights

$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Multi-Level Meta-Regression

The final table, Table (4) below presents the multi-level *MRA* results. We include these results to check the robustness of our earlier results given that that our coefficients are nested in the individual studies. The intercept is the only random component included in the 2-level multi-level *MRA*. In column (2) in the table, precision is negative and significant at the 1% level of significance. The number of explanatory variables, product fixed effects and logged dependent variables contribute to higher to t-statistics holding all else constant. The remaining significant variables in the final column of the table, number of years, cross-sectional studies and gravity regressions reduce the reported t-statistics holding all else constant. On the contrary, annual data and single country studies contribute to higher t-statistic values. All the variables in the preceding are significant at 1% with the exception of the number of years coefficient that is significant at the 10% level of significance. The random component of the model ($\ln \sigma_u$) and the residual standard error ($\ln \sigma_e$) are significant in all three columns. These indicate that the studies are largely different from each other. The variance partition component (*VPC*) corroborates this evidence together with the I^2 tests discussed earlier which all point to heterogeneous studies. The *VPC* calculated are 6%, 18.8% and 82.6% for columns (1) – (3) respectively. They indicate the level of variance in study level t-statistics that can be attributed to differences between the various studies in the sample. In column (3), the *VPC* is large and implies that, 82.6% of the variance is due to differences between the studies. On the contrary, the basic *MRA* in column (1) attributes only 6% of the variance to differences between the studies. Thus one observation from the table, is that increasing the moderator variables and controlling for some of the variation between studies tends to account for the larger values of the *VPC* observed in columns (2) – (3). In the appendix, we include Mueller (2008) to check if the study's exclusion affects the results presented in this section. Table (4) in the appendix shows that this is not the case. We observe similar estimates consistent with that presented here for the multi-level model. In addition, excluding the six large coefficients does not change the results and the results are similar to those presented here (the results are not presented in the paper).

In concluding, the number of explanatory variables, logged dependent variables, single country studies, cross sectional data and published studies are consistent in all three tables and maintain the same signs. The *FAT/PET* and *MST* in most cases have provided evidence of a genuine empirical effect and publication bias. Thus corroborating earlier evidence presented in the funnel and Galbraith plots of section (3). We do not find strong evidence, that textiles & apparel significantly increase the reported t-statistics. On the contrary, there is some evidence on agriculture increasing the t-statistic values relative to other products, all things equal. Last but not the least, we do find some evidence for the number of countries and composition of countries. However, the direction of the effect is not certain—we do obtain both positive and negative relationships of the coefficients in the results above.

Table 4: Multilevel meta regression results

	(1)	(2)	(3)
	T-stat	T-stat	T-stat
T-stat			
precision	0.00503	-1.182***	-0.108
	(0.009)	(0.106)	(0.412)
no. of explanatory variables		0.0267***	0.0422***
		(0.002)	(0.000)
product effects = 1		0.811***	0.400***
		(0.060)	(0.092)
logged dep. var. = 1		0.769***	0.339***
		(0.104)	(0.082)
country effects = 1		0.0419	-0.174
		(0.057)	(0.186)
published = 1		0.103^{+}	0.0124
		(0.057)	(0.013)
N (in logs)			-0.00713
			(0.008)
no. of years (logs)			-0.501^{+}
			(0.279)
no. of countries (logs)			-0.0210
			(0.017)
annual = 1			1.249***
			(0.307)
time effects = 1			0.00610
			(0.066)
cross section = 1			-3.395***
			(0.557)
other preferences included = 1			0.0183
			(0.105)
gravity regression = 1			-0.432***
			(0.110)
robust s.e. = 1			0.0385
			(0.030)
single country analysis			1.223***
			(0.240)
Constant	2.520	0.859	0.0797
	(2.889)	(1.148)	(0.953)
$\ln \sigma_u$ Random			
Constant	1.876***	1.178***	1.130***
	(0.422)	(0.289)	(0.237)
$\ln \sigma_e$ Residual			
Constant	3.249***	1.909***	0.352***
	(0.055)	(0.056)	(0.059)
Observations	173	173	173
LR test vs. linear regression	3.648	17.82	141.0
Variance partition component (%)	6	18.8	82.6

Standard errors in parentheses. All variables divided by the standard error.
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5 Conclusion

This paper has attempted a meta analysis of the *agoa* trade preference literature. The findings of the paper include evidence of publication bias and also the presence of a genuine empirical effect in the literature. The evidence of publication bias is corroborated by funnel and Galbraith plots presented in section (3) — which show clear signs of asymmetry in the plots. Secondly, the evidence of a genuine effect in our *MRAs* is also consistent with results obtained in the *MST* presented in the results section. There are some concerns though, of the changing signs of our coefficients of interest and non-significance of others (that is, (β_0/α_0 and β_1/α_1). An explanation of this, might be due to the conservative number of studies included in the meta analysis. In addition, the presence of several coefficients in each study which requires appropriate modelling of the *MRA* might also be an issue. In attempting to resolve this we used a multi-level model as a robustness check of our estimates. However, with multi-level modelling a good number of studies need to be used since the estimator has asymptotic properties. Possibly, in the near future there would be a lot more econometric studies on *agoa* to help resolve these issues by providing a larger sample of studies.

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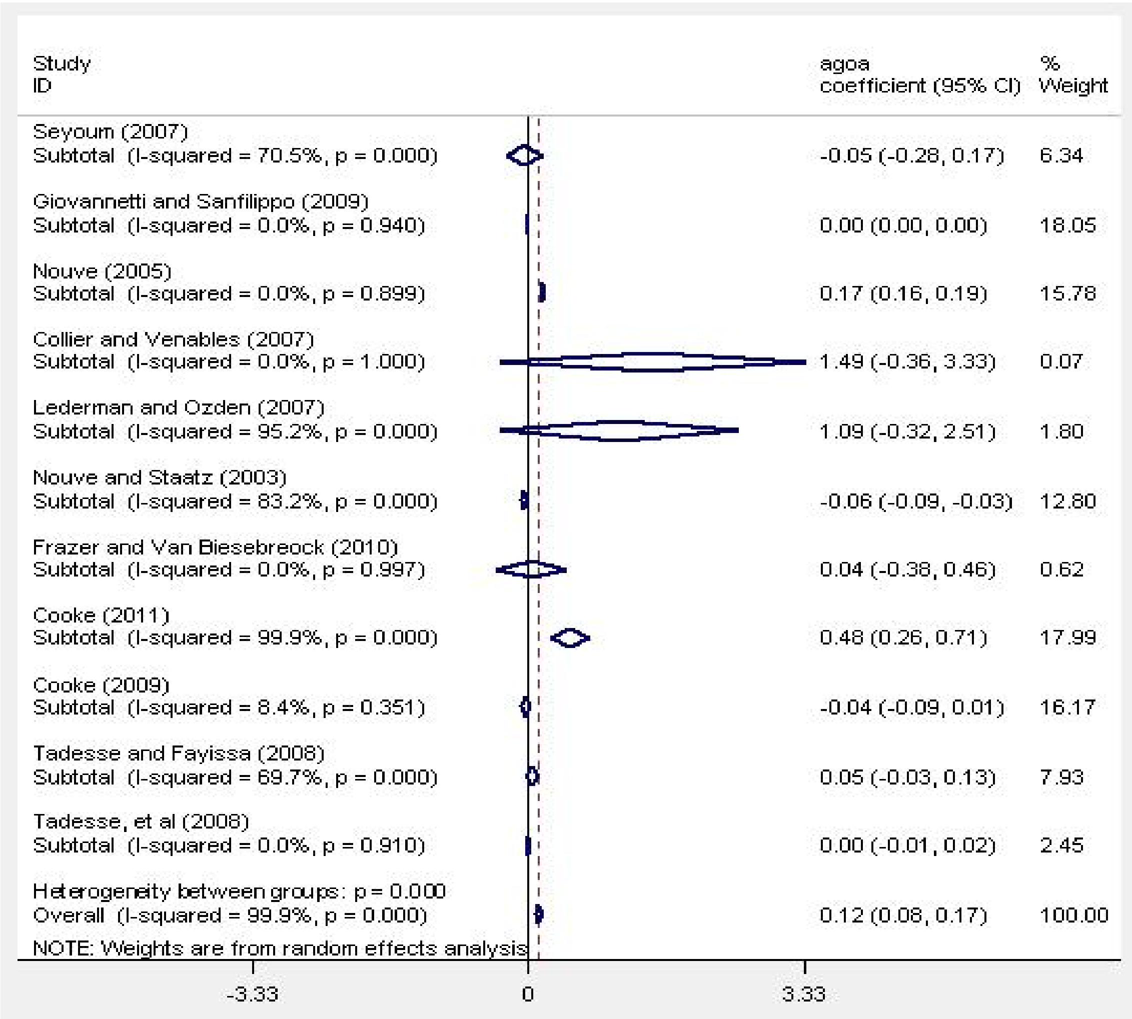
Appendix

Table 1: Summary Statistics

	description	count	mean	min	max
agoa coefficient	agoa coefficient reported in studies	174	16.874	-11.92	769.5
agoa standard error	standard error reported for agoa coefficient	174	20.383	0.000360	1097.127
T-stat	t-statistic reported (if not, $\frac{agoa}{standard error}$)	174	4.137	-7.579	307.500
Imputed T-stats from pvalues	t-statistics calculated from inverse t-distribution	25	-0.523	-1.656	2.333
no. of countries	number of countries in study	174	66.126	1	207
no. of years	number of years of data	174	11.989	1	18
no. of explanatory variables	number of explanatory variables (excluding constant and fixed effects)	174	11.161	2	37
N	sample size	174	3.27e+05	92	9.54e+06
annual = 1	dummy if data is annual	174	0.839	0	1
selection correction = 1	dummy if selection correction was used	174	0.034	0	1
published = 1	dummy for published studies	174	0.494	0	1
country effects = 1	dummy if regression includes country effects	174	0.695	0	1
time effects = 1	dummy if regression includes time effects	174	0.621	0	1
cross section = 1	dummy if data is a cross-section	174	0.029	0	1
other preferences included = 1	dummy if regression includes other preferences as explanatory variables	174	0.437	0	1
gravity regression = 1	dummy if gravity regression is used	174	0.511	0	1
agoa dummy = 1	dummy if agoa is defined as a 0,1 dummy	174	0.977	0	1
robust s.e. = 1	dummy if White's heteroscedastic-consistent standard are used errors are used	174	0.431	0	1
product effects = 1	dummy if product effects are included in the regression	174	0.161	0	1
single country analysis = 1	dummy if data is on a single country	174	0.057	0	1
logged dep. var. = 1	dummy if dependent variables is in logs	174	0.868	0	1
product group = "All/Total"	dummy for total/all products	174	0.408	0	1
product group = "Apparel & Textiles"	dummy for apparel and textile products in regression	174	0.092	0	1
product group = "Agriculture"	dummy for agriculture	174	0.167	0	1
reference category is other					
regions included = AGOA countries	dummy if only agoa countries are used in regression	174	0.552	0	1
regions included = AGOA + N. Africa	dummy if Africa is used in the regression	174	0.126	0	1
reference category is World					
definition of dep. var. = Exports	dummy if exports are used as dependent variable	174	0.489	0	1
definition of dep. var. = Imports	dummy if imports are used as dependent variable	174	0.477	0	1
reference category is other					
time frequency = Annual	dummy if data is annual	174	0.839	0	1
time frequency = Monthly	dummy if data is monthly	174	0.057	0	1
reference category is quarterly					
econometric method = GMM	dummy if a GMM approach is used	d 174	0.213	0	1
econometric method = Heckman/Tobit	dummy if Heckman/Tobit model is used	174	0.287	0	1
reference category is other					
level of aggregation = Aggregate	dummy if dependent variable is aggregated	174	0.609	0	1
level of aggregation = Less Aggregate	dummy if dependent variable is less aggregated	174	0.184	0	1
reference category is Least aggregated					
start year of data	dummy for initial year of data	174	1994.483	1991	2001
end year of data	dummy for final year of data	174	2005.489	2001	2009
Observations		174			

Table 2: Studies used in the meta-analysis

	No. of coefficients
Collier and Venables (2007)	9
Cooke (2009)	20
Cooke (2011)	20
Frazer and Van Biesebreock (2010)	4
Giovannetti and Sanfilippo (2009)	22
Lederman and Ozden (2007)	5
Mueller (2008)	1
Nouve (2005)	16
Nouve and Staatz (2003)	18
Seyoum (2007)	14
Tadesse and Fayissa (2008)	32
Tadesse, et al (2008)	13
N	174



Summary study effects reported for each study and total study effect. Tables 3a - 3c in the appendix present the underlying results.

Figure 1: Random effects meta-analysis by study

Table 3a: Meta analysis by Study and overall effect

Study	ES	95% Conf.	Interval	% Weight
Seyoum (2007)				
Sub-total				
D+L pooled ES	-0.054	-0.276	0.168	6.34
Giovannetti and Sanfilippo (2009)				
Sub-total				
D+L pooled ES	0.003	0.002	0.004	18.05
Nouve (2005)				
Sub-total				
D+L pooled ES	0.171	0.155	0.187	15.78
Collier and Venables (2007)				
Sub-total				
D+L pooled ES	1.486	-0.359	3.331	0.07
Lederman and Ozden (2007)				
Sub-total				
D+L pooled ES	1.093	-0.324	2.509	1.8
Nouve and Staatz (2003)				
Sub-total				
D+L pooled ES	-0.059	-0.092	-0.027	12.8
Frazer and Van Biesebreock (2010)				
Sub-total				
D+L pooled ES	0.037	-0.383	0.456	0.62
Cooke (2011)				
Sub-total				
D+L pooled ES	0.483	0.256	0.711	17.99
Cooke (2009)				
Sub-total				
D+L pooled ES	-0.039	-0.088	0.01	16.17
Tadesse and Fayissa (2008)				
Sub-total				
D+L pooled ES	0.047	-0.033	0.127	7.93
Tadesse, et al (2008)				
Sub-total				
D+L pooled ES	0.005	-0.011	0.021	2.45
Overall				
D+L pooled ES	0.124	0.075	0.173	100

Heterogeneity calculated by formula

$Q = \sigma_i \left(\frac{1}{variance_i}\right) \times (effect_i - effect_{pooled})^2$

where, $variance_i = \left(\frac{upper\ limit - lower\ limit}{2 \times z}\right)^2$

Table 3b: Tests of Heterogeneity

Test(s) of heterogeneity:	Heterogeneity statistic	degrees of freedom	P	I-squared**	Tau-squared
Seyoum (2007)	44.03	13	0.000	70.5%	0.0854
Giovannetti and Sanfilippo (2009)	11.98	21	0.940	0.0%	0.0000
Nouve (2005)	8.57	15	0.899	0.0%	0.0000
Collier and Venables (2007)	0.48	8	1.000	0.0%	0.0000
Lederman and Ozden (2007)	83.66	4	0.000	95.2%	2.4182
Nouve and Staatz (2003)	101.14	17	0.000	83.2%	0.0023
Frazer and Van Biesebreock (2008)	0.05	3	0.997	0.0%	0.0000
Cooke (2011)	16665.22	19	0.000	99.9%	0.2560
Cooke (2009)	20.75	19	0.351	8.4%	0.0011
Tadesse and Fayissa (2010)	102.28	31	0.000	69.7%	0.0072
Tadesse, et al (2008)	6.12	12	0.910	0.0%	0.0000
Overall	1.2e+05	172	0.000	99.9%	0.0572
Overall Test for heterogeneity between sub-groups:	1.0e+05	10	0.000		

** I-squared: the variation in ES attributable to heterogeneity

Table 3c: Significance test(s) of Study effect = 0

Significance test(s) of ES=0		
Seyoum (2007)	z= 0.48	p = 0.632
Giovannetti and Sanfilippo (2009)	z= 8.70	p = 0.000
Nouve (2005)	z= 21.51	p = 0.000
Collier and Venables (2008)	z= 1.58	p = 0.114
Lederman and Ozden (2007)	z= 1.51	p = 0.131
Nouve and Staatz (2003)	z= 3.60	p = 0.000
Frazer and Van Biesebreock (2010)	z= 0.17	p = 0.865
Cooke (2011)	z= 4.17	p = 0.000
Cooke (2009)	z= 1.55	p = 0.121
Tadesse and Fayissa (2008)	z= 1.14	p = 0.252
Tadesse, et al (2008)	z= 0.59	p = 0.558
Overall	z= 4.97	p = 0.000

Figure 4: Multilevel meta analysis results (all studies)

	(1)	(2)	(3)
	T-stat	T-stat	T-stat
T-stat			
precision	0.00504	-1.181***	-0.0458
	(0.009)	(0.105)	(0.405)
no. of explanatory variables		0.0267***	0.0422***
		(0.002)	(0.000)
product effects = 1		0.811***	0.398***
		(0.060)	(0.092)
logged dep. var. = 1		0.769***	0.337***
		(0.104)	(0.082)
country effects = 1		0.0420	-0.147
		(0.057)	(0.183)
published = 1		0.103^{+}	0.0123
		(0.057)	(0.013)
N (in logs)			-0.00748
			(0.008)
no. of years (logs)			-0.543*
			(0.274)
no. of countries (logs)			-0.0206
			(0.017)
annual = 1			1.295***
			(0.302)
time effects = 1			0.00454
			(0.066)
cross section = 1			-3.461***
			(0.549)
other preferences included = 1			0.00477
			(0.103)
gravity regression = 1			-0.444***
			(0.109)
robust s.e. = 1			0.0381
			(0.030)
single country analysis			1.253***
			(0.236)
Constant	2.470	0.850	-0.117
	(2.855)	(1.121)	(0.902)
$\ln \sigma_u$ Random			
Constant	1.867***	1.162***	1.111***
	(0.419)	(0.285)	(0.229)
$\ln \sigma_e$ Residual			
Constant	3.246***	1.907***	0.352***
	(0.055)	(0.056)	(0.059)
Observations	174	174	174
LR test vs. linear regression	3.642	17.78	141.0
Variation partition component (%)	6	18.4	82

Standard errors in parentheses. All variables divided by the standard error
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$