Is Regional Integration Beneficial For AgriculturalProductivity in Sub-Saharan Africa? The Case of CEMAC and WAEMU

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Abstract

This paper examines the effects of regional euro-currency integration on agricultural productivity in Sub-Saharan Africa. We utilize a propensity score matching estimator to estimate the treatment effect of Sub-Saharan African countries joining the CFA Franc Zone on agricultural value-added. Our parameter estimates reveal that CFA Franc Zone membership has positive effects on agricultural value-added. This suggests that as an institutional arrangement, regional currency union membership can improve agricultural productivity in Sub-Saharan Africa, which is an important component of achieving economic growth that is effective in reducing poverty.

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I. Introduction

The decline in the real value of output per capita in Sub-Saharan Africa relative to its population growth between 1961 - 2011 (Alston and Pardey, 2014) poses significant threats to individual welfare, as it could compromise food and human security (Rajaonarison, 2014) for individuals in Sub-Saharan Africa. Given the apparent critical role that agriculture has in reducing poverty (Collier and Dercon, 2014; Dethier and Effenberger, 2012), particularly for the poorest of the poor (Christiaensen, Demery and Kuhl, 2011), institutional and/or policy arrangements that induce increases in agricultural productivity in Sub-Saharan Africa can engender pro-poor economic development (Dorward et.al, 2004; Kidd et.al 2004)).

In this paper, we consider whether a particular institutional arrangement—a regional currency union—can be beneficial for agricultural productivity in Sub-Saharan Africa. We extend the analysis of Elu and Price (2008, 2014) and Price and Elu (2014), and consider whether membership in the CFA Franc Zone has beneficial and favorable treatment effects in the agricultural sector. Our results, while limited, will inform the extent to which institutional arrangements such as regional currency unions can enhance economic development in Sub-Saharan Africa through the agricultural sector.

The remainder of the paper is organized as follows. In Section II the data and empirical methodology are discussed. Our econometric strategy for identifying the treatment effects of regional currency integration is a potential outcomes approach, and utilizes a propensity-score matching estimator to determine the effects of regional currency union membership on total agricultural value We report parameter estimates in section III, and the last section concludes.

II. Data and Empirical Methodology

To estimate the treatment effect of currency union membership in Sub-Saharan Africa, we use *World Development Indicators* (2013) data SSA.[1] We parameterize the treatment effect of currency union membership within the potential outcomes framework (Imbens, 2004; Price, Spriggs and Swinton, 2011) of the Rubin causal model (Imbens and Rubin, 2010). For country observations indexed

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[1] *World Development Indicators* data are available at http://data.worldbank.org/data-catalog/world-development-indicators.

by $i = 1, \ldots N$, each observation is characterized by a pair of potential outcomes, $Y_i(0)$ for the outcome under the control treatment, and $Y_i(1)$ for the outcome under the treatment of currency union membership. Each unit is exposed to a single treatment W such that:

$$Y_i = Y_i(W_i) = \begin{cases} Y_i(0) & \text{if } W_i = 0 \\ Y_i(1) & \text{if } W_i = 1 \end{cases}$$

We utilize a propensity score matching scheme which selects control observations on the basis of the difference in propensity scores between treated and control observations.[2], and for the heterogeneity that can emerge in panel data. In particular, we estimate country-year-specific propensity scores similar to the panel-specific propensity score matching approaches Millard-Ball (2012) and Nielson and Sheffield (2009). In general, our propensity score matching scheme ensures that for matches in the sample, Sub-Saharan African countries who are members of CEMAC and WAEMU are compared only with those were most likely to have joined, but did no, as a function of panel-level observables, that may vary across panels a govern selection into the treatment. We implement this minimum distance algorithm with the Stata enabled matching with replacement program of Abadie et al. (2001).

As in Imbens (2004) and Price, Spriggs and Swinton (2011), for a sample characterized by (Y_i, X_i, W_i),, where X_i is a covariate measuring a characteristic, our matching estimator can identify three relevant sample treatment effect parameters (Abadie et al., 2001):

$$\tau_M^{sm} = \frac{1}{N} \sum_{i=1}^{N} [\hat{Y}_i(1) - \hat{Y}_i(0)]$$

$$\tau_M^{sm,t} = \frac{1}{N_1} \sum_{i:W_i=1} [\hat{Y}_i(1) - \hat{Y}_i(0)]$$

$$\tau_M^{sm,c} = \frac{1}{N_0} \sum_{i:W_i=0} [\hat{Y}_i(1) - \hat{Y}_i(0)]$$

τ_M^{sm} is the sample average treatment effect—the treatment effect for a randomly assigned country in the sample. This treatment effect not be policy relevant if there is selection into membership on the basis of eligibility requirements—of which not all countries can satisfy, or some who did satisfy, did

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[2]See Augurzky and Kluve (2007) for a consideration of propensity score distance matching.

not participate. In this context, $\tau_M^{sm,t}$ and $\tau_M^{sm,c}$, the sample average treatment effect on the treated and control observations respectively, can inform the impact of regional currency union membership on countries that actually joined currency unions, and those who were capable of joining a regional currency union but did not.

If we assume that assignment to the treatment is independent of the outcomes, then conditional on observables in X_i, as long as the conditional probability of receiving the treatment is between zero and unity, τ_M^{sm} and $\tau_M^{sm,t}$, and and $\tau_M^{sm,c}$ are identified. These two assumptions correspond to the ignorable treatment or selection on observables assumption of Rosenbaum and Rubin (1983). The practical import of these assumption is that they permit viewing data as if though it were generated from a randomized experiment. In this context, differences in the outcomes between treated and control observations are causally related to exposure to some treatment.

III. Results

We consider two binary treatments over the 1960 - 2013 time period, each associated with a Sub-Saharan African country joining the CFA Franc Zone which consists of two separate regional currency and economic unions in Sub-Saharan Africa: 1. West African Economic and Monetary Union (WAEMU) and 2. Central African Economic and Monetary Community (CEMAC). CEMAC includes the countries of Cameron, Central African Republic, Chad, Congo Republic of, Equatorial Guinea, and Gabon. WAEMU includes the countries of Benin, Burkina Faso, Cote d' Ivoire, Mali, Niger, Senegal and Togo. We report results on the effects of these treatments on the percent change in total agricultural value added from *World Development Indicators 2013*. It is defined as the net output of a country's formal agricultural sector after adding up all outputs and subtracting intermediate inputs. The propensity score, upon which the matching is based, is estimated as a function of a country's minimum gross domestic product over the 1960 - 2013 time period.[3] To allow for panel-specific heterogeneity across time (Millard-Ball, 2012; Nielson and Sheffield, 2009) the propensity score is estimated with a random country-year intercept. The propensity score matching estimates compares each treated observation with controls on the basis of 4 matches with replacement on a

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[3]This satisfies the requirement that a propensity score—the function determining the probability of selection into the treatment—is a function of covariates that cannot be altered by the treatment.

total of 1530 observations for which data on gross domestic product and total agricultural value-added were available in the data over the 1960 - 2013 time period.

Table 1 reports estimates of the treatment effects. In every instance, for both CEMAC and WAEMU, the treatment effect is positive and significant. That $\tau_M^{sm,c}$ is always positive and significant suggests that expansion of, or replication of CFAZ type regional currency unions could raise agricultural value-added for other Sub-Saharan African countries who are not currently members of a regional currency union. As for practical significance, on average the three treatment effects constitute an effect that is approximately 42 percent higher than average total agricultural productivity of all countries in the sample.

IV. Conclusion

This paper considered the effects of regional euro-currency integration on agricultural productivity in Sub-Saharan Africa. We utilized a propensity score matching estimator to estimate the treatment effect of Sub-Saharan African countries joining the CFA Franc Zone on agricultural value-added. Our parameter estimates reveal that CFA Franc Zone membership has positive effects on agricultural value-added. This suggests that as an institutional arrangement, regional currency union membership can improve agricultural productivity in Sub-Saharan Africa, which is an important component of achieving economic growth that is effective in reducing poverty.

As for limitations, our results are based on only one measure of agricultural productivity. There are other measures of agricultural productivity which are potentially more important for economic development in Sub-Saharan Africa. In future work, our aim is to consider these other measures and the extent to which regional currency unions favorably impact them.

Table 1

Propensity Score Matching Estimates of Currency Union Treatment Effect

Outcome:	Annual Growth in Agriculture Value-Added: CEMAC	Annual Growth in Agriculture Value-added: WAEMU
Treatment Effect:		
τ_M^{sm}	6.52	9.48
	$(1.06)^a$	$(.547)^a$
$\tau_M^{sm,t}$	9.18	5.49
	$(1.07)^a$	$(.572)^a$
$\tau_M^{sm,c}$	6.01	10.21
	$(1.21)^a$	$(.602)^a$
Number of Observations:	1530	1530
Number of Matches:	4	4

Standard errors in parentheses.
[a]Significant at the .01 level

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