ReSAKSS
Regional Strategic Analysis and Knowledge Support System
Facilitated by IFPRI

ReSAKSS Working Paper No. 40

September 2018

FROM MAPUTO TO MALABO: HOW HAS CAADP FARED?

Samuel Benin
International Food Policy Research Institute

About ReSAKSS:

The Regional Strategic Analysis and Knowledge Support System (ReSAKSS) is an Africa-wide network of regional nodes supporting the Common Market of Eastern and Southern Africa (COMESA), the Economic Community of West African States (ECOWAS), and the Southern African Development Community (SADC), in collaboration with the International Food Policy Research Institute (IFPRI) and the Africa-based centers of the Consultative Group on International Agricultural Research (CGIAR), to facilitate the implementation of the AU/NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP). The ReSAKSS nodes offer high-quality analyses to improve policymaking, track progress, document success, and derive lessons for the implementation of the CAADP agenda. ReSAKSS is jointly funded by the United States Agency for International Development (USAID), the UK Department for International Development (DFID), and the Swedish International Development Cooperation Agency (SIDA). The nodes are implemented by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Institute of Tropical Agriculture (IITA), the International Livestock Research Institute (ILRI) and the International Water Management Institute (IWMI), in collaboration with regional and national partners.

About the Working Paper series:

The goal of the ReSAKSS Working Paper series is to provide timely access to preliminary research and data analysis results that relate directly to strengthening ongoing discussions and critical commentaries on the future direction of African agriculture and rural development. It is expected that most of the Working Papers will eventually be published in some other form and that their content may be revised further.

Preferred citation:

Benin, Samuel. "From Maputo to Malabo: How Has CAADP Fared?" ReSAKSS Working Paper 40, International Food Policy Research Institute, Dakar, Senegal, and Washington, DC.

For more information, contact:

Samuel Benin (s.benin@cgiar.org), Deputy Division Director, Africa Regional Office
International Food Policy Research Institute
1201 Eye Street, NW
Washington, DC 20005 – 3915
Telephone: + 1 202 862 5606
Facsimile: + 1 202 467 4439
E-mail: resakss-africa@cgiar.org
www.resakss.org

THE AUTHOR:

Samuel Benin (s.benin@cgiar.org) is Deputy Division Director in the Africa Regional Office of the International Food Policy Research Institute (IFPRI).

ACKNOWLEDGEMENTS:

The authors acknowledge the contribution of data from the ReSAKSS nodes and Katrina Kosec, Danielle Resnick, Tewodaj Mogues, and John Ulimwengu for comments on a draft of this paper.

Funding for this work is from several agencies through the Regional Strategic and Knowledge Support System (ReSAKSS), which is funded by the United States Agency for International Development, the Bill & Melinda Gates Foundation, the International Fund for Agricultural Development, and the Ministry of Foreign Affairs of Netherlands. Earlier, ReSAKSS also received funding from the UK Department for International Development and the Swedish International Development Cooperation Agency.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMNS

agPER	agricultural public expenditure review
ATT	average treatment effect on the treated
AU	African Union
CAADP	Comprehensive Africa Agriculture Development Programme
COFOG	classification of the functions of government
GAFSP	Global Agriculture and Food Security Program
GDP	gross domestic product
IMR	inverse mills ratio
NAIP	national agricultural investment plan
NEPAD	New Partnership for Africa's Development
ODA	Official development assistance
ReSAKSS	Regional Strategic Analysis and Knowledge Support System

ABSTRACT

This paper uses panel data on 25 African countries from 2001 to 2014 and a country and year fixed-effects model to estimate the impacts of the Comprehensive Africa Agriculture Development Programme (CAADP), an agriculture-led integrated framework of development priorities in Africa, on government agricultural expenditure, official development assistance (ODA) for agriculture, and land and labor productivity. Instrumental variables and Heckman correction (inverse mills ratio) are used to address potential endogeneity and selection bias, respectively. The results show that implementing CAADP and reaching higher stages of implementation has had significant positive impact on government agricultural expenditure, ODA for agriculture, and land and labor productivity. The impact on government agricultural expenditure wanes over time, suggesting that there is substitution effect between the government's own funding and external sources of funding for the sector as countries advance in CAADP implementation. Implications for maintaining the positive impacts, as well as for further research, are discussed.

Keywords: Africa, agriculture, CAADP, treatment effects

JEL Codes: C23, C26, Q10

FROM MAPUTO TO MALABO: HOW HAS CAADP FARED?

1. INTRODUCTION

At the Second Ordinary Session of the Assembly of the African Union held in July 2003 in Maputo, Mozambique, the heads of state and government launched the Comprehensive Africa Agriculture Development Programme (CAADP). This agriculture-led integrated framework of development priorities in Africa is aimed at reducing poverty and increasing food security in the continent (AU-NEPAD 2003). Various processes at the national, regional, and continental levels have been put in place to facilitate the implementation of CAADP according to declared principles of African ownership and leadership, accountability and transparency, inclusiveness, and evidence-based planning and decision making, among others (AU-NEPAD 2014). The commitment to CAADP was renewed at the thirteenth Ordinary Session of the Assembly of the African Union in 2009 in Sirte, Libya, and again at the twenty-third Ordinary Session of the Assembly of the African Union in 2014 in Malabo, Equatorial Guinea. The private sector and development partners also committed to align accordingly; with for example the launch of the Grow Africa initiative for private sector enterprises (Grow Africa 2016) and development partners tying their assistance to progress in implementing CAADP, including the Global Agriculture and Food Security Program (GAFSP 2016) and the New Alliance for Food Security and Nutrition (New Alliance 2016).

Several achievements in the policy-making process have been associated with CAADP. For example, it is commonly mentioned that CAADP has raised the political profile of agriculture; has contributed to more specific, purposeful, and incentive-orientated agricultural policies; and has promoted greater participation of multiple state and nonstate actors in agricultural policy dialogue and strategy development (AU-NEPAD 2010). Some of the specific tools, mechanisms, and processes that have contributed to these achievements include the annual CAADP Partnership Platform and Business meetings since 2006 that bring the different stakeholders at different levels together to review progress and make plans for the future (AU-NEPAD 2014); preparation of the four pillar framework documents to guide adaptation of the CAADP principles and targets into national and regional policymaking (AU-NEPAD 2010); establishment of the knowledge systems to provide analysis that track progress, document success, and derive lessons for the implementation of the CAADP agenda (IFPRI 2014); development of a monitoring and evaluation

(M&E) framework (Benin, Johnson, and Omilola 2010) and a mutual accountability framework (Oruko et al. 2011); and establishment of the CAADP Multi-Donor Trust Fund to finance the CAADP processes at all levels (AU-NEPAD 2010). Prior to these observations, Ochieng (2007) argues that CAADP is an improvement on the policies that governed African agriculture in the past, as it has a broader vision that includes generating dynamic agricultural markets within countries and between regions and integrating farmers into the market economy, with farmers being a strategic partner in agricultural science and technology development. Brüntrup (2011) argues that because CAADP is continuously adapting to experiences during implementation and to expectations of stakeholders, it has not suffered the fate of many other African and AU-NEPAD (African Union–New Partnership for Africa's Development) initiatives that have faded away.

To our knowledge however, there has been no quantitative assessment of CAADP's impact on the development outcomes that it set out to achieve. This paper attempts to fill the knowledge gap by using panel data on 25 African countries from 2001 to 2014 to estimate the impact of countries' implementation of CAADP on several development indicators, including government agricultural expenditure, official development assistance (ODA) to agriculture, and agricultural land and labor productivity. A country and year fixed-effects model is used to estimate the impact of CAADP, which is defined in two ways based on the main milestones of achievement or the stage of CAADP implementation reached. A two-step control function (inverse mills ratio) procedure (Wooldridge 2010) is used to address endogeneity and selection bias, and different model specifications of the instruments and standard errors are employed to assess sensitivity of the results to different model assumptions. This is an improvement of the methodology used in Benin (2016) by better addressing endogeneity and selection bias, and including other relevant explanatory factors and year fixed-effects. Also, this paper focuses on government agricultural expenditure, ODA for agriculture, and land and labor productivity, which represent the more immediate outcome indicators of CAADP.

The results show that CAADP has had positive impact on government agricultural expenditure, ODA for agriculture, and land and labor productivity. Whereas the impact on government agricultural expenditure wanes over time and with advancement in implementation, the impact on land and labor productivity increases with advancement in implementation (i.e., when a country has a compact, an investment plan, and secured external sources of funding). The former suggests that there is substitution effect between the government's own funding and external sources of funding for the sector as countries advance in CAADP implementation. Because agricultural projects typically take a long time to produce results, the latter finding is not surprising, but it does highlight the importance of staying the course for the countries that started implementing CAADP late. Whereas these are generally consistent with the findings of Benin (2016), there are no puzzling results.

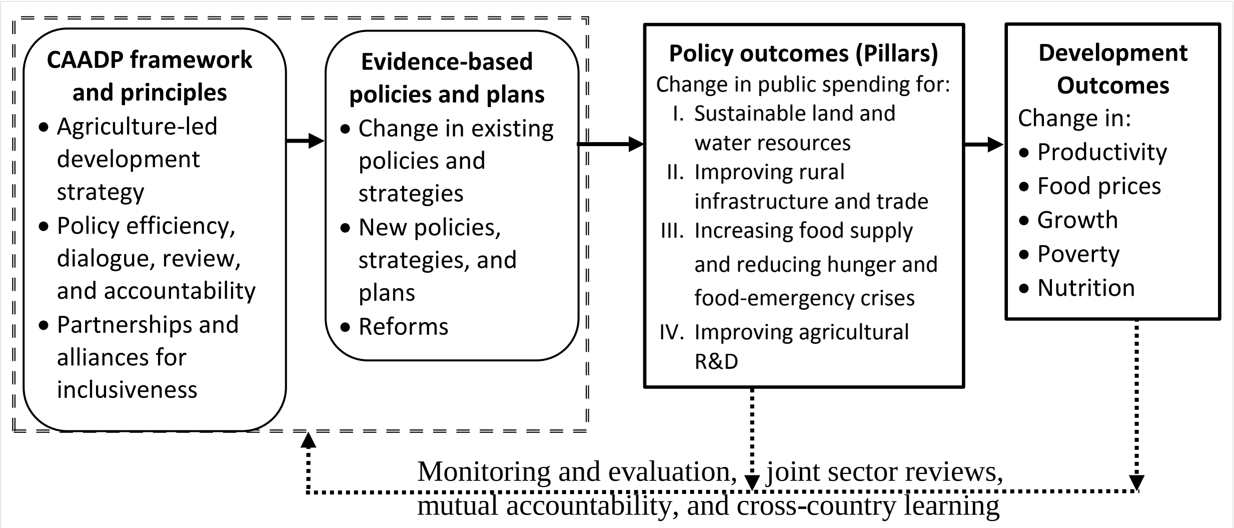
The next section of this paper presents a brief account of the CAADP implementation process and the conceptual framework used for measuring the treatment effects of CAADP. Section 3 presents the data and empirical methods used in the estimation. The results are presented and discussed in Section 4, followed by conclusions and implications in Section 5.

2. THE CAADP PROCESS AND CONCEPTUAL FRAMEWORK

When the African heads of state launched CAADP in 2003, they took on the Millennium Development Goal of reducing the 1992 levels of poverty and hunger by half by 2015, through the pursuit of 6 percent annual average growth in the agriculture sector, in addition to spending an annual average of 10 percent of total government expenditure in the sector. Various processes were put in place to facilitate implementation in a participatory, inclusive, evidence-based manner (AU-NEPAD 2010).

A generalized impact pathway of CAADP may be described as shown in Figure 1, where CAADP is a framework for supporting evidence- and outcome-based agricultural policy planning and execution. Adhering to the principles is expected to safeguard design and implementation of good policies and sound investments in four major areas or pillars, which are in turn expected to raise productivity, accelerate growth, reduce poverty, and achieve food and nutrition security. The feedback linkages associated with monitoring and evaluation and cross-country learning (represented by the dotted line-arrows) reflect the dynamism in the implementation process.

Figure 1. CAADP impact pathway

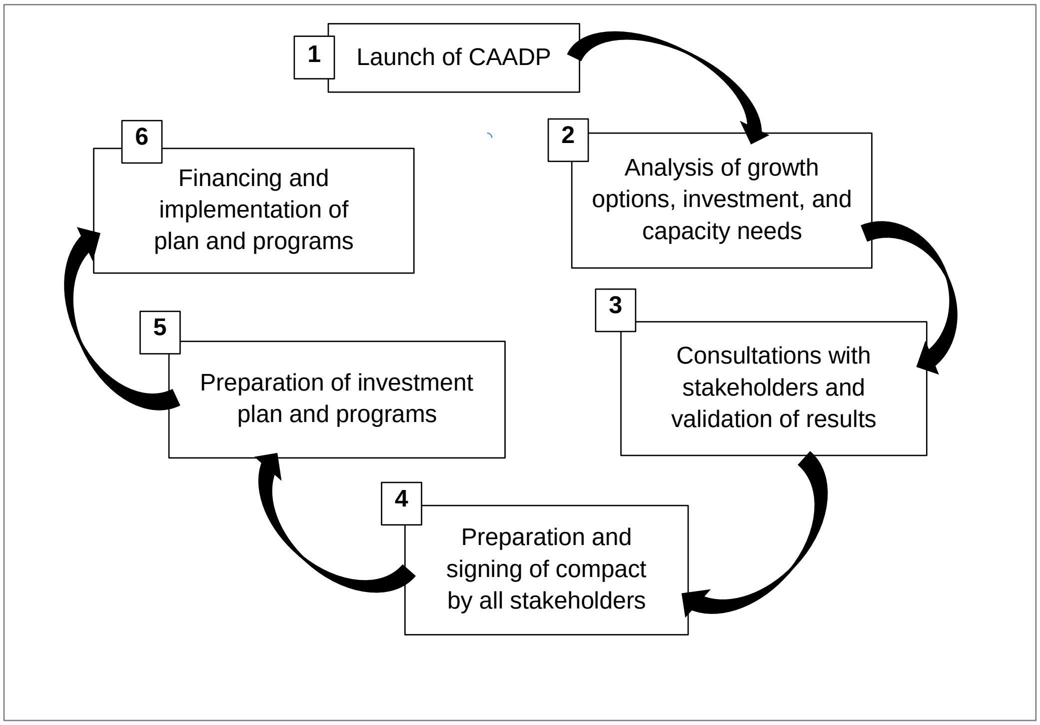


Source: Author's illustration.

Ideally, one would like to start with the adoption of the CAADP framework and principles in different countries and trace their consequences sequentially over time from changes in policies to policy and development outcomes. Thus, one would first demonstrate that the adoption of the CAADP framework and principles led to activities and outputs that had some influence on policies and plans, otherwise further steps along the impact pathway are not worth pursuing. Similarly, one would show that change in policies and plans led to change in public spending and programs, which in turn led to possible development outcomes. Unfortunately, CAADP is not a single well-specified intervention, but a set of a multi-component process and program, which suggests that the impact pathway is complex, with multiple relationships. Furthermore, we are dealing with multiple countries, each with a different policy environment and pursuing different policy priorities, which there is limited information on to analyze with the panel dataset that we have compiled for this study (more on this later). As such we cannot estimate the sequential relationships between the adoption of the CAADP framework, policy change, and policy outcome, and must settle for estimating a direct relationship between adoption of the CAADP framework and outcomes. Essentially, the steps along the impact pathway contained within the dashed rectangle in Figure 1 are intertwined, which, based on defined key milestones in the CAADP country process, can be illustrated further as shown in Figure 2.

Starting with a launch event in the country (stage 1 in Figure 2) where different stakeholders are sensitized about the objectives and principles of CAADP, as well as of the expectations of inclusive participation in implementation, evidenced-policies and plans can be seen as part of the adoption process. This is catalyzed by various analyses of policies and agricultural performance, growth and investment options, and capacities for implementation (stage 2), consultations with all stakeholders (stage 3), followed by the development and signing of the compact (stage 4), the national agricultural investment plans (NAIPs) and programs (stage 5), and financing and implementation (stage 6). Sources of funding includes the CAADP-aligned financing mechanisms such as the Global Agriculture and Food Security Program (GAFSP 2016) and the New Alliance for Food Security and Nutrition (New Alliance 2016).

Figure 2. Process of adoption of the CAADP framework at country level



Source: Author's illustration based on AU-NEPAD (2010).

Therefore, the analysis could be conceptualized as estimating the relationship between successive stages of adoption of the CAADP framework and the outcomes, with each stage having a specific channel of impact. For example, the launch of CAADP (stage 1) has been associated with governments being pressured to increase the amount spent on the agricultural sector to the 10 percent targeted by CAADP. When Ghana's Ministry of Finance and Economic Planning released the government's 2013 budget for example, the blog Food Security Ghana posted a commentary titled "Ghana Food and Agricultural Budget 2013 Part II—The Ten Percent Lie" pointing out that the budget allocated to the Ministry of Food and Agriculture represented only 1.4 percent and was far short of the 10 percent the government has been claiming to allocate to the agriculture sector (FSG 2013). Debate of what constitutes agricultural expenditures has also ensued, with different definitions arising and prompting various studies on agricultural public expenditure reviews (agPERs). Some of the agPERs supported by World Bank for example have used the COFOG-plus definition to include expenditures on feeder roads for example (MOFA 2013).[1] With analysis and evidence on various issues becoming available via stage 2, we can expect more informed dialogue on the issues, and consensus building going from stage 3 to 4. Signing of the compact, which identifies priority areas for investment and roles of the various stakeholders, is important for gaining buy-in from all the stakeholders. For the different stakeholders, the compact is typically signed by the minsters of agriculture and finance, and representatives for the private sector, civil society, development partners, regional economic community, and African Union. At this stage therefore, we can expect the channel of impact to derive from alignment of more immediate investments to the identified priority areas, as well as better coordination and harmonization of ongoing activities by the various stakeholders. This pathway is further enhanced with the development of the NAIPs and programs in stage 5, which focused on the options and resources required to reach specific national objectives. Financing and implementation of the NAIP and programs in stage 6 culminates into complete adoption of the CAADP framework, with the main channels of impact being determined by the allocation of resources to the different investment areas or pillars (AU-NEPAD 2003).

Estimating the relationship between the successive stages of adoption of CAADP and development outcomes, such as productivity, might be viewed as a reduced-form relationship, since we cannot explicitly demonstrate causation at each step along the impact pathway. Furthermore, given the distance between adoption of CAADP and development outcomes, credibility of any finding of a significant relationship between them relies on showing a significant relationship between adoption of CAADP and public investment. We use the theory and documented evidence of the impact agricultural programs in general to guide the choice of control variables to address this.

[1] COFOG is the classification of the functions of government (IMF 2001), which includes crops, livestock, fishery, forestry, and hunting.

2.1. Definition of Adoption of CAADP or Treatment

As Figure 2 shows, adoption of CAADP can defined in several ways. For example, it can be defined by an initial treatment represented by the launch of CAADP in the country (stage 1) and then with each subsequent achievement of a milestone representing a booster or incremental treatment. Examples of this type of treatment can be found in Papaioannou and Siourounis's (2008) study on the growth effects of democratization, which looked at regime transitions from autocracy to democracy, or in the epidemiological studies of survival analysis (see, for example, Robins, Hernan, and Brumback 2000). Adopting this definition of treatment for the CAADP analysis would require knowing when every country that is implementing CAADP achieved each of the milestones in Figure 2. Alternatively, achievement of a specific stage of implementation—say, preparation of an NAIP (stage 5)—could be used to represent a composite treatment, which would require knowing whether and when each country achieved that milestone only. This latter example is the typical definition of treatment that is used in many studies where a group of participants in an experiment or intervention receive the same treatment at the same time.

To simplify, let us define adoption of the CAADP framework and principles as an ordered qualitative variable indicating different levels or stages of CAADP implementation reached at time *t*, represented by d_t = (0, 1, 2, …, M). If y_t represents the outcome measured at time *t*, then the treatment-effects model within a country and year fixed-effects framework can be written generally as:

$$y_{jt} = \alpha + \tau t + \delta d_{jt} + \boldsymbol{x}'_{jt}\beta + v_j + \varepsilon_{jt} \tag{1}$$

$$d_{jt} = \boldsymbol{z}'_{jt}\gamma + v_j + u_{jt} \tag{2a}$$

$$d_{jt} = \begin{cases} M \; if \quad \mu_{M-1} < d^*_{jt} \\ \vdots \\ 2 \;\; if \quad \mu_{M-1} < d^*_{jt} \\ 1 \;\; if \qquad \mu_0 < d^*_{jt} \leq \mu_1 \\ 0 \;\; if \qquad\qquad d^*_{jt} \leq \mu_0 \end{cases} \tag{2b}$$

where y_{jt} is the value of the outcome in country *j* at time *t*; d^*_{jt} is the latent CAADP adoption process; the covariates $\boldsymbol{x}_{jt}$ and $\boldsymbol{z}_{jt}$ are distinguished for those in the outcome and treatment equations such that $\boldsymbol{x} \subset \boldsymbol{z}$; v_j captures unobserved cross-country heterogeneity; ε and u are unobservable error terms that are independent of each other and unrelated to $\boldsymbol{x}$ and $\boldsymbol{z}$; μ is a set of cutpoints; and $\alpha, \tau, \beta, \delta$, and γ are the parameters to be estimated.[2]

2.2. Treatment Effects and Hypotheses

Equation 1 is a country and year fixed-effects model, and δ is the treatment effect or measure of the impact of CAADP, which can be interpreted as the difference in the outcome associated with reaching different stages in implementing CAADP (i.e. for d_t = 1, 2, …, M) compared to the general level of the outcome prior to implementing CAADP (i.e. for d_t = 0). Because it takes time to secure stakeholder buy-in of the various CAADP processes (Figure 2) and for the processes to be institutionalized, the earlier a country starts the processes, the sooner the processes can begin reforming evidence-based planning and implementation. Similarly, because the benefits of reforms take time to materialize, the earlier a country advances in implementation, the sooner the effects may materialize. Furthermore, countries that reach higher levels of implementation (including gaining access to external sources of funding to implement their NAIP and related programs) have a greater chance of achieving their agricultural development objectives as the channels of impact are multiple, representing an accumulation of the preceding channels of impact.

Thus, the estimated treatment effect ($\hat{\delta}$) associated with d_t = (0, 1, 2, …, M) is expected to be larger for reaching higher stages of implementation compared to lower stages (i.e. $\hat{\delta}_{\mid d = \mathrm{M}} > \hat{\delta}_{\mid d = \mathrm{M}-1} > \cdots > \hat{\delta}_{\mid d = 1} > \hat{\delta}_{\mid d = 0}$), all other factors remaining unchanged. This could be expanded to account for both the time of the start and stage of implementation reached. Taking d = 3 for example and the effect evaluated at different times, we expect that $\hat{\delta}_{t \mid d = 3} > \hat{\delta}_{t-k \mid d = 3}$. Since CAADP is continuously adapting to experiences during implementation and to expectations of stakeholders, including countries' adaptation to fit their own national conditions and priorities, it may be possible for countries that started implementing CAADP at later periods to have more refined implementation strategies after taking account of the lessons from those that started implementing CAADP at earlier periods. Thus, by avoiding any of the pitfalls faced by the early-

[2] A more general specification would be to also model β as a function of d_{jt}, with the notion that CAADP may affect the marginal effects of the covariates (see e.g., Allen and Ulimwengu 2015). This is outside the scope of the study, which focuses on the total impact of CAADP rather than the specific channels of impact.

implementing countries, later-implementing countries could catch up in terms of the time between implementation and realization of outcomes.

2.3. Selection Bias, Endogeneity, Unobserved Heterogeneity, and Covariates

The main issues to deal with in the estimation of treatment effects are selection bias, endogeneity of treatment, and unobserved heterogeneity. The literature on these are well developed (see, for example, Heckman 1978, 1979; Maddala 1983; Wooldridge 2010; and Chiburis and Lokshin 2007). The issue of unobserved heterogeneity is addressed by inclusion of country-specific fixed effect v_j. Unobserved heterogeneity may derive from several sources, including willingness, capacity, and effort of governments to design and implement good policies to achieve stated objectives (Rodrik 2012). In addition, governments and countries may already have been engaging in policy reforms in harmony with the CAADP framework and principles prior to adopting CAADP, and much of the CAADP framework may have been derived from earlier strategies and successful agricultural reforms in several African countries. For example, CAADP's broad-based development strategy, including the need for poverty-focused growth, participatory processes in strategic planning, public–private partnerships, and other principles of inclusiveness, are similar to those of poverty reduction strategy papers pursued during the beginning of the new millennium.

Endogeneity of treatment (due either to simultaneity of outcome and treatment or omitted variables in the outcome equation) is addressed in a standard way by instrumental variables, which involves predicting treatment using variables that are correlated with treatment but orthogonal to the error term ε_s, following $\boldsymbol{x} \subset \boldsymbol{z}$. Because omitted variables problem could be due to unobserved heterogeneity, as discussed earlier, including the country-specific fixed effect also addresses some of this aspect of endogeneity. To address endogeneity and selection bias, we use the two-step control function approach proposed by Wooldridge (2010), where an estimate of the inverse mills ratio ($\hat{\lambda}$) from the first-stage estimation of equation 2 by random-effects ordered probit is included in the second-stage estimation of equation 1 according to:

$$y_{jt} = \alpha + \tau t + \delta d_{jt} + \boldsymbol{x}'_{jt}\beta + \kappa\hat{\lambda} + v_j + \varepsilon_{jt}, \qquad \forall d_{jt} > 0 \tag{1'}$$

Unbiased and consistent estimation of this model also relies on $\boldsymbol{x} \subset \boldsymbol{z}$. In general, the underlying assumption for an unbiased estimation of the treatment effect is that all the factors that affect the treatment ($\boldsymbol{z}$) and outcomes ($\boldsymbol{x}$) are known, measured, and used as explanatory variables in the estimation. Because it is genuinely difficult to find credible instruments that satisfy both the exogeneity and the exclusion requirements (i.e., $\boldsymbol{x} \subset \boldsymbol{z}$), comprehensive specification of the model becomes critical and the literature helps identify the elements of $\boldsymbol{z}$ and $\boldsymbol{x}$.

With respect to the treatment equation, the main conceptual factors deriving from the CAADP framework and the literature are: relevance of and cost to implement CAADP; political will, peer pressure, and capacity of governments to implement CAADP; and citizens' demands for, inclusiveness in, and capacity to implement CAADP, one of the nearly 50 charters, treaties, protocols, and conventions enacted by the AU since the AU Constitutive Act of 1963 (SOTU 2015). Apart from the Constitutive Act itself and the act on human rights, both of which have been ratified by all AU member states, there are substantial differences in the number of countries that have ratified the others. Much of the literature on treaties or international agreements suggests that compliance by states is commonly a reflection of states' preferences, as governments generally comply with the treaties that they sign or they sign treaties that they intend to comply with (Downs, Rocke, and Barsoom 1996; Simmons and Hopkins 2005; von Stein 2005). Furthermore, because ratifying and implementing a treaty is costly, governments that are willing and able to bear the cost would be more likely to comply. This is also consistent with the argument that governments are more likely to sign treaties that do not require significant departure from what they would have done without the treaties. Because CAADP is directly related to agriculture, variables that capture the role or potential of the agriculture sector in the economy would be good indicators of a country's preference in CAADP. Likewise, the size of the government's total budget would be a good indicator of its ability to bear the cost of implementing CAADP. Similarly, it should be less costly for countries that are closer to achieving the 10 percent agriculture expenditure and 6 percent agricultural GDP growth rate targets, and so we include the initial values of these indicators as part of the potential cost of implementing CAADP.

The literature on treaty compliance also suggests that political will is critical for whether a country ratifies a treaty. Political will is arguably unobservable; hence, Simmons and Hopkins (2005), for example, suggested some observable measures of political will, including prior implementation of preconditions in the treaty and membership in related treaties. Following this argument, a good variable for capturing political will in implementing CAADP is ratification of other AU charters. Other unobservable factors, such as peer pressure or negotiation posture, have been argued as key factors that influence treaty compliance (see, for example, Przeworski and Vreeland 2000;

Vreeland 2003). With respect to peer pressure in implementing CAADP, the share of neighboring countries that are implementing CAADP seems a good indicator to use, as it can be measured in terms of national borders or economic unions. The initial values of the two indicators with targets (i.e., 10 percent agriculture expenditure and 6 percent agricultural growth rate) may also convey some peer pressure. Regarding negotiation posture, a measure of the relative wealth or poverty of the nation seem useful. The ability, capacity, or effort of governments to implement CAADP is also unobservable. Looking at the process leading to the adoption of CAADP in 2003, the ministers of agriculture in the different countries played a significant role and were expected to champion CAADP implementation in their respective countries (AU-NEPAD 2003). Country case studies on CAADP implementation (see, for example, Zimmermann et al. 2009; Kolavalli et al. 2010) show that progress in implementation depended on how committed and engaged ministers of agriculture were, beyond just chairing meetings. In countries where implementation had not started or had stalled, it was commonly attributed to the minister's lack of interest in the process or to the minister's ignorance of CAADP, which is likely a problem caused by the turnover of minsters in the sector. Therefore, this paper uses the number of years each minister of agriculture is in the position as one measure of the government's capacity to implement CAADP. Regarding citizens' demand for, inclusiveness in, and capacity to implement CAADP, this paper uses different indicators of institutional, political, and democratic processes that have also been shown to work well as instruments for national policy decision making (Cox and McCubbins 1986; Lindbeck and Weibull 1993). These indicators may also capture some of the unobservable factors associated with governments' capacity to implement CAADP. To capture other unobservable factors and cross-country heterogeneity, indictors on stage of development or growth path, population density, civil unrest, infrastructure, and rainfall are included.

In terms of how the factors may affect treatment or implementation of CAADP, it is expected for example that countries in which agriculture contributes more to the economy or those that have high agricultural potential would have a greater likelihood of implementing CAADP, compared with those in which agriculture plays a smaller role or those that have lower agricultural potential. Similarly, it is expected that countries with larger total budgets or that have signed a greater number of other AU charters would be more likely to implement CAADP. The same applies to countries facing higher peer pressure, having lower costs, or having greater capacity to implement CAADP. Because of the time variation in treatment, it is rational to expect a differential effect of the factors over time. For example, peer pressure would likely have a greater effect on for example signing a compact in later periods or after many other countries have already signed one, compared with earlier periods or when only a small number of countries have signed one. The effect of factors controlling for cross-country heterogeneity, including stage of development or growth path, population density, civil unrest, infrastructure, and rainfall, are indeterminate a priori.

Regarding the factors that affect the outcomes ($\boldsymbol{x}$), most of those discussed above apply, as they either affect the outcome variables directly (e.g., those on agricultural potential, expenditures and budgets, and cross-country heterogeneity) or through policy (e.g., those on government capacity and institutional, political, and democratic processes). Thus, the ones that are likely to have an effect only through CAADP are those capturing peer pressure, which are tested for and used as the instruments and identification of equation 1. Because this paper is concerned with estimating the total (direct and indirect) effect of implementing CAADP on the specified outcomes, which are manifested via multiple pathways (see CAADP Monitoring and Evaluation and Results Framework [Benin, Johnson, and Omilola 2010; AU-NEPAD 2015]), it is important to not control for any intermediate processes, transformations, or outcomes that are expected to be influenced by CAADP. Using agricultural productivity as an example, in normal situations, it is expected that this would be influenced by inputs such as agricultural land, labor, capital, irrigation, seed, fertilizer, and so on, which, in turn, are expected to be influenced by CAADP. As such, these intermediate factors are excluded from $\boldsymbol{x}$ in the outcome equation.

3. ESTIMATION METHODS AND DATA

3.1. Treatment and Estimation Methods

To properly estimate the model, treatment must vary over time for each country or every country included in the analysis must have experienced each of the stages of CAADP implementation at some point in time. Information on the status of implementing CAADP in each country was obtained from ReSAKSS (IFPRI 2015b). We consider two definitions of treatment in this paper. In the first case, a binary variable d_t = (0, 1) is used, where 0 is for the precompact stage and 1 is for having signed a compact. As such, a value of 0 is given from year one until the year a compact is signed, and then a value of 1 is given for the rest of the remaining years. For the second definition of treatment, we use a four-ordered levels of treatment, d_t = (0, 1, 2, 3): where 0 is the precompact stage; 1 for signing a compact only; 2 for having a compact and NAIP, but have not secured any of three external sources of funding; and 3 for having a compact, NAIP, and secured one or more of three external sources of funding.[3] As such, a value of 0 is given from year one until the year a compact is signed; a value of 1 is given until the next level is achieved (i.e. NAIP is prepared); and then a value of 2 is given and so on. As each country must have experienced every treatment level at some point in time to be considered in the sample, there are potentially more valid countries when the first definition of treatment is used since at least 41 countries had signed a CAADP compact by the end of 2015, with about one-half of them having achieved level 3 of the second definition. (More on this later.)

With these two definitions of treatment, equation 2 is first estimated by a random-effects probit model for d_t = (0, 1) and by a random-effects ordered probit model for d_t = (0, 1, 2, 3) to generate the inverse mills ratio (IMR) $\hat{\lambda}$, which is then included with the treatment variable in a second-stage, fixed-effects estimation of equation 1′. In the case of the ordered probit model, the lower and upper cutpoints are $\mu_0 = -\infty$ and $\mu_{\mathrm{M}+1} = \infty$ (Chiburis and Lokshin 2007).[4] Following the hypotheses presented in the conceptual framework, we expect the estimated effect of CAADP when d_t = (0, 1) to represent the average effect for reaching different stages, so that $\hat{\delta} < \hat{\delta}_{1\mid d=(0,1)} < \hat{\delta}_{3\mid d=(0,1,2,3)}$, other factors remaining unchanged.

From the estimation of equation 1′, the direction and statistical significance of the selection bias can be assessed based on the sign and statistical significance of the estimated parameter $\hat{\kappa}$ associated with $\hat{\lambda}$, respectively (Maddala 1983). For example, a negative sign would indicate that unobservables that raise outcomes tend to occur with unobservables that lower CAADP implementation. In a binary selection model, identification of the second-stage parameters has relied on the non-linearity of the first-stage probit. In the ordered-probit selection model used here however, $\boldsymbol{x} \subset \boldsymbol{z}$ is necessary (Chiburis and Lokshin 2007), which coincides with addressing endogeneity. As the IMR is estimated, obtaining robust standard errors in the second-stage

[3] The three external funding sources considered here are Grow Africa, New Alliance Cooperation, and the Global Agriculture and Food Security Program (GAFSP). To date, 11 countries—Benin, Burkina Faso, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, and Senegal—have joined Grow Africa (Grow Africa 2016); 10 countries—Benin, Burkina Faso, Côte d'Ivoire, Ethiopia, Ghana, Malawi, Mozambique, Nigeria, Senegal, and Tanzania—have joined the New Alliance (New Alliance 2016); and 17 countries—Benin, Burkina Faso, Burundi, Ethiopia, Gambia, Kenya, Liberia, Malawi, Mali, Niger, Rwanda, Senegal, Sierra Leone, Tanzania, Togo, Uganda, and Zambia—have received GAFSP funds (GAFSP 2016).

[4] All the estimations were carried out with STATA software version 15.0 (StataCorp 2017).

estimation is sufficient, unless the estimated parameter $\hat{\kappa}$ is statistically significant, then corrected standard errors may be required (Wooldridge 2002).

As we use a panel dataset in which treatment status varies across time and we have observations on the outcome and control variables prior to the treatment, the two-stage estimation procedure may not be necessary (Wooldridge 2002). Thus, we also estimate and report results of the estimation of equation 1, i.e. without including the IMRs, which we compare to those of the two-stage estimation procedure.

3.2. Data, Sources, and Variables

The panel data are from 2001 to 2014 on 25 African countries, which are the ones that have data on the various indicators of interest and have signed a compact by the end of 2014, going by the first definition of CAADP implementation or d_t = (0, 1); with 18 of them having reached level 3 according to the second definition of CAADP implementation or d_t = (0, 1, 2, 3).[5] The data were compiled from several publicly available sources, including the Statistics on Public Expenditures for Economic Development (SPEED; IFPRI 2015a) and the Regional Strategic and Knowledge Support System (ReSAKSS; IFPRI 2015b) for data on government agricultural expenditure; the Creditor Reporting System (CRS: OECD 2017) for data on official development assistance (ODA); FAOSTAT (FAO 2016) for data on agricultural production; and the World Development Indicators (World Bank 2016a) for data on gross domestic product (GDP), population, infrastructure, and other variables. Regarding other data and sources, they include AU charters (SOTU 2015), governance (World Bank 2016b), ministers of agriculture (CIA 2016), autocracy-democracy index (SCP 2015), civil unrest (Sarkees 2015), and rainfall (World Bank 2017). We acknowledge the legitimate concerns about data reliability, as highlighted in Jerven (2013). Although this issue is not addressed in any specific manner, by combining self-reported data with several observed data (e.g. AU charters, civil unrest, ministers of agriculture, and rainfall), potential data pitfalls have likely been reduced.

[5] The countries are Benin, Burkina Faso, Burundi, Central African Republic, Democratic Republic of Congo, Ethiopia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mozambique, Nigeria, Rwanda, Senegal, Sierra Leone, Sudan, Swaziland, Tanzania, Togo, Uganda, and Zambia.

Policy and Development Outcome Variables

Policy outcomes are represented by government agricultural spending and ODA for agriculture. Government agricultural spending is measured in two ways—share of government agricultural expenditure in total government expenditure (AgExpsh) and ratio of government agricultural expenditure to agricultural value added (AgExpint). The first measure is associated with the CAADP 10 percent agricultural expenditure target, whereas the second measure, commonly referred to as agricultural spending intensity, better reflects commitments to sector relative to its role. ODA is similarly measured in two ways—share of total ODA disbursed for agriculture, forestry and fishery (AgODAsh) and ratio of ODA disbursed for agriculture to agricultural value added (AgODAint). Although ODA disbursed for agriculture is indirectly related to the CAADP 10 percent agricultural expenditure target, via its contribution to or effect on government agriculture expenditure, it is an important indicator in the CAADP agenda given that donor alignment is a critical component of the CAADP framework and principles. Also, both quantity and quality of government spending may change depending on the extent to which ODA is earmarked for specific investments. For development outcomes, we use agricultural productivity, which is measured by agricultural value-added per hectare (Agvaland) and agricultural value-added per worker (Agvalabor). Detailed description of the outcome variables is presented in Table 1. As we expect the effect of CAADP on government expenditure and ODA to materialize sooner than the effect on productivity, we estimate the short-to-medium term effects on government expenditure and ODA using one-year, two-year average, and three-year average lead (or forward-moving average) values of these indicators in the regressions. For land and labor productivity, a five-year forward moving average is used. Ideally, we would have liked to capture the medium-to-long term impacts of CAADP on productivity by using up to ten or even fifteen-year lead values, but the panel is not long enough to accommodate such time-series manipulations.

Table 1. Description of variables

Conceptual variable Empirical measure	Designation
Policy outcome variables	
Government agriculture expenditure (percent of total government expenditure)	AgExpsh
Government agriculture expenditure (percent of agricultural value-added)	AgExpint
ODA disbursed for agriculture expenditure (percent of total ODA disbursed)	AgODAsh
disbursed for agriculture expenditure (percent of agricultural value-added)	AgODAint
Development outcome variables	
Agriculture value-added per hectare of agricultural land (constant 2006 US$)	Agvaland
Agriculture value-added per agricultural worker (constant 2006 US$)	Agvalabor
Explanatory variables	
Relevance of CAADP/Role of agriculture/Cost to implement CAADP	
Agriculture value-added (percent of GDP)	AgGDPsh
Government agriculture expenditure (percent of total government expenditure)	AgExpsh
Agriculture value-added, annual growth rate	AgGDPgrow
Political will/ Government capacity/Negotiation posture	
Number of AU charters/treaties/protocols/conventions ratified (1 if >13, 0 otherwise)	AUcharters
Number of years agricultural minister is in position	Capacity
Stability of government (index ranging from –2.5 to 2.5)	Stability
Government effectiveness (index ranging from –2.5 to 2.5)	Effective
GDP, share in Africa's total (%)	AfGDPsh
Citizens demand and capacity	
Voice and accountability (index ranging from –2.5 to 2.5)	Voice
Autocracy-democracy (index ranging from –10 to 10)	Polity
Cross-country heterogeneity	
Growth path: GDP, annual growth rate	GDPgrowth
Civil unrest, number of civil clashes of significance	CivClash
Population density, ratio of agricultural labor to land	LabLand
Infrastructure, mobile subscription, number per 100 persons	Mobile
Rainfall, coefficient of variation of monthly amounts	Rainfall
Instruments (Peer pressure)	
Share of bordering countries at the next stage of implementation	PressureC
Share of countries in geographic region at the next stage of implementation	PressureR

Source: Authors' representation, based on compiled panel data.

Explanatory Variables and Instruments

Data on the variables that are conceptualized to affect the treatment (***z***) and outcomes (***x***) were also obtained from most of the various sources listed earlier. Detailed description of these variables is also presented in Table 1. The main point to discuss here is the instruments, which we use either of the peer pressure variables: share of bordering countries at the next stage of CAADP implementation (PressureC); or share of countries in geographic region at the next stage of CAADP implementation (PressureR). In lieu of any formal test, the validity of the instruments is checked by analyzing the statistical significance of the coefficient on the instruments in a regression of each dependent variable on all the control variables and instrument. This is in the spirit of the typical "first-stage diagnostic results" for checking the validity of instruments in a linear endogenous variable model. A strong instrument will be a strong predictor of adoption of CAADP (i.e., have high a statistical significant coefficient in the probit or ordered model), but have no statistical significant correlation with the agricultural expenditure, ODA, or land and labor productivity. Based on this analysis, both PressureC and PressureR worked very well as instruments, although PressureC worked better with the regular probit or when d_t = (0, 1) and PressureR worked better with the oredered probit or when d_t = (0, 1, 2, 3).

3.3. Other Estimation Issues

As there are about 20 regressors (excluding the time t dummy variables) in each regression, multicollinearity is a potential problem. We tested for it using the condition number and variance decomposition proportions among the regressors (Belsley, Kuh, and Welsch 1980) and found the variable on rainfall to be the one of concern. Initially, we had intended to use the total or average amount of rainfall in a year, which turned out to be much worse in terms of multicollinearity. The coefficient of variation measure works better, as the associated condition number is 31, which is only slightly higher than the maximum of 30 suggested by Belsley, Kuh, and Welsch (1980). Therefore, we estimate the regressions with and without the rainfall variable to assess sensitivity of the results to including and excluding it, respectively. All continuous variables were transformed by natural logarithm before using them in the regressions.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics of Variables

Table 2 shows descriptive statistics of all the variables at the baseline (2001-2003) and for successive treatments or stages of CAADP implementation reached. The most notable differences or changes over across treatment are number of AU charters or treaties that have been ratified (AUcharters), years agricultural minister has been in position (Capacity), and the peer pressure variables or instruments (PressureC and PressureR), which have significantly improved over time or with reaching higher levels of CAADP implementation, especially compared to the baseline.

4.2. Treatment Equation Results

Results of the fixed-effects probit and ordered probit are presented in Table 3. Variables representing peer pressure (PressureC or PressureR), relevance of agriculture (AgGDPsh), government capacity (Capacity), population density (LabLand), and infrastructure (Mobile) are the most important ones in terms of being statistically significant across both definitions of treatment and different model specifications. These variables are positively related to signing a compact or achieving higher levels of implementation, except LabLand, which has a negative relationship. Also, PressureC works better in the probit or when d_t = (0,1), whereas PressureR works better when d_t = (0, 1, 2, 3). For several of the remaining variables, their statistical significance is confined to one of the definitions of treatment only. For example, growth path (GDPgrowth) has a positive effect on signing a compact only, Stability and Polity have a positive effect on reaching higher levels of implementation, and Voice and CivClash have a negative effect on reaching higher levels of implementation. Exclusion or inclusion of the rainfall variable, which was associated with slight multicollinearity, did not seem to influence the results. The estimates based on robust standard errors generated more statistical significant parameters and, in several cases, stronger statistical significance of the parameters. With the probit estimation too, the overall models are statistically significant only in the model specification with robust standard errors, as measured by the Wald chi-square statistic.

Table 2. Summary statistics of variables at the baseline (2001–2003) and by level of treatment after the baseline, 2001-2014

Variable	Treatment d_t = (0, 1)						Treatment d_t = (0, 1, 2, 3)									
	Baseline		$d_t = 0$		$d_t = 1$		Baseline		$d_t = 0$		$d_t = 1$		$d_t = 2$		$d_t = 3$	
	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.	Mean	S.E.
Outcome																
AgExpsh	4.8	0.6	6.1	0.8	6.0	0.8	5.2	0.7	6.8	1.0	6.9	1.0	7.1	1.0	7.7	1.0
AgExpint	4.8	1.2	6.1	1.1	6.4	1.0	4.1	0.7	5.8	1.1	6.1	0.9	6.8	1.2	8.3	2.0
AgODAsh	4.4	0.6	4.8	0.6	6.7	0.7	4.4	0.7	4.5	0.6	6.8	0.8	7.6	1.0	7.7	0.7
AgODAint	1.9	0.4	2.1	0.3	2.4	0.3	1.9	0.4	2.3	0.4	2.7	0.3	2.9	0.3	3.0	0.5
Agvaland	248.2	36.0	263.4	40.4	310.7	52.7	284.6	43.2	310.3	50.6	365.6	63.5	378.8	69.1	409.8	78.0
Agvalabor	933.1	206.3	977.7	244.2	1124.0	323.4	857.9	231.1	937.1	298.4	980.3	344.2	1019.8	381.6	1082.4	422.4
Controls																
AgGDPsh	34.5	3.1	31.5	2.9	30.4	2.7	36.5	3.4	34.3	3.1	34.0	2.8	31.6	2.6	31.5	2.7
AgExpsh	4.8	0.6	6.1	0.8	6.0	0.8	5.2	0.7	6.8	1.0	6.9	1.0	7.1	1.0	7.7	1.0
AgGDPgrow	2.8	2.0	3.3	0.7	3.8	0.6	4.2	2.5	3.7	0.9	3.2	1.8	2.4	1.2	3.9	0.4
AUcharters	0.3	0.1	0.7	0.1	0.8	0.1	0.3	0.1	0.9	0.1	0.9	0.1	0.9	0.1	0.9	0.1
Capacity	1.9	0.1	4.8	0.2	8.1	0.3	2.0	0.1	4.8	0.2	6.9	0.2	7.6	0.3	9.0	0.3
Stability	-0.8	0.2	-0.7	0.2	-0.8	0.2	-0.7	0.2	-0.5	0.2	-0.5	0.2	-0.5	0.2	-0.6	0.2
Effective	-0.8	0.1	-0.8	0.1	-0.8	0.1	-0.8	0.1	-0.7	0.1	-0.7	0.1	-0.7	0.1	-0.7	0.1
AfGDPsh	1.4	0.6	1.5	0.7	1.6	0.8	1.5	0.8	1.7	1.0	1.7	1.0	1.8	1.0	1.9	1.1
Voice	-0.6	0.1	-0.6	0.1	-0.5	0.1	-0.5	0.1	-0.4	0.1	-0.4	0.1	-0.4	0.1	-0.4	0.1
Polity	2.5	1.0	2.9	1.0	3.2	0.9	3.3	0.9	3.9	0.9	3.7	1.0	3.6	1.0	3.7	1.0
GDPgrowth	3.9	1.1	5.7	0.5	5.3	0.4	4.3	1.5	6.4	0.6	5.8	0.5	5.9	0.6	5.8	0.4
CivClash	1.0	0.4	0.8	0.3	0.8	0.4	0.6	0.3	0.4	0.2	0.3	0.3	0.3	0.2	0.3	0.2
LabLand	5.0	1.0	4.7	0.9	4.2	0.7	3.8	0.9	3.6	0.8	3.3	0.8	3.2	0.7	3.1	0.7
Mobile	6.9	0.7	20.4	2.0	54.6	4.7	6.9	0.9	18.6	2.2	38.0	4.6	49.5	5.2	63.9	7.0
Rainfall	125.3	9.7	123.6	10.0	124.9	10.6	117.0	8.9	116.6	8.7	131.1	13.3	124.6	9.8	125.4	10.3
Instruments																
PressureC	0.0		4.4	1.1	34.8	3.8	0.0		3.9	1.2	46.8	5.8	44.0	7.4	17.3	4.2
PressureR	0.0		4.4	1.2	32.7	3.2	0.0		2.7	0.8	44.2	4.7	38.4	5.6	12.6	3.1

Source: Model results.

Notes: Detail description of the variables is provided in Table 1. Number of countries and observations are 25 and 299, respectively, for when d_t = (0, 1) and 18 and 223, respectively, for when d_t = (0, 1, 2, 3).

Table 3. Fixed-effects probit and ordered probit results for the level of CAADP implementation reached, 2001–2014

Variable	Probit: treatment d_t = (0, 1)				Ordered probit: treatment d_t = (0, 1, 2, 3)			
	Models based on PressureC		Models based on PressureR		Models based on PressureC		Models based on PressureR	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
PressureC	0.08 * rr	0.07 ** rrr			0.01 rr	0.01 r		
PressureR			0.06	0.04 r			0.02 * rr	0.02 * rr
AgGDPsh	0.14 * rr	0.14 ** rr	0.17	0.13 * r	0.09 * rr	0.10 ** rr	0.10 ** rr	0.10 ** rr
AgExpsh	0.21 r	0.20 * r	0.25	0.21 r	0.04	0.05	0.03	0.05
AgGDPgrow	-0.03	-0.04	-0.04	-0.04	-0.03	-0.03	-0.03	-0.03
AUcharters	-1.06	-0.31	-0.92	-0.22	-1.33	-1.15	-1.16	-0.98
Capacity	1.12 * rrr	1.07 ** rrr	1.53 * rrr	1.29 ** rrr	1.93 *** rrr	1.89 *** rrr	1.92 *** rrr	1.89 *** rrr
Stability	0.42	0.70	-0.11	0.34	1.55 * r	1.60 ** r	1.60 ** r	1.66 ** r
Effective	-2.55	-1.92	-5.78	-3.84	1.16	1.11	1.16	1.10
AfGDPsh	0.12	0.13	0.11	0.12	0.12	0.11	0.12	0.12
Voice	0.94	0.23	2.33	1.24	-4.84 *** rrr	-4.86 *** rrr	-4.91 *** rrr	-4.95 *** rrr
Polity	0.00	0.02	-0.02	0.01	0.36 ** rr	0.37 ** rr	0.37 ** rr	0.38 ** rr
GDPgrowth	0.19 rrr	0.15 rrr	0.29 rr	0.19 rrr	0.03	0.03	0.03	0.03
CivClash	0.10	-0.02	0.01	-0.04	-0.18 rr	-0.15	-0.25 rrr	-0.20 rr
LabLand	-2.36 * rr	-1.49 r	-4.28 * rr	-2.31 r	-1.56 ** rr	-1.39 * rr	-1.61 ** rr	-1.44 ** rr
Mobile	0.19 * rrr	0.16 ** rrr	0.30 * rr	0.19 * rr	0.09 *** rrr	0.10 *** rrr	0.10 *** rrr	0.10 *** rrr
Rainfall		0.02		0.02 r		0.01		0.01
Intercept	-18.39 ** rrr	-20.02 *** rrr	-25.68 * rr	-22.80 ** rrr				
Cutoffs:								
Cutoff 1					16.62	17.55	16.74	17.83
Cutoff 2					19.36	20.28	19.60	20.69
Cutoff 3					22.05	22.91	22.27	23.31
Wald chi-square	5.04 rrr	9.45 rrr	4.67 rrr	7.27 rrr	46.05 *** rrr	46.85 *** rrr	45.02 *** rrr	45.35 *** rrr

Source: Authors' calculation, based on treatment-effect regression model results.

Notes: Detailed description of the variables is provided in Table 1. Explanatory variables are lagged by one year. *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. ^{r}, ^{rr}, and ^{rrr} indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, based on robust standard errors. Blank cells mean the relevant variable is not included in the model or parameter is not estimated or not applicable.

4.3. Estimated Treatment Effects of CAADP on Government Agricultural Spending and ODA

Tables 4a and 4b shows detail regression results of the estimated treatment effects on government agricultural spending and ODA for agriculture for the two definitions of treatment, d_t = (0, 1) in Table 4a and d_t = (0, 1, 2, 3) in Table 4b. The results in these two tables are based on the dependent variable measured by a 1-year lead value. Then in Table 4c, we present a summary of the estimated effects for different measures of the dependent variable, i.e. 1-year, 2-year average, and 3-year average lead values. In all cases, the results are shown for when the IMR is included and excluded, as well as statistical significance of the parameters without and with robust standard errors.

From Table 4a, the estimated short-term effect of having at least a CAADP compact on government agricultural expenditure, measured as share of total government expenditure (AgExpsh) or relative to agricultural value added (AgExpint), and agricultural ODA, measured similarly (AgODAsh and AgODAint), is generally positive and statistically significant. The estimated effect is about 1.5 to 3.2 percentage points difference for government agricultural expenditure and 0.9 to 1.5 percentage points difference for agricultural ODA. The short-term effects are larger for reaching higher levels of implementation beyond the compact, as the results in Table 4b show. The estimated effects here go up to 7.2 percentage points difference for agricultural spending intensity (AgExpint) and up to 3.4 percentage points difference for agricultural ODA intensity (AgODAint), depending on the model specification.

The results from Table 4c show that the effect on government agricultural spending and ODA for agriculture wanes over time or is characterized by an inverted-U shaped pattern, which is evident from comparing the estimated effects associated with the one-year, two-year average, and three-year average lead values of the dependent variables. This is more pronounced for government agricultural expenditure in the case of d_t = (0, 1, 2, 3) where most of the estimated effects associated with the three-year average lead values are statistically insignificant or negative for reaching level 3. These, especially the latter, seem to suggest a substitution effect between governments' own funding and external (or off-budget) sources of funding for the sector.[6] This is not surprising as reaching level 3 also tends to bring in more sources of external funding for the sector.

---

[6] Off budget means outside the government's financial management and procurement processes.

Regarding the influence of other variables on government agricultural spending and ODA for agriculture, the main influential ones (that is, those that are statistically significant at the 5 percent or 1 percent level across the different definitions of CAADP adoption and model specifications) are the relevance of agriculture (AgGDPsh), initial share of government agricultural expenditure (AgExpsh), government capacity (Capacity and Effective), growth path (GDPgrowth), and population density (LabLand). These variables have differential effects on the dependent variables however. For example, AgGDPsh is negatively associated with government spending and ODA intensity, whereas governance measure of the effectiveness of government (Effective) is positively associated with agricultural ODA, and countries on a higher growth path are negatively associated with ODA intensity. The positive effect of the initial share of government agricultural expenditure means that countries with an initial high share tend to increase it in subsequent years.

Several of the year-fixed effects are statistically significant, especially with respect to government agricultural expenditure and when CAADP adoption is defined as $d_t = (0, 1, 2, 3)$. In general, the results suggest that spending intensity (AgExpint) was highest from 2006 to 2009, whereas the share (AgExpsh) has increased over time.

The effect of the IMR is mixed, mostly statistically insignificant when CAADP adoption is defined as $d_t = (0, 1)$, but negative and statistically insignificant when CAADP adoption is defined as $d_t = (0, 1, 2, 3)$. This seem to indicate that unobservables that are positively associated with government agricultural expenditure or ODA for agriculture tend to occur with unobservables that hinder reaching higher levels of CAADP implementation.

Table 4. Fixed-effects regression results of effect of CAADP [dt = (0, 1)] on government agricultural expenditure and agricultural ODA, 2001–2014

Variable	AgExpsh		AgExpint		AgODAsh		AgODAint	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
$d_t = 1$	1.45 * rr	1.45 * rr	3.15 *** rrr	3.15 *** rrr	1.49 *	1.49 *	0.89 *** rrr	0.89 *** rrr
AgGDPsh	-0.06	-0.06	-0.24 *** r	-0.22 *** rr	-0.04	-0.02	-0.06 ** rr	-0.05 ** r
AgExpsh	0.30 *** rrr	0.30 *** rrr	0.20 ** r	0.21 ** rr	0.11	0.12	0.00	0.00
AgGDPgrow	0.01	0.01	0.02	0.01	0.02	0.01	0.01 rr	0.01 rr
AUcharters	-0.79	-0.79	1.11	1.32	-1.21 *	-1.10	-0.47 *	-0.38
Capacity	-0.26	-0.26	-1.12 ***	-1.00 ***	-0.03	0.04	-0.13	-0.08
Stability	0.35	0.35	1.15	1.36	0.44	0.55	0.01	0.11
Effective	1.18	1.18	6.40 ***	5.66 ***	4.15 *** rrr	3.75 ** rr	2.34 *** rrr	2.01 *** rrr
AfGDPsh	-0.52	-0.52	-0.75	-0.74	0.38	0.38	-0.15	-0.14
Voice	-0.60	-0.59	-0.82	-1.23	-1.92	-2.13	1.01 * rr	0.83 rr
Polity	0.16	0.16	-0.03	-0.02	0.15	0.16	-0.01	-0.01
GDPgrowth	0.03	0.03	-0.05	-0.02	-0.07	-0.06	-0.05 ** rr	-0.04 ** r
CivClash	0.27	0.27	0.50	0.49	-0.26	-0.26	0.05	0.04
LabLand	1.63	1.63	-6.74	-7.04	-6.20	-6.36	-0.65	-0.78
Mobile	0.00	0.00	0.00	0.01	0.03	0.04	0.00	0.00
Rainfall	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.00
IMR	0.00		-0.29		-0.15		-0.13 *	
Year fixed-effect:								
2003	0.33	0.33	0.53	0.75	-1.12 rr	-1.01 r	-0.04	0.05
2004	1.14	1.14	0.80	1.18	-0.36	-0.17	-0.19	-0.02
2005	1.43	1.42	0.75	1.29	-2.85 ** rrr	-2.56 ** rrr	0.04	0.28
2006	2.49 *	2.48 **	2.55	3.34 **	-0.08	0.33	0.33	0.68
2007	3.19 **	3.19 **	2.26	3.26 *	-0.31	0.22	-0.36	0.09
2008	3.82 **	3.81 **	2.34	3.61 *	-0.28	0.38	-0.25	0.31
2009	1.87	1.86	0.91	2.42	-1.27	-0.46	-0.63	0.05
2010	1.30	1.28	-0.82	0.90	-1.68	-0.77	-0.83	-0.06
2011	1.17	1.16	-0.85	0.92	-2.43	-1.50	-1.18	-0.40
2012	1.65	1.64	-0.07	1.67	-2.54	-1.62	-0.76	0.01
2013	3.03	3.02	2.29	3.79	-1.68	-0.89	-0.81	-0.14
2014	2.66	2.65	3.47	4.83	-2.48	-1.76	-0.34	0.27
Intercept	3.51	3.54	28.93 ***	24.29 ***	17.72 ** rr	15.27 ** rr	9.63 *** rrr	7.57 *** rr
R-squared	0.18	0.18	0.24	0.24	0.28	0.28	0.25	0.23
F-statistic	1.91 ***	1.98 ***	2.75 ***	2.78 ***	3.37 ***	3.46 ***	2.75 ***	2.68 ***

Source: Authors' calculation, based on treatment-effect regression model results.

Notes: Detailed description of the variables is in Table 1. Values of dependent variables are one year lead values. *, **, and *** indicate statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively. ^{r}, ^{rr}, and ^{rrr} indicate statistical significance at 10 percent, 5 percent, and 1 percent levels, respectively, based on robust standard errors. Blank cells mean the variable is not included in the model, not estimated, or not applicable. The overall model *F*-statistic was not available for the robust standard errors option

Table 5. Fixed-effects regression results of effect of CAADP [d_t = (0, 1, 2, 3)] on government agricultural expenditure and agricultural ODA, 2001–2014

Variable	AgExpsh						AgExpint						AgODAsh						AgODAint					
	Model 1			Model 2			Model 1			Model 2			Model 1			Model 2			Model 1			Model 2		
d_t = 1	1.79			0.72			4.08	**	rr	2.72	*		2.05	**	r	1.57	*		1.53	***	rrr	1.05	**	rr
d_t = 2	3.52	**		1.78			7.22	***	r	5.01	**		2.93	**	rr	2.16	*		2.79	***	rrr	2.01	***	rrr
d_t = 3	4.72	**	r	1.84			7.26	**	r	3.60			3.08			1.81			3.40	***	rrr	2.11	***	rr
AgGDPsh	-0.16	**		-0.15	**		-0.25	***	rr	-0.25	***	rr	-0.05			-0.05			-0.05	*		-0.04	*	
AgExpsh	0.27	***	rrr	0.28	***	rrr	0.14			0.15			0.03			0.03			0.00			0.00		
AgGDPgrow	0.03			0.03			0.06		r	0.06		r	0.04			0.04			0.02	*	rr	0.02	*	rr
AUcharters	-0.90			-1.00			0.95			0.81			-0.25			-0.30			-0.04			-0.09		
Capacity	-1.39	***	rrr	-1.07	***	rr	-1.92	***	rr	-1.51	***	r	0.00			0.14			-0.27	*		-0.13		
Stability	-1.07			-1.01			2.36	**		2.44	**		0.81			0.83			0.24			0.27		
Effective	-0.52			0.01			5.26	**		5.93	**		3.56	**	rr	3.80	**	rr	1.64	**	r	1.88	***	r
AfGDPsh	-0.86	*		-0.93	*		-1.00		r	-1.08		r	0.15			0.12			-0.01			-0.04		
Voice	-1.71			-1.72			-4.18	*		-4.20	*		-2.61	*		-2.62	*		0.19			0.18		
Polity	0.43	**		0.42	**		0.29			0.29			0.30			0.30			0.07			0.07		
GDPgrowth	0.02			0.02			-0.02			-0.01			-0.03			-0.03			-0.03			-0.03		
CivClash	0.31			0.25			0.80	**		0.73	*		0.34			0.31			0.26	**		0.23	**	
LabLand	3.04			4.12			-6.34			-4.97			-3.50			-3.02			-6.10	***	rr	-5.62	**	rr
Mobile	-0.04	*		-0.03			0.02			0.03			0.00			0.00			-0.01			-0.01		
Rainfall	-0.02			-0.02			-0.02			-0.02			-0.02		r	-0.02		r	-0.01			-0.01		
IMR	-0.75	**	rr				-0.95	*	rr				-0.33						-0.33	**	rr			
Year fixed-effect:																								
2003	1.07			0.86			1.11			0.84			-0.89		r	-0.99		r	0.22			0.12		
2004	3.24	***	rr	2.79	**	rr	3.23	**	r	2.66	*		-0.02			-0.22			0.38			0.18		
2005	5.00	***	rrr	4.31	***	rr	3.95	**		3.07			-3.03	**	rr	-3.34	***	rr	0.63			0.32		
2006	7.25	***	rrr	6.28	***	rr	7.74	***	rr	6.51	***	r	0.70			0.27			1.28	*		0.84		
2007	8.54	***	rrr	7.31	***	rr	7.97	***	rr	6.41	**		0.69			0.15			0.72			0.17		
2008	9.60	***	rrr	8.44	***	rr	8.46	***	rr	6.98	**		0.76			0.25			0.75			0.23		
2009	8.95	***	rr	7.76	***	rr	7.34	**		5.82	*		0.81			0.28			0.68			0.15		
2010	8.82	***	rr	8.20	***	rr	5.44			4.65			-0.23			-0.50			-0.39			-0.67		
2011	8.45	***	rr	8.21	**	r	4.45			4.15			-0.89			-0.99			-1.20			-1.31		
2012	9.02	**	r	9.03	**	r	5.10			5.12			-0.73			-0.72			-1.06			-1.05		
2013	11.93	***	r	11.82	***	r	8.95			8.81			0.25			0.20			-1.12			-1.16		
2014	12.16	***	r	11.89	***	r	10.96	*		10.61	*		0.38			0.26			-0.39			-0.51		
Intercept	7.98			7.05			25.53	***	rr	24.35	***	rr	12.65	**	rr	12.24	**	rr	12.10	***	rrr	11.69	***	rrr
R-squared	0.32			0.30			0.35			0.34			0.48			0.47			0.36			0.33		
F-statistic	2.60	***		2.49	***		3.07	***		3.00	***		5.12	***		5.25	***		3.11	***		2.93	***	

F-test of d_t:								
1 = 2	2.89 *	1.17	4.80 **	2.76 *	0.99	0.48	10.57 *** rrr	6.59 ** r
2 = 3	1.19	0.00	0.00	1.04	0.03	0.17	2.09	0.07

Source: Authors' calculation, based on treatment-effect regression model results.

Notes: Detailed description of the variables is provided in Table 1. Values of dependent variables are one year lead values. *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. [r], [rr], and [rrr] indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, based on robust standard errors. Blank cells mean the relevant variable is not included in the model or parameter is not estimated or not applicable. The overall model F-statistic was not available for the robust standard errors option.

Table 6. Summary of fixed-effects regression results of effect of CAADP on government agricultural expenditure and agricultural ODA, 2001–2014

Variable	AgExpsh		AgExpint		AgODAsh		AgODAint	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
d_t = (0, 1)								
1-year lead	1.45 * rr	1.45 * rr	3.15 *** rrr	3.15 *** rrr	1.49 *	1.49 *	0.89 *** rrr	0.89 *** rrr
2-year average lead	1.58 ** rr	1.57 ** rr	3.65 *** rrr	3.60 ***	1.05	1.04	0.77 *** rrr	0.75 *** rrr
3-year average lead	1.14 *	1.10	3.41 *** rr	3.22 ***	1.07 *	1.10	0.73 *** rrr	0.68 *** rrr
d_t = (0, 1, 2, 3)								
1-year lead								
$d_t = 1$	1.79	0.72	4.08 ** rr	2.72 *	2.05 ** r	1.57 *	1.53 *** rrr	1.05 ** rr
$d_t = 2$	3.52 **	1.78	7.22 *** r	5.01 **	2.93 ** rr	2.16 *	2.79 *** rrr	2.01 *** rrr
$d_t = 3$	4.72 ** r	1.84	7.26 ** r	3.60	3.08	1.81	3.40 *** rrr	2.11 *** rr
2-year average lead								
$d_t = 1$	1.46	0.28	3.76 ** r	2.48 *	1.75 ** r	1.16	1.46 *** rrr	0.97 *** rrr
$d_t = 2$	3.07 **	1.12	5.97 *** r	3.87 **	2.15 * r	1.18	2.18 *** rrr	1.39 *** rr
$d_t = 3$	3.44 *	0.20	4.14	0.67	2.73 *	1.14	2.52 *** rrr	1.22 ** r
3-year average lead								
$d_t = 1$	1.47	0.05	2.52 **	1.45	2.01 *** rrr	1.25 ** rr	1.26 *** rrr	0.80 *** rrr
$d_t = 2$	2.57 *	0.18	2.04	0.26	2.21 ** rr	0.96	1.37 *** rr	0.61
$d_t = 3$	2.70	-1.17	-1.75	-4.66 ** r	3.27 ** rr	1.22	1.82 *** r	0.57

Source: Authors' calculation, based on treatment-effect regression model results.

Notes: Detailed description of the variables is provided in Table 1. Models 1 and 2 are for when the inverse mills ratio (IMR) is included and excluded, respectively. *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. r, rr, and rrr indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, based on robust standard errors

4.4. Estimated Treatment Effects of CAADP on Agricultural Productivity

The estimated effect of CAADP on agricultural land and labor productivity in the medium term (based on five-year forward moving average) is mixed. Detail regression results are shown in Table 5. The estimated effect on land productivity is statistically significant only in the case when treatment is defined as d_t = (0, 1, 2, 3) and in the model specification when the IMR is excluded. Then, land productivity is about 11 and 17 percent higher for reaching stages 2 and 3 of CAADP implementation, respectively, compared to the pre-compact stage. The estimated effect on labor productivity is statistically significant for both definitions of treatment and in the different model specifications. For d_t = (0, 1), the estimated effect on labor productivity is about 4 percent higher for the post-compact state, compared to the pre-compact state. For d_t = (0, 1, 2, 3), the estimated effect is about 10–14 and 17–23 percent higher for reaching stages 2 and 3, respectively, compared to the pre-compact stage. Furthermore, the differences across successive stages are statistically significant (see test results in bottom rows of Table 5).

Looking at the influence of other variables, the main influential ones (i.e., those that are statistically significant at the 5 percent or 1 percent level across the different definitions of CAADP adoption, productivity measures, and model specifications, are negotiation posture (AfGDPsh) and population density (LabLand), both of which are positively associated with productivity. For several of the other variables, their effect is statistically significant in one or two of the above dimensions only. For example, the effect of government effectiveness, growth path, and civil unrest is statistically significant in the regressions when treatment is defined as d_t = (0, 1, 2, 3), whereas the effect of the other capacity variables (Stability, Voice, and Polity) is statistically significant in the regressions when treatment is defined as d_t = (0, 1). Also, the relevance of agriculture (AgGDPsh) has opposing statistical significant effects on land productivity when treatment is defined as d_t = (0, 1), compared to the effect on labor productivity when treatment is defined as d_t = (0, 1, 2, 3). Most of these confined effects are not statistically significant under the robust standard errors option however. The year-fixed effects are statistically significant, suggesting that agricultural land and labor productivity have increased rapidly over time.

Table 7. Fixed-effects regression results of effect of CAADP on agricultural land (Agvaland) and labor (Agvalabor) productivity, 2001–2014

Variable	d_t = (0, 1)				d_t = (0, 1, 2, 3)			
	Agvaland		Agvalabor		Agvaland		Agvalabor	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
dt = 1	0.030	0.031	0.038 *	0.040 *	0.016	0.041	0.031	0.047 ** r
dt = 2					0.068	0.105 ** r	0.104 **	0.131 *** rr
dt = 3					0.103	0.161 * r	0.160 ***	0.203 *** rrr
AgGDPsh	-0.007 **	-0.007 ***	0.003	0.002	0.002	0.001	0.004 **	0.004 **
AgExpsh	-0.004	-0.004 *	-0.002	-0.003	-0.003	-0.003	-0.002	-0.002
AgGDPgrow	0.002 ** rr	0.002 ** rr	0.001	0.001 rr	0.002 * rr	0.002 ** rr	0.001 rr	0.001 rr
AUcharters	0.007	0.007	0.005	0.003	-0.017	-0.014	-0.021	-0.019
Capacity	0.006	0.005	0.000	-0.005	-0.013	-0.022 *	-0.020 *	-0.027 *** r
Stability	-0.061 **	-0.062 **	-0.014	-0.017	0.008	0.001	-0.009	-0.011
Effective	0.068	0.072	0.015	0.031	0.119 **	0.111 **	0.086 *	0.077
AfGDPsh	0.036 * rr	0.036 * rr	0.058 *** rrr	0.059 *** rrr	0.052 *** rrr	0.052 *** rrr	0.071 *** rrr	0.072 *** rrr
Voice	-0.125 **	-0.123 **	-0.033	-0.027	-0.059	-0.061	0.001	0.000
Polity	0.015 ** r	0.015 ** r	0.008 *	0.008	0.004	0.003	-0.003	-0.003
GDPgrowth	-0.002	-0.003	-0.001	-0.002	-0.002 * rr	-0.002 * rr	-0.002 * rr	-0.002 * rr
CivClash	-0.001	0.000	-0.002	-0.001	0.016 ** rr	0.017 ** rr	0.012 * rr	0.013 ** rr
LabLand	0.491 ** r	0.495 ** r	0.562 *** rrr	0.565 *** rrr	0.451 ** rr	0.429 ** r	0.318 **	0.307 **
Mobile	-0.002	-0.003	0.001	0.000	-0.002	-0.002	-0.001	-0.001
Rainfall	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IMR	0.002		0.006		0.016		0.010	
Year fixed-effect:								

2003	0.032		rr	0.032		rr	0.019			0.016			0.047	**	rr	0.054	**	rrr	0.037	*	rr	0.042	**	rrr
2004	0.075	**	rrr	0.074	**	rrr	0.039			0.033			0.099	***	rrr	0.113	***	rrr	0.068	**	rr	0.079	***	rrr
2005	0.101	***	rrr	0.100	***	rrr	0.059	**		0.051	*		0.145	***	rr	0.166	***	rrr	0.110	***	rr	0.126	***	rrr
2006	0.145	***	rrr	0.142	***	rrr	0.086	**		0.075	**		0.207	***	rrr	0.237	***	rrr	0.150	***	rr	0.173	***	rrr
2007	0.195	***	rrr	0.192	***	rrr	0.124	***	r	0.110	***	r	0.262	***	rrr	0.299	***	rrr	0.195	***	rrr	0.223	***	rrr
2008	0.226	***	rrr	0.222	***	rrr	0.151	***	r	0.133	***	r	0.316	***	rrr	0.352	***	rrr	0.236	***	rrr	0.265	***	rrr
2009	0.256	***	rr	0.251	***	rrr	0.142	**		0.120	**		0.335	***	rrr	0.373	***	rrr	0.228	***	rrr	0.259	***	rrr
2010	0.308	***	rr	0.304	***	rr	0.156	**		0.131	**		0.370	***	rrr	0.400	***	rrr	0.221	***	rr	0.245	***	rrr
2011							0.163	**		0.139	**								0.221	**	rr	0.241	***	rr
Intercept	4.757	***	rrr	4.797	***	rrr	5.554	***	rrr	5.672	***	rrr	4.995	***	rrr	5.032	***	rrr	5.980	***	rrr	5.995	***	rrr
R-squared	0.573			0.573			0.375			0.372			0.695			0.690			0.593			0.589		
F-statistic	8.850	***		9.270	***		4.330	***		4.470	***		9.460	***		9.660	***		6.710	***		6.900	***	
F-test of d_t:																								
1 = 2													2.820	*		4.880	**	rr	9.310	***	rr	14.850	***	rrr
2 = 3													0.220			0.570		r	2.760	*		5.660	**	rr

Source: Authors' calculation, based on treatment-effect regression model results

Notes: Detailed description of the variables is provided in Table 1. Values of dependent variables are five-year average lead values. *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. ^{r}, ^{rr}, and ^{rrr} indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, based on robust standard errors. Blank cells mean the relevant variable is not included in the model or parameter is not estimated or not applicable. The overall model *F*-statistic was not available for the robust standard errors option.

5. CONCLUSIONS AND IMPLICATIONS

This paper attempted to quantify the impact of CAADP on government agricultural expenditure, ODA for agriculture, and land and labor productivity using panel data on 25 African countries from 2001 to 2014. A country and year fixed-effects model was used, employing two definitions of treatment: first, by a binary variable of pre- and post-compact states and, second, by a four-level ordered variable according to the stage of CAADP implementation (pre-compact, compact, NAIP, and external funding) reached. A two-step control function (inverse mills ratio) procedure (Wooldridge 2010) was used to address endogeneity and selection bias. Different model specifications of the instruments, dealing with potential multicollinearity, and standard errors were employed to assess sensitivity of the results. Because the implementation of CAADP involves several processes that take time to be institutionalized—and whose effect takes time to materialize—the short-to-medium term impacts on government agricultural expenditure and ODA for agriculture was estimated using one-year, two-year average, and three-year average lead values of the dependent variables. For agricultural land and productivity, five-year average lead values were used. The main findings and implications are summarized below.

Factors Influencing Signing a Compact or Level of Implementation Reached

Based on a conceptual framework that draws mostly on the literature on compliance with international agreements or treaties and on national policy decision-making processes, we find that variables representing peer pressure, relevance of CAADP, government implementation capacity, growth path, and infrastructure have a positive influence on a country to implement CAADP or reaching higher levels of implementation, as expected. On the other hand, variables representing population density and civil unrest have a negative influence, whereas variables representing citizens' demands and capacity have mixed effects.

Impact of CAADP on Government Agricultural Expenditure, ODA, and Productivity

Results show that the estimated impact of CAADP on government agricultural expenditure and ODA for agriculture is generally positive. The estimated short-term effect for having at least a compact is about 1.5 to 3.2 percentage points difference for government agricultural expenditure and 0.9 to 1.5 percentage points difference for agricultural ODA, compared to the pre-compact stage. The short-term effects are larger for reaching higher levels of implementation beyond the compact and can go up to 7.2 percentage points difference for government agricultural expenditure and up to 3.4 percentage points difference for agricultural ODA, depending on the measure of the dependent variable or the model specification. The effect on government agricultural spending and agricultural ODA wanes over time however, and is more pronounced for government agriculture expenditure, which seem to suggest a substitution effect between governments' own funding and external (or off-budget) sources of funding for the sector.

The estimated effect on land and labor productivity also is positive. The effect on land productivity is about 11 and 17 percent higher for reaching stages 2 and 3 of CAADP implementation, respectively, compared to the pre-compact stage. For labor productivity, the estimated effect is about 10–14 and 17–23 percent higher for reaching stages 2 and 3, respectively, compared to the pre-compact stage.

Overall Implications

Because CAADP is a framework for inclusive stakeholder participation, ownership, evidence-based policy making, and donor alignment for an agricultural-led development, several interconnecting processes and activities take time to gain buy-in from all the stakeholders to safeguard successful implementation. As such, finding a shortcut may be difficult. A process that is likely to yield benefits would be one that includes a systematic effort to identify strategies that are likely to work (as expected of the growth options and investment and capacity requirements analyses), to articulate those strategies in a plan that is adequately funded and implemented accordingly, and to monitor and evaluate progress to continuously refine the investments and programs. It is important for countries to continue to innovate in ways that sustain or raise the returns to effort, including transitioning from growth that is driven by expansionary agricultural production process to growth that derives from shifting out of the agricultural technological frontier (Benin and Nin-Pratt 2016). Further research on the quality of the processes in developing and implementing CAADP, as well as on the investments in different productivity-enhancing, in different countries is needed to substantiate the findings in this paper. As more years of data become available, the impact on other CAADP development outcomes, for example, income and food and nutrition security may be assessed, since the effect on these takes even longer times to materialize.

Although finding a shortcut to the CAADP process may be difficult, it is possible for countries to have good policy processes and mechanisms in place irrespective of whether they are implementing CAADP or not. Furthermore, it may be possible for countries that start implementing CAADP at later periods to have more refined plans and implementation strategies after taking account of the lessons from those that started implementing CAADP at earlier periods. Thus, by avoiding any of the pitfalls faced by the early-implementing CAADP countries, later-implementing CAADP countries could catch up in terms of the time between implementation and realization of outcomes to the extent that lessons from the early-implementing CAADP countries are known and applied.

REFERENCES

Allen, S.L. and Ulimwengu, J. 2015. "Agricultural Productivity, Health and Public Expenditures in Sub-Saharan Africa," *European Journal of Development Research*, Vol. 27(3):425-437.

AU-NEPAD (African Union–New Partnership for Africa's Development). 2003. *Comprehensive Africa Agriculture Development Programme*. Midrand, South Africa.

AU-NEPAD (African Union–New Partnership for Africa's Development). 2010. The Comprehensive Africa Agriculture Development Programme (CAADP) in Practice: Highlighting the Success. Midrand, South Africa.

AU-NEPAD (African Union–New Partnership for Africa's Development). 2014. "Implementing the CAADP Agenda." Accessed April 2014. www.nepad-caadp.net/implementing-caadp-agenda.php.

AU-NEPAD (African Union–New Partnership for Africa's Development). 2015. *The CAADP Results Framework, 2015–2025: Going for Results and Impact*. Midrand, South Africa.

AU (African Union). 2017. OAU/AU Treaties, Conventions, Protocols & Charters. Accessed January 5, 2017. (https://au.int/en/treaties)

Benin, S. 2016. Impacts of CAADP on Africa's agriculture-led development. IFPRI Discussion Paper 1553. Washington, DC: International Food Policy Research Institute.

Benin, S., M. Johnson, and B. Omilola. 2010. *Monitoring and Evaluation (M&E) System for the Comprehensive Africa Agriculture Development Programme (CAADP).* ReSAKSS Working Paper 6. Washington, DC: International Food Policy Research Institute.

Benin, S., and A. Nin-Pratt. 2016. "Inter-temporal Trends in Agricultural Productivity." In *Agricultural Productivity in Africa: Trends, Patterns, and Determinants,* edited by S. Benin. Washington, DC: International Food Policy Research Institute.

Belsley, D., E. Kuh, and R. Welsch. 1980. Regression Diagnostics. Wiley.

Brüntrup, M. 2011. "The Comprehensive Africa Agriculture Development Programme (CAADP): An Assessment of a Pan-African Attempt to Revitalize Agriculture." *Quarterly Journal of International Agriculture* 50 (1): 79–106.

Chiburis, R. and Lokshin, M. 2007.Maximum likelihood and two-step estimation of an ordered-probit selection model, *Stata Journal* 7(2): 167-182.

CIA (US Central Intelligence Agency). 2016. “Chiefs of State and Cabinet Members of Foreign Governments” (January editions of reports from 2001 to 2014). Accessed May 20, 2016. https://www.cia.gov/library/publications/resources/world-leaders-1/.

Cox, G. W., and M. D. McCubbins. 1986. “Electoral Politics as a Redistributive Game.” *Journal of Politics* 48 (2): 370–389.

Downs, G., Rocke, D. and Barsoom, P. 1996. “Is the Good News about Compliance Good News about Cooperation?” *International Organization* 50: 379–406.

FAO (Food and Agriculture Organization of the United Nations). 2016. “FAOSTAT: Commodities by Country.” Accessed October 5, 2016. http://faostat.fao.org/site/339/default.aspx.

FSG (Food Security Ghana). 2013. Ghana Food and Agricultural Budget 2013: Part II, the Ten Percent Lie. Accessed December 15, 2013. http://foodsecurityghana.com/2013/03/28/ghana-food-and-agricultural-budget-2013-part-ii-the-ten-percent-lie/.

GAFSP (Global Agriculture and Food Security Program). 2016. “Recipient Countries.” www.gafspfund.org/content/recipient-countries.

Grow Africa. 2016. “Investment Commitments.” Accessed June 30, 2016. https://www.growafrica.com/countries.

Heckman, J. 1978. “Dummy Endogenous Variables in a Simultaneous Equation System.” *Econometrica* 46: 931–959.

Heckman, J. 1979. Sample selection bias as a specification error. *Econometrica* 47: 153-162.

IFPRI (International Food Policy Research Institute). 2015a. DATASET. “Public Expenditure Database: Statistics on Public Expenditure for Economic Development (SPEED).” Accessed March 15, 2015. www.ifpri.org/book-39/ourwork/programs/priorities-public-investment/speed-database.

IFPRI (International Food Policy Research Institute). 2015b. “Regional Strategic Analysis and Knowledge Support System (ReSAKSS).” Accessed April 15, 2015. www.resakss.org/about.

Jerven, M. 2013. *Poor numbers: how we are misled by African development statistics and what to do about it?* Ithaca, NY: Cornell University Press.

Kolavalli, S., K. Flaherty, R. Al-Hassan, and K. Owusu Baah. 2010. *Do Comprehensive Africa Agriculture Development Program (CAADP) Processes Make a Difference to Country*

Commitments to Develop Agriculture? The Case of Ghana. IFPRI Discussion Paper 1006. Washington, DC: International Food Policy Research Institute.

Lindbeck, A., and J. Weibull. 1993. "A Model of Political Equilibrium in a Representative Democracy." *Journal of Public Economics* 51 (2): 195–209.

Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics.* Cambridge, UK: Cambridge University Press.

MOFA (Ministry of Food and Agriculture). 2013. Basic Agricultural Public Expenditure Diagnostic Review. Report under Strengthening National Comprehensive Agricultural Public Expenditure in Sub-Saharan Africa implemented by the World Bank.

New Alliance. 2016. "Partner Countries." https://www.new-alliance.org/countries.

New Alliance/Grow Africa. 2015. "Joint Annual Progress Report, 2015–2015." Accessed June 30, 2016. https://www.new-alliance.org/resource/2014-2015-new-alliance-progress-report.

OECD (Organization for Economic Co-operation and Developmet). 2017. Creditor Reporting System. Accessed January 5, 2017. http://stats.oecd.org/index.aspx?DataSetCode=CRS1

Ochieng, C. M. O. 2007. "Revitalizing African Agriculture through Innovative Business Models and Organizational Arrangements: Promising Developments in the Traditional Crops Sector." *Journal of Modern African Studies* 45 (1): 143–169.

Oruko, L., I. Randall, M. Bwalya, S. Kisira, and M. Wanzala. 2011. "Mutual Accountability Framework." Accessed April 15, 2014. http://www.nepad.org/system/files/CAADP%20MAF%20Final%20Draft%20Report%20%20March%202011.pdf.

Papaioannou, E., and G. Siourounis. 2008. "Democratization and Growth." *The Economic Journal* 118: 1520–1551

Przeworski, A., and J. Vreeland. 2000. "The Effect of IMF Programs on Economic Growth." *Journal of Development Economics* 62: 385–421.

Robins, J. M., M. A. Hernan, and B. Brumback. 2000. "Marginal Structural Models and Causal Inference in Epidemiology." *Epidemiology* 11: 550–560.

Rodrik, D. 2012. "Why We Learn Nothing from Regressing Economic Growth on Policies." *Seoul Journal of Economics* 25 (2): 137–151.

SCP (Center for Systemic Peace). 2015. “Polity IV Project: Political Regime Characteristics and Transitions, 1800–2013.” Accessed September 15, 2015. www.systemicpeace.org/polity/polity4.htm.

Simmons, B. A., and D. J. Hopkins. 2005. “The Constraining Power of International Treaties: Theories and Methods.” *American Political Science Review* 99 (4): 623–631.

SOTU (The State of the Union). 2015. “Status of Ratification of AU Charters, Treaties, Protocols and Conventions as at December 2015.” Nairobi, Kenya.

StataCorp. 2017. STATA Version 15.1: Statistics/Data analysis, parallel edition. College Station, TX.

von Stein, J. 2005. “Do Treaties Constrain or Screen? Selection Bias and Treaty Compliance.” *American Political Science Review* 99 (4): 611–622.

Vreeland, J. 2003. *The IMF and Economic Development.* Cambridge, UK: Cambridge University Press.

Wooldridge, J.M. 2010. Econometric Analysis of Cross Section and Panel Data, Second Edition. MIT Press, Cambridge, Massachusetts.

World Bank. 2016a. *World Development Indicators.* Washington, DC.

World Bank. 2016b. “Worldwide Governance Indicators.” Accessed September 15, 2015. data.worldbank.org/data-catalog/worldwide-governance-indicators.

World Bank. 2017. Climate change knowledge portal. Accessed October 31, 2016. http://sdwebx.worldbank.org/climateportal/?page=downscaled_data_download&menu=historical.

Zimmermann, R., M. Brüntrup, S. Kolavalli, and K. Flaherty. 2009. *Agricultural Policies in Sub-Saharan Africa: Understanding CAADP and APRM Policy Processes*. DIE Study 48. Bonn, Germany: Deutsches Institut für Entwicklungspolitik (DIE, German Development Institute).

ReSAKSS

Regional Strategic Analysis and Knowledge Support System

Facilitated by IFPRI

For more information, contact:

Samuel Benin, Deputy Division Director, Africa Regional Office
International Food Policy Research Institute
1201 Eye Street, NW
Washington, DC 20005 – 3915
Telephone: + 1 202 862 5606
Facsimile: + 1 202 467 4439
E-mail: resakss-africa@cgiar.org
www.resakss.org