An Exploration of the Effects of Different Policy Instruments in Colombian Agricultural Policy

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Abstract

Recent changes in Colombian agricultural policy have focused on implementing domestic support measures aimed at protecting farmers' income and enhancing sectoral productivity. However, estimates of expected impacts arising from the policy, measured as changes in value added, are small. As the policy uses several instruments for achieving its objectives, the question arises as to whether estimated impacts are dependent upon the way resources are allocated among them. We explore this issue for a set of three of the main policy instruments employed by the Colombian government, in a short run context, by means of a Computable General Equilibrium model. Our results indicate that in the presence of short term rigidities, specially capital fixity, all policy instruments lead to small estimated effects and that in a longer run scenario the behavior of investment seems critical for attaining more significant impacts and a better potential for reaching the policy's objectives.

Keywords: Agricultural policy, Computable General Equilibrium, Colombia.

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1 Introduction

In 2007 the Colombian government implemented an ambitious program for enhancing competitiveness in the agricultural sector and for protecting farmers' income in the face of international agricultural price distortions and further trade liberalization measures. The program was also significant in that it expanded the set of domestic support measures that the government historically had in place, shifting to some degree the focus of sectoral policy.

Simulations of the expected results from the program (Arguello, 2011) show that, in a short run context, they are small at the activity (subsectoral) level and even more so at the sectoral level. Although the program's structure is relatively complex, its main policy instruments reduce to an small set of incentives that are amenable of quantitative analysis. In particular, from the set of incentives provided by the program, there are three that are of interest given the relative size of resources devoted to them and the availability of information for their analysis. These are working capital subsidies, productive capital subsidies, and irrigation subsidies. As actual operation of the program involves using a combination of these incentives, the question arises as to how much expected results can change if a different mix of subsidies is used.

Among the different alternative ways of exploring this issue, we follow one that is sensible for providing some intuition on the way these incentives work in a short term context. Specifically, we simulate the expected effects from the program under the hypothetical scenarios in which resources are devoted to provide only one of the subsidies listed above, while maintaining the same subsectoral (activity) distribution of resources that was actually observed. For this, we use a static Computable General Equilibrium model specialized in the agricultural sector, running on a 2007 Social Accounting Matrix with detailed information on the Colombian agricultural sector.

We first simulate, as a benchmark, the expected impacts arising from the actual implementation of the program and then add three what-if scenarios, each simulating the expected effects coming from the use of a single policy instrument. Results indicate that the impact of the program on sectoral and activities value added do not differ much from the attained under the benchmark case, although differences in the size of the impacts are observed between the three policy instruments considered. Discussion of the results shows the importance of the assumption of a short run horizon, specially having capital that is sector specific, and, in a different dimension, imperfect land mobility. These considerations also lead to paying attention to the role that investment plays in the longer run effects of the program, an issue we cannot discuss here but around which we provide some comments.

The paper is organized as follows. The second section provides the policy context and states the research objective. In section three we present the methodology used, starting with a short description of the model, followed by an schematization of the way the program operates in terms of the incentives it provides, and by a depiction of the way we model these incentives. Results from the four scenarios are presented in section four, as well as a discussion of the intuition behind them. Lastly, section five provides some concluding comments.

2 Policy Context and Objective

In the wake of negotiations for establishing a Free Trade Agreement (FTA) with the United States, the Colombian government promised farmers' organizations that a policy package would be designed and put in place for smoothing the impact of the implementation period of the FTA and for boosting sectoral competitiveness. Announced in March 2006, the program was put in place in April 2007 with the signing of a law that layed out its general principles and allocated a budget to it.[1] The program, termed Agriculture Secured Income (AIS for its acronym in Spanish), was assigned a budget of around US$217 million, that for 2007 represented 35% of the yearly total public sectoral budget (excluding debt servicing). By law, the budget assigned to AIS has to keep its real value and hence it was indexed to the Consumer Price Index. Although in relative terms the size of the program is modest (around 2.3% of sectoral GDP) it is by far the largest domestic support policy instrument in sectoral policy in Colombia.

AIS has a relatively complex structure. Its two main components target different objectives. One of them is devoted to provide direct support for farmers in order to protect their income during the implementation period of the FTA with the US (Sectoral Direct Support Component -SDSC). The other is aimed at enhancing sectoral competitiveness, increasing its producivity and helping launch restructuring processes (Competitiveness Enhancement Component - CEC). Each component addresses a specific objective assigned to the program at its inception. Direct support is provided unconditionally to farmers and is set to be selective and temporary. The government reserves for itself the role of defining "in an objective manner" the activities eligible for this type of support, the amount of support to be given to each, and the conditions that beneficiaries must fulfill. By design, after six years of program operation, all direct support measures should have been phased out. On the other hand, competitiveness enhancement measures should be allocated no less than 40% of the program's total budget, and the government assumes the commitment to give priority to Departments (States) that lag behind in terms of productivity and competitiveness indexes, while assuring there is an equitable regional distribution of resources from the program.

Each component has its own internal structure. CEC has three main policy instruments: productivity incentives, subsidized credit, and marketing support. Productivity incentives are aimed at enhancing technical assistance, technology development and transfer, implementing good agricultural practices, fostering associativeness, and land conversion, irrigation and drainage cofinancing. Subsidized credit is targeted for supporting productive restructuring, land conversion, productivity enhancement, and new investment for promoting agricultural modernization. Marketing support is aimed at implementing traceability systems, domestic absorption mechanisms, and other supplementary activities.

[1] Law 1133 of 2007.

These sets of instruments are basically channeled through nine subprograms, of which the most important for our purposes are: the Special Credit Line (SCL), the Incentive for Rural Capitalization (IRC), and the Call for Irrigation and Drainage Projects (CID).[2] The SCL is a subsidized credit scheme aimed at supporting productivity improvements and restructuring (shift between agricultural activities) that is provided through the financial system. Credit conditions have varied through time, but on average imply significantly lower interest rates as compared to normal credit (between 12 and 5 percentage points, according to the type of farmer and the year). Small farmers tend to use it for planting and maintenance of crops, while large farmers for acquisition of machinery for primary transformation of products. Medium size farmers tend to be the main beneficiaries from this scheme (in terms of their share in the total amount disbursed by the program) and devote its resources to planting and maintenance of crops and to land preparation.

The IRC is intended to foster agricultural investment by means of a credit line that operates at market interest rates but that entails limited credit forgiveness. As a program, IRC existed before the implementation of AIS but the latter uses the same scheme to allocate part of its resources. AIS also extends the set of activities that are eligible, beyond the boundaries of the original IRC. Under its provisions, small producers are given 40% forgiveness on the value of credit devoted to activities included in a eligibility list. Medium size and large farmers are given 20% forgiveness subject to some exceptions (related to the activities carried on). In the case of construction, enlargement or rehabilitation of large irrigation projects, forgiveness is at the level of 40%, regardless of farmer size, and there are no limits in the amount of the incentive.[3] The list of eligible activities includes land preparation and water management; productive infrastructure; biotechnology development and application; machinery and equipment for agricultural production; livestock and aquaculture equipment; low technology fishing; primary transformation of agricultural goods; planting, maintenance, and renewal of perennial crops; acquisition of pure breed bovine livestock; implementation of integrated livestock and forestry projects; and investment in generic agricultural inputs.

The CID is a subprogram aimed at cofinancing irrigation and drainage projects that are tied to existing or prospective production. The amount of subsidy granted by the government varies according to the type of project (individual, cooperative, regional) and may reach up to 80% of direct costs. The rest of the costs have to be either covered by regional institutions or directly by the farmers or both. Funds for this program are allocated on a competitive basis. Proponents have to prepare a proposal, including an economic evaluation, and enter in a contest through which it is determined who gains access to the funds.[4]

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[2] The other subprograms are: Incentive for Technical Assistance, Livestock Sanitation, Coffee Extension Service, Forestry Incentive Certificate, Science and Technology, and a fertilizer program (Fertifuturo).

[3] Some of these conditions change from time to time.

[4] This is the program that mainly gave rise to criticism of AIS, since large farmers were

The SDSC uses some of the same subprograms that the CEC uses, specially the SCL and the IRC. As mentioned, a difference here is that funds from this component target specific sectors according to an evaluation performed by the government. The other difference is that the level of subsidization is higher in this case. Credit forgiveness for medium size and large farmers benefiting from IRC are higher, for instance (30% as compared to 20% under the CEC). In 2007, all resources of the component were directed to cereals and rice and disbursed in close proportions under the SCL and IRC (44% and 56% on average). In 2009, it was given priority to the cut flowers sector (for social and environmental purposes), to planting of corn for feedstock purposes, and to planting of beans in coffee growing areas.

In spite of the fact that negotiations for the FTA with the US ended in November 2006 and that only in October 2011 the treaty was approved by the US Congress (which implies that implementation could only begin in 2012), AIS entered into force in 2007 and has been in place since then.[5] To accommodate the fact that the trade pact was not in place and therefore there was a weak basis for implementing the SDSC, the government determined that 72% of the budget should be allocated to the CEC, 26% to the SDSC, and the remaining 2% to the administration of the program. This allocation rule, in the sense of giving priority to the CEC, has been in place during the following years.[6] From 2007 to 2009 the program executed around US$740 million.

As provided in the design of the program, in 2010 the Ministry of Agriculture contracted an independent evaluation that was carried out by Econometria Consultores and SEI S.A., two Colombian consultancy firms.[7] The Econometria (2011) study surveyed 1,865 beneficiaries that entered into the program between January and May of 2008[8] and 4,057 non-beneficiaries allowing for having two control groups against which to test the behavior of beneficiaries. One of the control groups is integrated by farmers located in areas in the proximity of beneficiaries and the other by farmers located far away so spillover effects can be controled for. The distinction between controls that had access to and used credit and those that did not have access to credit was also taken into account. Around 43% of the sample of beneficiaries obtained subsidies through the SCL, 28% from the IRC, 28% from the CID, and the remaining 1% from the ITA.[9] As

better positioned to present good proposals than small farmers. Furthermore, large farmers fragmented their projects in order to violate the ceilings imposed on the amount of the subsidy, managing to illegally get access to a big proportion of resources.

[5] In 2009 the program came under fire when missallocation of resources was made public by the press. With a new government in power, the program was rebranded as Equitable Rural Development (DRE for its acronym in Spanish) in 2011, big farmers where denied access (unless they are involved in joint projects with small farmers) and marginal changes were introduced in its operation. Its basic structure, organization, and policy instruments in use continue being the same.

[6] Budget allocation for 2008 was as follows: 93.6% to CEC, 5.2% to SDSC, and 1.2% for administrative costs.

[7] We refer to this as the Econometria study for short.

[8] Which amount to around 5.6% of total beneficiaries from the program.

[9] The sampling took into account the proportion of projects benefiting from each subprogram as well as geographical and farmer size characteristics.

a number of beneficiaries surveyed for the study was also included in the sample for constructing the base line, both Propensity Score Matching and Difference-in-Difference techniques were employed for analyzing the data. The survey was conducted between October and December 2010.

Among the variables analyzed in the Econometria study, there are four that are of interest for us: competitiveness (measured as monthly production costs per hectare), productivity (measured as monthly net income per hectare), productive investment (measured as total investment made in agricultural activities), and employment (measured as working days devoted to in-farm agricultural activities). In summary, the findings from the study are the following. First, small farmers showed increases in costs per hectare, lower investment levels and in spite of attaining higher gross incomes, these were insufficient for increasing net income. On the other hand, large producers kept their investment levels, decreased production costs, and sustained their net income. Employment levels increased in the case of small farmers and also in the general case in which the activity is based on perennial crops.

No effects were found in the case of both demand for technical assistance and systematic use of technical training. There is, however, greater evidence of increased use of machinery when producers are firms (as opposed to households), regardless of the type of activity, and in the case of individual producers (households) when they grow perennials. In the case of firms, it is also observed that they sustained high investment levels and, in some cases, attained positive net income effects. Lastly, there were found no spillover effects.

The above implies that, in general, use of subsidized credit from the program has either non significant or negative effects on outcomes for producers (specially in terms of competitiveness and productivity), and that positive effects tend to concentrate in firms and producers whose activities are based on perennial crops. As the study highlights, of a total of 2,012 possible impacts, only in 350 cases (17.4% of the total) there were significant effects and half of them point away from the expected direction. As a consequence, it can be said that, on average, the program has no significant effects on beneficiaries and therefore does not generate differences between beneficiaries and non-beneficiaries outcomes (with the possible exception of certain firms and producers).

Also, as noted in Arguello (2011) examination of the actual performance of the agricultural sector does not support the idea that the program is delivering the expected outcomes. Given this, it is of interest to examine what the expected outcomes of the program could be, had it concentrated its resources in a particular policy instrument instead of spreading them across all instruments.

3 Methodology

For answering the above question, we use a Computable General Equilibrium (CGE) model specialized in agriculture and run simulations in which it is considered that the total amount of resources used by the program in 2008, is allocated to only one type of policy instrument while its distribution among activities follows the one actually observed. Alternative ways of allocating subsidies among activities could be envisioned but as we want to run a simple what-if scenario keeping the actual distribution is the most appropriate assumption. In the following, we first provide a brief description of the CGE model, a classification of the policy instruments according to the type of incentives they create, a description of the way these incentives are modeled, and an overview of the conditions under which the simulations are run (the model closure rules).

3.1 Structure of the CGE Model

The model is based upon the PEP Standard CGE model (single country, static; PEP-1-1). It has a neoclassical structure with equations that describe producers' production and input decisions, households' behavior, government demands, import demands, market clearing conditions for commodities and factor markets, and numerous macroeconomic variables and price indexes. Demand and supply equations for private-sector agents are derived from the solutions to optimization problems, in which it is assumed that agents are price-takers and markets competitive. The external sector is modeled as a single region and a "mild" version of the small country assumption is used.[10] A thorough documentation of the model is found in Decaluwé et al (2009).

The model is adjusted in two major ways. First, a production structure is included specifically for the agricultural sector, that allows for a convenient representation of agricultural production. Second, a structure for the supply of land services is added too, so as to have a more realistic behavior of land allocation between agricultural activities. However, our definition of agriculture excludes livestock, dairy production, meat production, forestry and fisheries.[11] The main reason for this being that we have no dependable information about land use in this type of activities (specially for livestock).

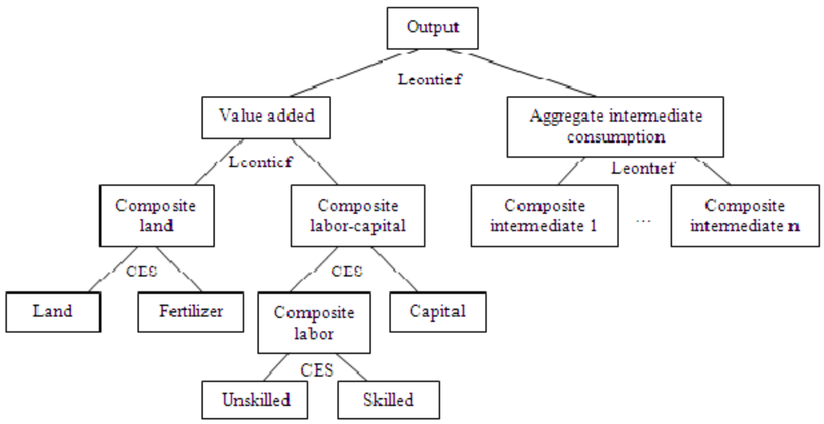
With respect to the structure of production, we have at the top that value added and a composite intermediate good are used in fixed proportions (Leontief). Then, in a second nest, value added is defined as a Leontief function of composite land and a composite of capital and labor. On the composite intermediate good side, the structure is described, again, by fixed proportions. This specification reflects the marked degree of complementarity that agricultural production tends to exhibit. Moving on to the value added nest, the composite of capital and labor is modeled as a Constant Elasticity of Substitution (CES) combination of composite labor and composite capital (third nest). Composite labor is in turn a CES combination of skilled and unskilled labor (fourth nest). While the model allows for a composite of several capital types, currently only one type of capital is used. On the other hand, composite land (third nest) is a CES combination of land and fertilizer, allowing for the latter to play a

[10] In the sense that local producers can increase their share in international markets as long as they can offer a price that is advantageous with respect to the world price (and subject to a price elasticity of export demand).

[11] Although, these sectors are included in the model.

role in determining value added. The structure of agricultural production is represented in Figure 1.

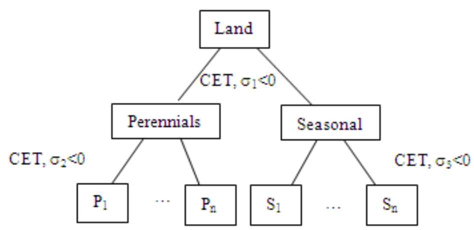
Fig. 1: Structure of Agricultural Production



As regards land services, agricultural land is assumed heterogeneous in the model and only land for agricultural use is considered (no land services for livestock, forestry, and industrial use are taken into account). However, crops compete for land services with no regard for the agroecological conditions that they require and land services are rendered to each crop type with certain restrictions. This feature, responds to two considerations. First, it approximates the fact that land is heterogeneous: land availability is tied to climate and other characteristics that suite some crops but not others and, as a consequence, it cannot be freely "mobile" across crops. Second, agricultural land use is conditioned upon certain economic constraints. In particular, land use may depend on the easiness with which land can be allocated to different crop types, according to characteristics such as the way cash flows produced or required by the activity behave, or to the size of initial investments. Therefore, land allocation is "sluggish" in the model and a Constant Elasticity of Transformation (CET) function is used to represent it.

In particular, land allocation is done according to the degree of "easiness of entry" into a particular activity. Activities for which it is required to make sizable investments in land preparation or for which the maturing period is large, are deemed to experience lower propensities to be switched to from other uses. Hence, supply of land services at the top is divided among perennial and seasonal crops (first nest with an elasticity given by σ_1). This is a decision usually associated to the need for relatively lumpy investments and cash flow constraints, given that perennials take some time to begin producing. Then, in the second nest land is allocated to particular crops (both perennial and seasonal with elasticities given by σ_2 and σ_3, respectively). At this level, land allocation decisions differ according to the type of crop. Land allocation within seasonal crops is the most flexible given that investments required to switch from one crop to the other are relatively low. In contrast, land allocation between perennials is less easy as switching from one crop to the other entails incurring in higher costs. The following relationship holds for the three elasticities: $\sigma_1 < \sigma_2 < \sigma_3$. The structure of the supply of land services is shown in Figure 2.

Fig. 2: Supply of Land Services



The model uses a 2007 SAM with 31 activities and 31 commodities. 23 activities and commodities belong or are directly related to the agricultural sector: nine are seasonal crops, nine are perennial crops, and the remaining five are perennials that are not productive yet (agricultural investment), livestock and poultry, forestry, agricultural services, and agroindustry. Among the non-agricultural sectors, there are two services sectors (services in general and financial services) and two sectors that produce agricultural inputs (fertilizers and other agrochemicals). There are three production factors: land, labor, and capital. Land is used only by crops, so livestock and poultry, forestry, and agricultural services, only use labor and capital. Labor is split into four categories, rural unskilled, rural skilled, urban unskilled, and urban skilled, and there is only one type of capital. Households are disaggregated into rural and urban and each type is, in turn, split in income quintiles, for a total of 10 household types.

3.2 Incentives Provided by AIS

In spite of the institutional complexity of AIS (two components, eleven subprograms, different access rules and subsidization levels for each subprogram-component-beneficiary type combination), when it comes down to the economic incentives that it creates for farmers, the situation is relatively simple. Table 1 lists (in a simplified way) the main activities that were financed in 2008 through the SCL, the IRC, an the CID, and groups them according to the type of incentive they create.[12] A couple of comments are in order with respect to the classification provided in the table. First, since items that are eligible for a working capital subsidy are broad and tend to cover a wide range of productive activities (ranging from inputs purchases, to outsourcing of different activities) it is convenient to represent the effects of this subsidy as spreading across the whole financing of the production process and, hence, as having the effect of lowering unit costs. Second, both investment financed through the SCL or through the IRC, is almost entirely devoted to support and enhance capital use and its effects are better represented as a subsidy on capital. There are, however, some exceptions to this. Investment subsidies allocated for planting and crop maintenance or for agricultural production, tend to be general in terms of items that are eligible and therefore behave in a manner similar to that of working capital subsidies, so their effects are also viewed as lowering unit costs. On the other hand, although subsidies for land adequation may include in some cases irrigation related activities, most of the times it only involve activities that do not comprise irrigation or water management. As in the basic simulation (that corresponding to the actual allocation of subsidies during 2008) we want to have a clear divide between irrigation related subsidies granted through the SCL or the IRC from those granted through the CID, we treat land adequation subsidies as capital subsidies.[13] As there is no distinction in the model between farmer types, subsidies conveyed through the program are relevant only as aggregates at the activity level.

All AIS subprograms except the SCL, the IRC, and the CID, are expected to yield results that are difficult to pin down in an evaluation and more so by means of a CGE model. For instance, technical assistance (as enhanced through the ITA and the Coffee Extension Service) is expected to raise yields as better production techniques are supposed to be put in place, pest and insect control is fostered, and better use of inputs can be made. However, the extent to which yields may increase is uncertain and a priory estimates may be lacking. Therefore, use of the CGE model is restricted to an estimation of the expected impacts arising from the three subprograms mentioned above, which according to the Econometria (2011) study were three of the four subprograms to which

[12] Items and activities change from year to year, but the way incentives work is similar in spite of this. We illustrate the situation for 2008 since this is the year we use as the basis for the simulation.

[13] While this implies a distortion in the way we evaluate the expected impacts of the program in the basic simulation, the effect of this assumption is negligible as irrigation financing through the SCL and the IRC is quite small in relative terms. For the rest of simulations (the what-if scenarios) the assumption has no bearing.

Tab. 1: Incentives Created by the Program

Subprog	Item	Activity	Effect	Incentive
SCL	Working Capital	N.A.	W. capital subsidy	Lower unit cost
	Investment	Productive infrastructure	Capital subsidy	Lower capital cost
		Processing	Capital subsidy	Lower capital cost
		Machinery	Capital subsidy	Lower capital cost
		Land adequation	Capital subsidy	Lower capital cost
		Planting, maintenance	W. capital subsidy	Lower unit cost
		Agricultural production	W. capital subsidy	Lower unit cost
		Crop maintenance	W. capital subsidy	Lower unit cost
		Livestock acquisition	Not considered	N.A.
		Services infrastructure	Not considered	N.A.
		Livestock maintenance	Not considered	N.A.
	Credit refinancing	N.A.	Not considered	N.A.
IRC	N.A.	Agricultural machinery	Capital subsidy	Lower capital cost
		Production infrastructure	Capital subsidy	Lower capital cost
		Late yield perennials	Capital subsidy	Lower capital cost
		Land adequation	Capital subsidy	Lower capital cost
		Primary processing	Capital subsidy	Lower capital cost
		Livestock acquisition	Not considered	N.A.
CID		Irrigation	Land subsidy	Lower land cost
			Productivity enhancement	Higher productivity

Source: author's schematization.

the majority of resources were allocated (the fourth one is the ITA) .

3.3 Modeling of Incentives

In consonance with the discussion above, we model all subsidies having an effect akin to a lowering of unit costs as creating a (negative) wedge between an activity's unit cost and its basic price:

$$PT_j = (1 + ttip_j - SWK_j)PP_j \tag{1}$$

where:

PT_j: Activity j basic price

PP_j: Activity j unit cost

SWK_j: Working capital subsidy rate (endogenous)

$ttip_j$: Tax rate on activity j production (parameter)

Likewise, productive capital subsidies lower the cost of capital for beneficiary activities so the price of this factor decreases according to the implied subsidy rate (for the whole activity):

$$RTI_j = R_j(1 + ttik_j - SKD_j) \tag{2}$$

where:

RTI_j: Rental rate of capital payed by activity j

R_j: Rental rate of capital in activity j

SKD_j: Productive capital subsidy rate (endogenous)

$ttik_j$: Tax rate on capital used in activity j (parameter)

Lastly, irrigation subsidies entail two effects. On one side, they lower the cost of using land and therefore act in the same way as the subsidy for productive capital. On the other, they are expected to have an effect on productivity since enhanced water availability and management is expected to increase yields. These effects are modeled as follows:

$$RTT_j = RTS_j(1 + ttit_j - STI_j) \tag{3}$$

$$CT_j = CTPF_j Bct_j[\beta ct_j TD_j^{-\rho ct_j} + (1 - \beta ct_j)FD_j^{-\rho ct_j}]^{\frac{-1}{\rho ct_j}} \tag{4}$$

where:

RTT_j: Rental rate of land payed by activity j

RTS_j: Rental rate of land supplied to activity j

STI_j: Subsidy rate on land rent for activity j (endogenous)

CT_j: Composite land used in activity j

$CTPF_J$: Productivity parameter from irrigated land for activity j (endogenous)

TD_j: Land used by activity j

FD_j: Fertilizer used by activity j

$ttit_j$: Tax rate on land used by activity j

Bct_j: Scale parameter for activity j (CES-composite land)

βct_j: Share parameter for activity j (CES-composite land)

ρct_j: Elasticity parameter for activity j (CES-composite land)

The productivity effect arising from irrigation should ideally be calibrated on a crop by crop basis. Unfortunately there is no enough and reliable information for doing this and in the simulations it is assumed a single value for all crops. Furthermore, the parameter is estimated on the basis of the (average) yield gap that is deemed to exist between irrigated and non-irrigated land for several crops. Data on yield gaps come from information available for some crops and from experts' judgment.[14]

Finally, it is convenient to describe the general characteristics of the simulations. First, it is given consideration to the financing of the program. For this, it is assumed that governmental expenses incurred in for subsidizing agricultural activities are financed through direct taxes designed to raise the exact amount needed (therefore, the corresponding tax rates adjust endogenously). Second, the scenarios are simulated using the following closure rules. The nominal exchange rate is the numeraire, labor is in fixed supply, fully utilized, and freely mobile between all sectors, government expending is fixed, investment is saving-driven, the current account balance is fixed, and total land demand is fixed.[15] We define our time horizon as short term, so capital is assumed sector specific. This feature is not only consistent with the idea that most capital used in agricultural activities relates to trees and plants and less so to machinery and equipment,[16] but also with the fact that, even in the case of capital that is not strictly specific to an activity (like machinery), the time span considered in the simulation makes it unlikely that there could be any significant capital reallocation between activities.

Given the above depiction of the type of policy instruments that are modeled and the time frame some of them require for being fully operational, it is convenient to clarify the scope of the short term nature of the simulations. We

[14] Given the nature of this information, sensitivity analysis is conducted to appraise the effect of changes in this parameter.

[15] Since we have land demand governed by a CES aggregate (of composite land) and land supply by a CET aggregate, land supply (supply of land services) has to be endogenous.

[16] At least for the Colombian case, on average.

understand short term in this context as a time period of up to two years, allowing enough time for new capital investments to be built and operational (in particular productive capital and land improvements and irrigation), but not for new areas planted with perennials to enter their productive stage. In this way we reconcile the static nature of the model with the main features of the policy package, so the simulation is meaningful. In particular we do not deal with the fact that part of the policy instruments are aimed at fostering new planted areas of perennial crops or with the entrance of already planted areas into production, both of which would require use of a dynamic model.

4 Results

We run a total of four simulations. First a base scenario is provided in which the expected effects of the program are estimated. Then, three what-if scenarios are simulated, assuming that the program uses its resources alternatively only to provide working capital subsidies, productive capital subsidies or irrigation subsidies, and that resources are allocated to activities in the same manner they were actually allocated during 2008.

4.1 Expected results from AIS

A total of about US$144 million in subsidies was granted by the government during 2008 through the three subprograms we consider here. From their allocation, Table 2 shows the resulting subsidy rates at the activity level, each rate being calculated from the relevant variables. That is, working capital subsidy rates are percentages over total costs, productive capital subsidy rates are percentages over the total cost of capital, land use subsidy rates are percentages over total cost of land use, and productivity shocks are percentage increases in equivalent land use. Among the features arising from these figures, it is worth mentioning three. First, given the size of the program relative to sectoral GDP, there is a large gap between the subsidy rate that is given to the average beneficiary from the program and the ensuing subsidy rate for the activity as a whole. For instance, while the subsidy rate granted to the average coffee producer that benefits from subsidies for productive capital is 22.9%, the corresponding subsidy rate for the coffee sector amounts to just 0.72%. Therefore, beneficiaries from the program potentially gain a significant advantage over non-beneficiaries and this effect is not captured in this experiment, since we do not differentiate among different producers within an activity or between beneficiaries and non-beneficiaries.[17]

[17] Simple average actual subsidy rates for working capital are at 3.4%, for productive capital are at 15.7%, and for land use are at 73.4%. Meanwhile, simple average subsidy rates, as reported in Table 2, are at 0.3%, 3.1%, and 15.6%, respectively (differences may be even higher as actual rates are computed based on the total value of individual projects and activity rates as described in the main text). However, it must be kept in mind that, according to the Econometria (2011) study, basically there are no differences in behavior between beneficiaries and non-beneficiaries.

Tab. 2: Subsidy Rates at the Activity Level Granted through the Program

Activity	Working capital	Productive capital	Land use	Productivity
Coffee	0.00	0.72	4.52	0.88
Cereals	0.09	0.09		
Corn	0.18	11.80	8.28	2.49
Rice	0.15	1.92	4.08	1.15
Potatoes	0.07	0.18	12.53	2.04
Legumes	0.07	0.06	31.32	10.29
Vegetables	0.07	0.19	15.91	6.33
Tubers	0.01	0.01	0.42	0.20
Bananas		0.17	18.08	3.64
Plantain		0.01		
Fruits	0.00	0.07	23.97	6.06
Oil plam		0.15	36.61	10.54
Oil seeds	0.03	0.92		
Other crops	0.00	0.26	0.22	0.02
Cocoa		0.87	51.91	16.98
Tobacco	1.10	0.18	20.77	4.71
Sugar cane		0.45	2.13	0.98
Cotton	1.51	0.12	3.61	0.92
Ag. investment		41.09		

Source: CGE simulation

The second feature is that the relatively more significant subsidies are those that reduce the cost of productive capital or of irrigated land use, being the latter the most important in relative terms. Lastly, productive capital subsidies are the most important for agricultural investment (that is, new plantings of perennials), followed by corn and rice, while irrigation subsidies are more widespread across activities in terms of their importance (eight activities receive land subsidies above 12%).

Table 3 shows results arising from the simulation in terms of expected changes in value added, demand for composite labor, demand for land, and demand for fertilizer, for each agricultural activity. It must be remembered that value added is a fixed proportions combination of composite capital-labor and composite land, therefore percentage changes for these three variables are the same. As all activities receive subsidies it could be expected that value added would increase in all cases. However, as follows from the table, this is not true: the quantum of value added decreases for plantain, other crops, and agricultural investment, although in very low proportions (between 0.08% and 0.14%). From the supply side, the feature limiting output expansion is capital fixity and it largely determines the outcome presented in the table. Given the structure of agricultural production, any change in value added must be accommodated in the composite capital-labor nest as a change in demand for composite labor (LDC). As Table 3 shows, changes in labor demand exceed the change in value added, the difference being driven by the share of labor in the composite capital-labor (the larger the labor share, the more close these two changes are) and by the elasticity of substitution between composite labor and capital.[18]

Prices accommodate to ensure optimality at all stages of production and to keep with the fixed proportions assumption between composite capital-labor and composite land. For this reason, changes in demand for land and fertilizer (composite land) need to move in the same direction as changes in composite capital-labor. However, as irrigation subsidies have a positive effect on productivity, there are cases in which changes in demand for land and fertilizer do not necessarily have the same sign as changes in demand for composite labor (as greater productivity amounts to an increase in composite land). In fact, a comparison between the expected effects on productivity arising from irrigation subsidies, as presented in Table 2, and changes in land and fertilizer demand shows that the higher the expected productivity effect, the lower the increase (or the higher the decrease) in demand for composite land (specially as reflected in lower fertilizer use).

The behavior of changes in demand for land and fertilizer is explained by two main factors. First, the degree of complementarity or substitutability between them. In this particular case, we assume that land and fertilizer are weak substitutes,[19] so these changes tend to roughly move in the same direction. However,

[18] As the same elasticity value is assumed for all activities, there are no differences across sectoral behavior in this regard. We use an elasticity value of 1.5.

[19] We assume the same elasticity of substitution for all activities, at the level of 0.5. This is in line with the view that fertilizer and land infrastructure can be regarded as complements while

Tab. 3: Changes in Value Added and Input Usage in Agriculture (percentage changes in quantities)

Activity	Value added	Composite labor	Land	Fertilizer
Coffee	0.06	0.10	-0.4	-1.0
Cereals	0.18	0.51	0.7	-0.5
Corn	2.42	2.70	2.6	-2.4
Rice	0.16	0.66	0.8	-2.4
Potatoes	0.28	0.55	3.8	-3.3
Legumes	0.37	1.79	0.3	-17.9
Vegetables	0.22	0.94	-2.7	-12.6
Tubers	0.01	0.05	0.0	-1.5
Bananas	0.41	0.95	1.4	-4.8
Plantain	-0.12	-0.25	-0.6	1.0
Fruits	0.24	0.88	1.1	-8.8
Oil plam	0.89	3.43	2.3	-14.9
Oil seeds	0.24	0.95	0.4	-0.9
Other crops	-0.14	-0.17	-1.1	0.0
Cocoa	3.13	4.88	5.2	-21.5
Tobacco	1.09	2.51	4.7	-7.1
Sugar cane	0.01	0.22	-1.0	-0.8
Cotton	1.80	2.58	2.5	-0.2
Ag. investment	-0.08	-0.11	-1.1	0.0

Source: CGE simulation

as we have relatively sizable subsidization levels for land use (as illustrated in Table 2), relative prices within composite land show high variations and substitutability between land and fertilizer is enhanced yielding several cases in which land and fertilizer demand move in opposite directions. The average change in relative prices between land and fertilizer arising from the shock is 11.3%, with extreme cases as high as 30% to 40% and as low as 0.3%, basically depending on the size of the subsidy to land use.

The second factor impinging upon land and fertilizer substitutability comes from the side of supply of land services. As allocation of land services is more "sluggish" between perennials and seasonal crops, and more "sluggish" within perennials than within seasonals, competition for land services is more intense among perennials.[20] As land is not easily reallocated from seasonal to perennial crops, there are cases in which even though a perennial crop benefits from a relatively high subsidy to land use, its demand for land decreases as other perennials have higher subsidies and can expand land use at its expense. This is the case of coffee, that shows a 4.52% subsidy for land use but its demand for land decreases by 0.4%.[21]

The case of agricultural investment is worth a short comment, as this activity secures the highest subsidy rate for productive capital use but its output shrinks. This result is driven by several factors. First, as capital is sector specific, the subsidy on capital has no impact on demand for this factor. Instead, the behavior of demand for composite capital-labor depends on the change in the relative price between capital and composite labor. In this particular case (as is also true in the cases of plantain and other crops), this relative price decreases leading to a reduction in composite labor use and to a decline in output. On the demand side, agricultural investment enters, in fixed proportions (in value), into the economy's investment account so its expansion is limited on that side too as the model is saving-driven.

In summary, agricultural activities tend to increase their output (measured as quantity of value added) and do so in a way consistent with the relative level of subsidies each of them receive, and the competition for resources that the particular mix of subsidies and resource allocation restrictions impose. Overall, the average percentage increase in output is low (0.6%) and it is also low at the aggregate level of the agricultural sector (0.2%).

Regarding international trade, we observe that as domestic prices tend to fall, the ratio of FOB prices to international prices (exogenously given) also falls and exports tend to increase in quantity. This is true for all activities but plantain and other crops. Nonetheless, the extent to which exports increase is

fertilizer and land as substitutes (Ruttan, 2001). As we do not have the means to distinguish between land and land infrastructure, we adopt a midway substitutability/complementarity relationship.

[20] In the sense that it is more difficult to increase land use.

[21] The group of perennial crops comprises coffee, bananas, plantain, fruits, tubers, oil palm, other crops, cocoa, sugar cane, and agricultural investment. On the other hand, seasonal crops include cereals, corn, rice, potatoes, legumes, vegetables, oil seeds, tobacco, and cotton. (tobacco is considered seasonal given that blond tobacco, which is seasonal, has greater areas planted and production than black tobacco, which is perennial).

Tab. 4: Changes in Quantities Traded (percentages)

Activity	Exports	Domestic demand	Imports
Coffee		0.06	
Cereals	0.14	0.18	0.06
Corn	2.75	2.41	-0.58
Rice	1.05	0.10	-1.79
Potatoes	0.66	0.22	-0.91
Legumes	0.54	0.30	-0.45
Vegetables	0.39	0.22	-0.31
Tubers	0.02	0.02	0.11
Bananas	0.39	0.35	-0.09
Plantain	-0.48	-0.10	0.63
Fruits	0.43	0.24	-0.33
Oil plam	2.19	0.08	-4.09
Oil seeds	0.30	0.23	-0.16
Other crops	-0.16	-0.06	0.19
Cocoa	9.12	2.96	-9.03
Tobacco	1.82	0.77	-1.93
Sugar cane	0.00	0.07	
Cotton	2.47	1.79	-1.30

Source: CGE simulation

relatively low with the exception of cocoa, corn, cotton, and oil palm, as shown in Table 4. Furthermore, the ratio of prices received by export crops to local prices determines the relative size of changes in the market of destination. If local prices increase more than export prices, the proportional change in supply to the domestic market is higher than that to the export market and vice versa. In general, the increase in exports tend to be higher than the increase in supply to the domestic market, with a few exceptions. Lastly, the ratio of the domestic price to the import price, determines the behavior of imports. In most cases this ratio decreases, leading to a decline in imports that, with some exceptions, tends to be small (the relevant figures are also presented in Table 4).

4.2 What-If Scenarios

We now turn to the remaining three scenarios, one in which only working capital subsidies are granted, one with only productive capital subsidies, and one with only irrigation subsidies. The corresponding subsidy amounts for the first two types and the corresponding rates are shown in Table 5. From there, it can be appreciated that, compared to the benchmark scenario, the simple average subsidy rate for working capital subsidies increases from 0.3% to 4.1% and that in the case of productive capital subsidies it increases from 3.1% to 4.8%. In some cases, as tobacco and cotton under working capital subsidies or corn and agricultural investment under productive capital subsidies, the subsidy rates could have been substantial had all program resources been devoted to the particular subsidy type.

On the other hand, Table 6 shows the subsidy amounts, resulting subsidy rates, and productivity shocks arising from the case where only irrigation subsidies are granted. In this case the simple average subsidy rate goes from 15.6% to 24.1% while the average productivity shock increases from 4.5% to 7.8%. In general, as the initial composition of subsidies was 3% for working capital subsidies, 52% for productive capital subsidies, and 45% for irrigation subsidies, the largest differences are found in the hypothetical case in which only working capital subsidies were granted.

Turning to the results from the simulations, percentage changes resulting for value added are presented in Table 7. As could be expected, the higher changes tend to belong to the activities receiving the higher subsidization levels. However, this outcome shows great variation from case to case as we explain in what follows. With respect to subsidies for working capital, it is observed that they generate the second largest largest changes in value added. The simple average subsidy rate is 4.1% and the resulting simple average change in value added is 3.6%, so there is a expected decay in the effect of the subsidy as the supply of value added is positively sloped. For all activities that do not benefit from the subsidy there is shrinkage in value added, as resources are bid away from them by activities that do benefit. However, decreases in value added are small as all changes in the model are limited by the fact that we assume capital is sector-specific, as we model short run scenarios. As capital can not be bid away from the activities that get no benefits, both increases and decreases in value added and in other variables are dampened.

Furthermore, changes in value added must be proportional to changes in demand for composite labor, since capital fixity implies that changes in the composite capital-labor can only originate in changes in the latter, as explained above. As a consequence, changes in demand for composite labor are always greater (in absolute value) than changes in value added. On average, changes in demand for composite labor locate at around 6.4%, 2.8 percentage points above changes in value added. On the other hand, changes in demand for composite land must be equal to those found for value added, given the assumed production structure. Hence, demands for land and fertilizer accommodate via relative prices to meet the behavior of value added and of the composite capital-labor.

Tab. 5: Subsidy Amounts and Rates of Subsidy at the Activity Level Under Working and Productive Capital Subsidies (US$ million)

Activity	Working capital subsidies		Productive capital subsidies	
	Amount	Rate	Amount	Rate
Coffee	1.1	0.0	8.8	1.4
Cereals	14.2	2.6	0.0	0.2
Corn	36.5	5.2	2.6	20.8
Rice	17.9	4.5	8.6	3.7
Potatoes	6.3	2.2	0.6	0.4
Legumes	14.7	2.1	0.2	0.1
Vegetables	5.7	2.1	1.6	0.4
Tubers	0.0	0.4	0.1	0.0
Bananas	0.0	0.0	0.7	0.3
Plantain	0.1	0.0	0.1	0.0
Fruits	0.0	0.0	1.4	0.1
Oil plam	1.2	0.0	1.0	0.3
Oil seeds	0.0	0.9	0.8	1.8
Other crops	0.0	0.0	0.6	0.5
Cocoa	13.4	0.0	0.3	1.7
Tobacco	0.0	26.4	0.1	0.4
Sugar cane	32.8	0.0	8.6	0.9
Cotton	0.0	32.0	0.0	0.2
Ag. investment	0.0	0.0	107.6	57.4

Source: author's calculation and CGE simulation

Tab. 6: Irrigation Subsidy Amounts, Subsidy Rates, and Productivity Shocks (US$ million)

Activity	Amount	Rate	Productivity
Coffee	8.2	9.5	2.0
Cereals	0.0	0.0	0.0
Corn	5.7	18.8	5.4
Rice	7.3	9.6	2.6
Potatoes	8.8	27.5	4.5
Legumes	6.1	66.1	22.9
Vegetables	8.9	39.1	14.1
Tubers	0.8	1.0	0.5
Bananas	5.8	35.4	8.1
Plantain	0.0	0.0	0.0
Fruits	31.6	46.3	13.5
Oil plam	31.6	65.2	23.3
Oil seeds	0.0	0.0	0.0
Other crops	0.1	0.5	0.1
Cocoa	12.7	80.9	37.1
Tobacco	0.7	44.5	10.5
Sugar cane	15.2	4.4	2.2
Cotton	0.4	8.6	2.1
Ag. investment	0.0	0.0	0.0

Source: author's calculation and CGE simulation

Since land is not perfectly mobile, and it is more mobile between seasonal crops than between perennials, changes in demand for land for seasonal crops situate closer to the levels found for changes in value added . In contrast, changes for perennial crops tend to show higher differences with changes in value added since land mobility is lower and demand for land cannot accommodate as smoothly as in the case of seasonal crops.

Outcomes under the scenario with only productive capital subsidies are the lowest among the three scenarios. While the simple average subsidy rate is 4.8%, the average change in value added is negative (about one thousand percent decrease). These results should not be surprising as capital is sector specific and even though activities are subsidized for their capital use, they are unable to increase demand for it. Therefore, under capital fixity the effect of this type of subsidy essentially bids up capital rents with little effect on production. While this short run scenario can be viewed as an extreme case of capital fixity, it can be argued that the situation in a longer run would not necessarily be very different. The basic reason for this is that the majority of capital used in agricultural activities in Colombia seems to be plants and trees and not machinery and equipment. If this is so, an important degree of capital fixity would continue being a characteristic of the agricultural sector even in the longer run, qualitatively generating the same type of result.[22]

In this sense, the potential for this type of subsidy to enhance value added appears to be highly dependent on the behavior of investment, a direction of inquiry that is beyond the scope of this paper. While we do have an agricultural investment activity in the model, it comprises areas planted with perennial crops not yet productive and whose potential increase is also dumped by the capital fixity assumption.

Small changes in value added imply small (but slightly magnified) changes in demand for composite labor. Similarly, small changes in demand for land and fertilizer are attained. Both situations follow from the fact that relative prices change very little, as the subsidy basically is absorbed by the rental rate of capital and transferred to capital owners with nill effects on agricultural production.

Changes in value added coming out from the scenario with just irrigation subsidies (and the corresponding productivity shocks) are (just marginally) the largest among the simulations when the whole agricultural sector is considered, but still significantly below those under working capital subsidies when average changes across activities are considered. In this case, both the subsidy on land use and the productivity shock are higher for perennial than for seasonal crops. However, this not necessarily reflects in higher changes in value added. As in the previous cases, changes in value added are limited by capital fixity and this

[22] It is unfortunate that we are not in a position to test this idea, since we do not have information for splitting capital represented in trees on side and in infrastructure, machinery, and equipment on the other. Even if we had it, it would be an issue to determine which of the latter could actually be mobile. For instance, machinery for extracting oil from palm kernels or infrastructure for primary processing of coffee, clearly are sector-specific, while tractors and combines could be mobile.

Tab. 7: Percentage Changes in Value Added Under the What-If Scenarios

Activity	Working capital subsidy	Productive capital subsidy	Irrigation subsidy
Coffee	0.01	0.00	0.10
Cereals	2.05	0.10	0.55
Corn	7.09	0.02	5.51
Rice	0.62	-0.01	0.38
Potatoes	0.75	0.00	0.65
Legumes	0.51	0.00	0.70
Vegetables	0.48	-0.01	0.51
Tubers	0.11	-0.01	0.13
Bananas	-0.30	0.02	0.76
Plantain	-0.26	-0.01	-0.40
Fruits	-0.22	-0.01	0.48
Oil plam	-0.14	0.00	1.63
Oil seeds	1.08	-0.03	1.25
Other crops	-0.37	0.02	-0.39
Cocoa	-0.29	0.02	5.21
Tobacco	16.99	-0.13	1.31
Sugar cane	-0.26	0.00	-0.15
Cotton	39.97	-0.03	1.26
Ag. investment	-0.36	0.05	-0.27

Source: CGE simulations

also limits changes in demand for composite land. Furthermore, as irrigation entails a productivity shock and it enhances the amount of composite land (independently of the effect of the subsidy), the potential effect of both the subsidy and the productivity shock is dampened. Higher subsidies to land use tend to enhance demand for this factor, while higher relative productivity shocks tend to decrease it. There are two forces at play here. On one hand, capital fixity limits the ability of activities to grow and therefore the extent to which demand for the land composite can increase. On the other, total land demand is fixed, so the “sluggishness” of land reallocation exerts greater restrain on mobility. Hence, subsidies push for higher land use while productivity shocks, by making composite land larger (that is, more productive), constrain land increases in the face of total land demand fixity and low mobility.

As mentioned, land subsidies are, on simple average, larger for perennial than for seasonal crops (almost 27% and 22%, respectively) and the same is true for productivity shocks (9.6% and 6.2% for perennials and seasonals). However, prices effectively paid on average by perennial crops decrease 15.6% while those paid by seasonal crops decrease 29.5%. Viewed from the angle of landowners, nominal land rents received from activities devoted to perennials increase 20.7% while those accruing from activities devoted to seasonal crops decrease almost 10%. In a way, given imperfect land mobility and fixed land availability, the higher subsidies for perennials get “capitalized” in land rents. Therefore, the average activity devoted to perennial crops increases land use by 0.5% and the average activity linked to seasonal crops increases it by 5.9%. In total, land demand by perennial crops decreases 1.8% and that by seasonal crops increases 3.8% in spite of perennial crops receiving higher subsidies and achieving higher productivity shocks.

In general, changes in demand for land translate in changes in value added. To appreciate this pattern more clearly it is necessary to consider perennial and seasonal crops separately,[23] as land mobility differs between and within both groups. Almost all activities devoted to perennials that receive subsidies show increases in demand for land and in value added, the exceptions to this behavior being basically coffee and sugar cane. In the case of coffee, land demand decreases but value added increases slightly while in the case of sugar cane both land demand and value added decrease. The reason for this behavior is that the ratio of land to fertilizer is lower for coffee while its ratio between the composite capital-labor and composite land is higher. Therefore, the impact of the reduction for land demand on value added is lower for coffee.

In the case of seasonal crops we find a similar pattern: all crops receiving subsidies show increases in land demand and in value added. However, even activities that do not benefit from subsidies show increases in land demand and in value added, a fact that is consistent with the behavior of land rents. As land rents paid by seasonal crops decrease in all cases, land demand tends to increase and this increase pushes value added up. The case of vegetables is singular in the sense that this activity has high subsidy levels, the value of the land rent it

[23] See footnote 21 for the listing of the two types of crops.

pays decreases and, nonetheless, it shows a decrease in demand for land (and a slight increase in value added). The particularity here stems from this activity having a relatively low land to fertilizer ratio that leaves little room for further land expansion which, in the face of increased competition for land with other seasonal crops, leads to the mentioned decrease.

Tables 8 and 9 show, for completeness, percentage changes in demand for composite labor and for land demand for the three scenarios.

5 Concluding Comments

There is evidence indicating that recent adjustments in agricultural policy in Colombia are not yielding the expected results. In particular, the AIS program seems to lack, at least in the short run, capability for either protecting farmers' income or for enhancing agricultural productivity, its two main declared objectives. We further explore this issue by conducting the following experiment: what could be the expected results arising from the program had it concentrated all its resources in just one type of policy instrument, instead of allocating them among three of the instruments it has at its disposal.

For this, we use a CGE model calibrated to the Colombian economy and specialized in the agricultural sector (in the sense that it uses a production structure appropriate for representing agricultural production and runs on a SAM with relatively high agricultural sector detail). We run four scenarios, aimed at isolating the expected effects arsing from three of AIS' main subprograms, the SCL, the IRC, and the CID. The way these subprograms work is through four incentive mechanisms, subsidization of working capital, subsidization of productive capital, subsidization of land use, and increased land productivity, and we use this characterization for modeling the effects of these subprograms.

While there are several ways for sectoraly (at the activity level) allocating each incentive's resources, we simply choose to assume that allocation is done in the same way it was actually done by the program during 2008. Since our purpose is to explore the way these incentives work and not to figure out what the "best" subsectoral allocation is, almost any allocation criterion could be deemed appropriate, so it is the actual 2008 allocation. The most relevant characteristic of the simulations is that they are short run. In particular, we assume that capital is sector specific and that land is not perfectly mobile.

The results indicate that the expected impact from the program, as actually implemented, tends to be modest in terms of generating changes in value added at both the activity and the whole sectoral level. Against this benchmark (a 0.6% average increase in value added per activity and a 0.2% increase in agricultural value added), results from the what-if scenarios show that the higher effects are attained from irrigation subsidies alone (1% on average and 0.34% for the whole sector), followed by subsidies on working capital alone (3.6% on average and 0.32% for whole sector), and lastly from productive capital subsidies alone (less than one thousand percent decreases in both cases). While this "ranking" not only lacks importance but is also flawed since the allocation of

Tab. 8: Percentage Changes in Demand for Composite Labor Under the What-If Scenarios

Activity	Working capital subsidy	Productive capital subsidy	Irrigation subsidy
Coffee	0.01	-0.02	0.19
Cereals	5.88	0.05	1.12
Corn	7.90	0.03	5.96
Rice	2.51	-0.06	1.46
Potatoes	1.44	-0.02	1.23
Legumes	2.49	0.01	3.42
Vegetables	2.04	-0.08	2.08
Tubers	0.41	-0.16	0.33
Bananas	-0.69	0.16	1.99
Plantain	-0.56	-0.10	-0.71
Fruits	-0.79	-0.28	1.87
Oil plam	-0.53	-0.03	6.64
Oil seeds	4.24	-0.04	3.76
Other crops	-0.45	0.20	-0.42
Cocoa	-0.45	0.02	8.48
Tobacco	41.57	-0.07	3.03
Sugar cane	-3.92	-0.01	-0.83
Cotton	60.03	-0.02	1.65
Ag. investment	-0.46	0.35	-0.31

Source: CGE simulations

Tab. 9: Percentage Changes in Demand for Land Under the What-If Scenarios

Activity	Working capital subsidy	Productive capital subsidy	Irrigation subsidy
Coffee	-1.89	0.01	-2.76
Cereals	3.32	0.07	3.07
Corn	8.01	0.00	8.30
Rice	2.30	-0.02	3.76
Potatoes	2.96	-0.02	12.15
Legumes	1.96	-0.01	11.34
Vegetables	1.42	-0.02	-2.50
Tubers	0.62	-0.01	0.66
Bananas	-2.07	0.03	1.35
Plantain	-1.28	0.00	-2.41
Fruits	-1.90	0.01	1.49
Oil plam	-1.78	0.01	5.45
Oil seeds	1.38	-0.03	1.80
Other crops	-2.28	0.02	-4.21
Cocoa	-1.83	0.03	13.42
Tobacco	16.75	-0.13	14.93
Sugar cane	-1.06	0.01	-3.11
Cotton	36.49	-0.04	5.12
Ag. investment	-2.34	0.04	-4.37

Source: CGE simulations

resources among activities is not similar (and therefore results are not comparable), what is of interest here is what we can infer about the way these subsidies work.

Aggregate effects arising from irrigation subsidies and from working capital subsidies are comparable and not far from the aggregate effect arising from the base scenario (actual implementation of the program). This shows that, in principle, the size of the program (its relative smallness as compared to agricultural value added) dominates over the choice of policy instruments. That is, only in the case of subsidies for productive capital use, we obtain a result that can be considered significantly different, but overall expected impacts from the program are modest.

A slightly different story arises when average changes in value added across activities are considered. In this case, the largest changes are attained from working capital subsidies, followed by irrigation subsidies, and by productive capital subsidies. Although there may be some influence from the particular choice in resource allocation among crops, this result shows that there possibly is an advantage from using working capital subsidies, since their effects are similar to a uniform subsidy spread across the structure of production within each activity, avoiding in a better way the short run restrictions that the simulations portray (capital fixity and "sluggish" land mobility).

Irrigation subsidies are powerful as they decrease payments for land use and simultaneously increase composite land productivity. However, on average they are not better than working capital subsidies given that land cannot expand and its mobility is imperfect. Furthermore, as shown, higher irrigation subsidies do not necessarily lead to higher increases in value added so subtle trade-offs impinge upon their potential for expanding output.

Somehow in the same direction, results from productive capital subsidies yield the worst results. The reason is simple. As capital is sector specific, these subsidies basically bid up capital rents perceived by capital owners with scant or no effect on production. Therefore, in the short run program results are limited (to an unknown extent) by the impossibility of capital reallocation and expansion (a similar idea, although nuanced, applies for land).

The above leads us to consider the role of investment for obtaining better outcomes from the policy. If long(er) run conditions do not imply relatively high capital mobility, it is very likely that, even under this time frame, expected results from the program will be modest. Capital used in agricultural production mainly consists of infrastructure for particular activities (as post-harvesting treatment and storage), machinery and equipment, tools, primary processing, and trees. It is very likely that infrastructure and equipment for primary processing is subsector (activity)-specific, as are trees. Therefore, if it is the case that the majority of productive capital turns out to be activity-specific, capital mobility would be low even in the long run, leading to results similar to what our simulations indicate.

In this situation, more promising results can only come from a dynamic behavior of investment, that increases capital availability and allows for a lower "capture" of subsidies by capital rents. We are not in a position to infer anything about this issue. However, results from the Econometria study partly touch upon it, showing a negative impact on investment for producers in general (MADR, 2011). In particular, small producers that were beneficiaries of the program decreased their investment levels while large producers and agribusinesses kept the investment levels they attained when first benefited from it. Evidence of increase use of machinery was only found for agribusinesses and farmers growing perennial crops, but no evidence was found of increased use of technical assistance (with a few exceptions) or of better quality inputs (Econometria, 2011).

Therefore, it not only seems that the program does not succeed in promoting a more dynamic behavior of investment but that it also fails in enhancing productivity. If it is the case, the potential of the program for fulfilling its objectives may be very limited. Since recent policy changes[24] mainly imply conditioning access of large farmers to cases in which they develop joint projects with small farmers, a narrower focus on small and medium size farmers, and a seeming shift away from favoring perennial crops, while maintaining the same set of policy instruments in place, these concluding comments carry over to the actual set of agricultural policies put in place by the current administration.

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