Impact Evaluation of Tea Sector Reforms in Rwanda
Methodology Note
November 12, 2013

1. Abstract
This note outlines the empirical strategy to identify the causal effect of the tea price reforms on the Government of Rwanda (GoR)’s objectives for tea-growing households and sector growth: increased income, increased farm-level investment, increased farm-level productivity (of tea and non-tea crops), and increased cultivation of tea. In addition, key indicators for the GoR’s World Bank Group (WBG)-supported tea expansion plans will also be tracked, such as household perceptions and knowledge of reforms, farmer intentions regarding expanding existing tea cultivation (or engaging in de novo cultivations), nature and extent of farmer organization, variety of crops grown, and food security variables, among others.

2. Background

Tea in Rwanda
Rwanda’s trade with the rest of the world consists mostly of agricultural products, with tea and coffee as the main export crops. The tea sector is the third largest employer in Rwanda, behind coffee and the public sector, and currently employs about 60,000 people. Tea production is organized around 11 estates, all but one of which was publically owned up to 2004. An ‘estate’ comprises a factory that is supplied with green tea leaves by a plantation, known as a Bloc Industriel, and locally based farmers who cultivate small tea plots (on average, 0.25 ha in size) within a 15-20 km radius of the factory. There are about 27,000 such independent small growers who own about 70% of the total area under tea cultivation. Smallholder farmers either harvest their own leaves or employ pluckers paid at a daily rate for the task.

The following salient features of tea as a crop are relevant to understanding the approach used in the proposed analysis. Tea is a perennial tree crop and new plants take approximately three years to yield a first harvest. Plucked tea must be delivered to a factory very soon after plucking, so that smallholders within a factory radius only supply that particular factory. Vertical integration is therefore almost perfect and price setting (see below) is easily monitored. Unlike coffee, no primary processing occurs on the farm. Given the scale of its production relative to the global market, Rwanda is a price taker on the international market.

The Government of Rwanda (GoR) views the tea sector as central to the country’s economic development across a number of key dimensions, including its potential to raise smallholder farmer incomes (and thus reduce poverty), provide investment opportunities for private investors, and assist the country to meet its balance of payments targets. The GoR therefore undertook a number of reforms of the sector. In early 2000 the GoR embarked on a program to privatize the tea estates. This objective was ultimately achieved by 2012. In support of the drive for greater production and quality, GoR also introduced reforms to the way green leaf tea is priced (see below). Most recently, GoR has articulated
ambitious tea sector expansion plans, through which it hopes to increase not only the quality, but also the area of cultivation under tea by 18,000 ha.

**IFC and WBG in Rwanda Tea**

Throughout these reforms, there have been four distinct phases in IFC support to the tea sector in Rwanda: (1) An investor conference in November 2010; (2) A privatization strategy note for the two publicly owned factories remaining in 2011; (3) The green leaf pricing reform of July 2012; and (4) The collaboration with the World Bank for a WBG concept note in support of the GoR’s further tea sector expansion program. These reforms fall under the second phase of the Rwanda Investment Climate Reform Program (Project ID: 576907), which aims to improve agribusiness market efficiency through market, legal, and regulatory remedies. This phase of the program draws on the recent gains from extensive Doing Business (DB) reforms, and is a part of a broader WBG effort to increase exports and investment in the Rwandan agribusiness sector, with a particular focus on horticulture and tea. The GoR has since formally requested assistance with their ambitious tea sector expansion program from the WBG.

**Green Leaf Pricing Before and After the Reform**

In July 2012, the GoR passed a reform to the green leaf pricing mechanism, which came into force at the end of 2012. The reform links green leaf prices to international market prices for ‘made tea’. This was in contrast to the previous mechanisms by which prices were determined annually using the self-declared costs of a factory or cooperative. This approach, common in many commodity markets across the globe, has the effect of distorting incentives for production and investment, as follows:

Before the reform, the price of green leaf tea paid to farmers was determined on the basis of the self-declared cost of factories rather than on the actual market prices received by the factories for their made tea. This had a number of critical limitations: (1) the system did not have a mechanism to reward better quality tea; (2) the self-declared nature of the pricing system made it cumbersome and contentious to revise annually; the approach largely separated Rwanda green leaf from market price signals; (3) the distortions to incentives encouraged the report of inflated factory costs in order to maximize factory profits at the expense of the prices paid to farmers. The overall effect was thus to reduce the incentives to farmers for planting more tea in an environment where planting other crops was invariably more profitable (see Figure 1).

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1 In FY10, under Phase 1, Rwanda became the global top DB reformer and made DB reform history recording the biggest ever improvement of 76 ranks in one year. It is now ranked 67th out of 183 countries. Furthermore, impressive gains were made in other important areas such as reducing the time and cost to trade, obtaining business licenses, registering a business and the overall strengthening of the legal, regulatory and policy framework for special economic zone developments in the country.
Finally, under the old pricing system, plucker wages were kept below the market rate leading to a shortage of pluckers, longer plucking rounds, and hence lower leaf quality. While this has affected farmer welfare negatively (through lower tea revenues) it has also undermined the aims of tea investors to fully utilize factory capacity, representing losses in factory revenue and in export earnings for the GoR.

After the reform, under the new pricing mechanism—designed in line with international best practices—the price paid to farmers is linked to the price obtained for Rwanda’s tea in the international market, on which Rwanda is a price-taker. Accordingly, farmers supplying each factory will receive a fixed percentage (30%) of the average per kg price of made tea (average gross revenue) realized by individual factories. Each factory’s made tea price will be calculated as a weighted average price of all sales. Prices are fixed every six months for each factory using the average auction price for that factory for the previous six months and a target percentage change in price. Initially farmers are paid 5% less than the target with a top-up payment based on actual auction prices achieved at the end of the six month period. In addition, farmers can receive up to a 10% bonus for high quality (defined as above the 75% technical quality threshold), and penalties for low quality. In order to limit the downside risk on international price movements, the farm gate price can never fall below the current floor of RWF 100.

The key feature of the price reform in terms of the impact evaluation is that it now effectively links the farm gate price to exogenous price movements in the international market. Most of the variation in
price now comes from its linkage to external markets, which are easily netted out from the smaller bonus or penalties that may be earned.

3. Intervention: What and for Whom?
The GoR had originally embarked on the tea factory privatization program in response to inefficiencies in government owned factories and to stimulate private investment and growth in the sector (Essama-Nssah et al, 2008). The intended beneficiaries of the program included farmers—who would achieve higher productivity, output and incomes—private sector investors, and ultimately, the GoR with its balance of payments targets. The green leaf pricing system reform was undertaken by the GoR with similar objectives of increasing farmers’ incomes and enhancing incentives to raise the productivity and the quality of the raw material utilized by the tea factories. In addition to the Government’s rural poverty alleviation objectives, price reform was seen as critical to improving the efficiency and competitiveness of Rwandan tea factories and increasing tea export revenues (MINAGRI, 2012). The key implementers are the Ministry of Agriculture and Animal Resources (MINAGRI) and the Rwanda National Agricultural Export Board (NAEB).

The proposed research will evaluate the impact of green leaf tea reform measures on income, increased farm-level investment, increased farm-level productivity (of tea and non-tea crops), and increased cultivation of tea. In addition, key indicators for the GoR’s WBG-supported tea expansion plans will also be tracked, such as household perceptions and knowledge of reforms, farmer intentions regarding expanding existing tea cultivation (or engaging in de novo cultivations), nature and extent of farmer organization, variety of crops grown, and food security variables, among others.

4. Theory of change
Rwanda’s reform activities in tea stem from the GoR’s core economic objectives of growth in exports, jobs, investments, and from their poverty reduction goals of raising rural incomes and providing greater food security. Figure 2 links the GoR green leaf tea sector reform initiatives, with their immediate objectives for the sub-sector and their longer terms outcomes (as articulated in GoR key strategy documents). As delineated in Figure 2, the GoR undertook the green leaf price reforms to remove distortions to incentives for improving the quality and output of tea. The ultimate increase in export earnings desired by the GoR comes from increased factory investment (hence, the earlier privatization program), in turn dependent on sufficient raw material and the market-based incentives to cultivate it. Improvements in prices for farmers also boost their incomes and better enable them to achieve food security through an increase in purchasing power over a broader range of food stuffs. Productivity gains

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3 Figure 2 was developed through a series of consultative workshop activities with the NAEB and in Ministerial meetings.
on tea crops are also assumed to have spillover effects\textsuperscript{4} for food security crops, where these are also grown.

**Figure 2: Theory of Change in Rwanda Tea Sector Reforms**

This impact evaluation looks at the causality between the GoR green leaf price reform and the intended outcomes for farmers, and for growth and investment in production. The assumed direction of causality in Figure 2 is rooted in a vast literature on agricultural price reforms. The large scope for reform in agricultural prices have been extensively documented, with a long history of price distortion in every region of the world, spanning farm gate to export prices (see Andersen, 2009). Unsurprisingly, farm-gate price reforms have been found empirically to relieve a key constraint on supply across a variety of commodities and regions,\textsuperscript{5} but with variation in the degree to which they do so. The variation in the

\textsuperscript{4} There is a large empirical literature on spillover effects from export crop production to food staples for sub-Saharan Africa (SSA), particularly in terms of improving the productivity of the non-export (food) crops. For examples, see: J. Govereh et al (2003); B. Minten et al (2006); and T.S. Jayne et al (2004).

\textsuperscript{5} For examples of country and commodity specific evidence on price response, see: Mose et al (2007); McKay et al (2006); and Tao et al (2008).
literature’s findings is partly due to the difference between aggregate and crop specific elasticities, with the former being considerably lower than the latter (McKay et al., 2006). More importantly, variations in supply response to price reforms are often a product of incomplete price reforms (Timmer, 1991; Krueger et al., 1992). Price reforms tend to have the strongest supply response when they are undertaken in conjunction with privatization or other institutional, legal and investment reforms in the sector.

5. Evaluation design

The central research question of the impact evaluation is to evaluate by how much, if at all, the income, on-farm (tea) investment and productivity of tea-producing farmers has changed as a result of the GoR’s tea price reforms. The main identification strategy of this design is that of a natural experiment where the price reform now introduces tea price changes based on price movements in international markets, and can therefore be treated as an exogenous change. Panel data constructed using a baseline survey collected in 2013 and a follow-up in 2015, will allow for a before and after analysis with the following complementary identification strategies.

1. Fixed Effects Regression

A fixed effects regression of the outcome variables for tea farmers on price and an array of other observable factors that might be correlated with the outcome variables, provides a basis to quantify the impact of the pricing policy reforms on various farmer welfare metrics while controlling for the effect of time invariant farmer specific characteristics such as differing levels of farmer ability not observable or measured by other quantifiable attributes in the survey. The analysis will also model the change in the area of tea cultivated by established tea farmers (i.e., farmers engaged in tea production both in 2012 and 2015) between the two points in time of the panel as a function of changes in household level characteristics and relative tea price, where the prices are relative to other competitor crops. It is expected that the variation in relative prices will provide adequate variation to empirically identify such price effects. Thus, in the 2015 survey information on whether or not there was new investment in the planting of tea bushes, for example, will be solicited as will the number and timing. The information on the timing of the investment or cultivation decision will then be aligned with the price data (described below under Data Collection) to facilitate the empirical analysis.

As already noted, the price variation across factories was determined by variation in a factory’s reported costs prior to the reforms, and was therefore unrelated to international tea prices. In the context of the new price reforms, while there is likely to be modest variation across regions, the most important source of tea price variation is along the temporal dimension and this again highlights the importance of constructing a panel of farmers in the tea producing areas over time. Such a panel then provides an opportunity to model the role of price, and obviously other factors, in farmer tea production decisions both for existing tea producers and any new tea producers that may be incentivized to engage in tea production by the new price system. Thus, the panel data will allow the assessment of whether farmers have increased their levels of tea cultivation in response to the price changes and/or have invested in tea-related production activities.
2. **Panel D-i-D with Fixed Effects**

The foregoing analysis largely focuses on the behavior of baseline tea producers. The analysis described in this section includes analysis for the non-tea producers as well. The sample with therefore be drawn from the full population of farmers in the geographic radius of each of the 11 tea estates and thus not limited to established tea growers (sampling strategy further described below under *Data Collection*). The inclusion of non-tea growing farmers in the survey permits the division of the sample into the sub-population exposed to the treatment of the price changes (i.e. the tea-producing farmers), and a control group (i.e., the non tea-producing farmers). This represents the natural experiment alluded to above. Tracking the same farmers over time will allow the construction of a panel as above and permit a panel difference-in-difference (D-i-D) framework with farmer fixed effects included to control for unobservables. The potential time-varying covariates will include, among other things, household demographics, land-holdings, off-farm activities of the household, crop-composition and district/umudugudu variables.

This framework will permit the analysis to further gauge the effect of the price reforms on the household welfare of tea producers, conditional on a number of assumptions. Key among these is the assumption that non-tea growers will not be incentivized by the price reforms to engage in tea production. In order to ensure second order incentive effects do not contaminate the estimates of the analysis, the panel data analysis will be restricted to those farmers who did not change their production status between the two time periods and will focus on the impact on welfare metrics like household income, expenditure and poverty. In the event that the survey data reveal that the incidence of status change is sizeable and systematic, it may prove necessary to allow explicitly for any selection bias that occurs through this restriction. This will require the use of identifying variables that shift the probability of a status change but not the level of the welfare outcome. Thus, care is required in the design of the survey questionnaire to elicit adequate information to enable the construction of potential instrumental variables. It is not, however, anticipated many farmers will make this switch over the short duration period of the panel largely for the same reasons that we do not anticipate any investments to have been made prior to the reforms in anticipation of these reforms taking place (see below).

Finally, across all analyses, there is an assumption that tea and non-tea producing farmers did not anticipate the price reforms and invest in tea bushes and other aspects of tea production prior to the GoR announcement of 2012 (so that recall is limited to the 12 month past-season recall, which is normal for agricultural surveys). This assumption is plausible for a crop like tea, which is perennial and leaves farmers with no income for three years until it is ready to harvest for the first time. The average size of smallholder plots in Rwanda, depending on the region, lies between 0.2 and 0.7 ha, with the average

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6 Using a regression based framework, the analysis allows us to control for observable attributes that permit comparison across the two groups. In addition the sampling strategy will ensure that tea farmers and non-farmers are drawn from the same geographical radius.

7 It may well be the case that household members of non-tea producing farms may be incentivized to work as tea pluckers on tea producing farms. The draft survey under development elicits information on the extent to which this is the case and this will inform the appropriate empirical strategy to adopt (i.e., whether we restrict the analysis to non-plucker households in the control group).
area under tea cultivation 0.25 ha. The decision to plant more land with tea is the decision to render unproductive (for food or other uses) that part of a very small plot for around three years, or to undertake lumpy investments in land in a context where access to finance is limited. The decision to invest in tea is therefore not taken lightly by Rwandan smallholders who live close to the poverty line. The decision to invest in new tea is very unlikely to be based on the rumor of a reform. More generally, World Bank research in crop selection and technology adoption provides ample evidence on the risk aversion of smallholders in similar investment and technology related decisions. Similar reasoning lies behind the team’s view that there may not be significant switching between 2013 and 2015 in the sample from non-tea to tea growers to bias or undermine the D-i-D analysis suggested here.

Data Collection

The 2013 IE tea sector survey provides a baseline for the empirical assessment of the price reforms going forward. The time frame for the analysis will span the effective introduction of the price reforms to end-2015, when a follow-up survey is envisaged. The Cabinet decision of July 2012 only cleared the legislative process in September 2012 and became effective across tea growing regions over the period October to November 2012, implying up to a one year recall period for surveyed households. The sampling strategy is to stratify the sample by the geographic radius of each of the 11 tea factories in Rwanda. These radii span several districts, which are defined and registered with the tea regulatory body. In each of the 11 tea growing areas (or radii), the study samples across the lowest administrative unit (the umudugudu) in the associated districts and finally sample tea growing and non-tea growing households within each umudugudu selected.

Finally, returning to the issue of tea investments, although the nature of these investments (e.g., tea-trees, land) is lumpy, high frequency price data (every six months, see footnote Error! Bookmark not defined.) from the factories from 2012 onwards will also be collected. In addition, the prices of other relevant competitor crops (e.g., potatoes, plantains, cassava) over the same time period are also potentially important. The relative prices with respect to these commodities would also efficaciously incorporate both regional as well as temporal variation. This enhances the degree of overall variation in these price series and potentially helps the empirical identification of the price effects. Fortunately, these data are currently collected on a regular basis by the Rwandan Ministry of Agriculture and Animal Resources (MINAGRI).

6. Policy relevance and impact

The tea sector is expected to play a key role in realizing Rwanda’s “vision of transforming its economy from subsistence agricultural” by 2020” (Vision 2020). It is the GoR’s objective to perform a fundamental transformation of the sub-sector, in order to increase investment, jobs, exports, and to reduce poverty for farmers. Key to this transformation is the green tea pricing reform, but this reform was preceded or accompanied by the factory privatization and institutional reforms (of the older ‘tea board’, Ocir-Thé, to the NAEB) and by sector co-ordination efforts with cooperatives. Going forward, the development of the

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8 This is identical to the sampling strategy used for the 2004 pre-privatization baseline tea survey financed by the World Bank Enquête Quantitative de Base Auprès des Ménages des Zones Théicoles (EQBT), 2004.
tea sector strategy and concerted investment promotion in tea both form part of the GoR’s ambitious tea sector expansion program to a further 18,000 ha of quality tea, for which WBG support has been requested.

It is precisely in light of the GoR’s proposed tea expansion plan, that the impact evaluation’s contribution to evidence-based policy is most evident. The proposed research outputs on the impacts of the new green leaf pricing mechanism on productivity and production will be useful in the implementation of GoR tea sector policy going forward along (at least) three dimensions: (1) The impact evaluation will inform on the feasible availability of quality raw material for factories that can guide the scale and scope of the envisaged expansion program and investor outreach; (2) In addition to the final impact evaluation outputs, at the specific request of the Minister of Agriculture, the baseline household data will be used to provide MINAGRI with concrete cross-sectional estimates of current income and profit effects for farmers, differentiated by gender, calculated across different quintiles, and across management models of the tea factories. These results can inform the selection of privatization modalities in the upcoming GoR expansion; and (3) The impact evaluation will inform on both the rural poverty alleviation and economic growth agendas of policy makers by providing empirical data on changes in income, productivity and output for farmers in this key sector. Finally, the study will set the stage for further important areas of research, such as modeling how the reformed price system differs from the prices expected under perfectly competitive markets; or following on with experimental analyses of complementary quality enhancing programs and their incremental impacts on quality in the context of the price reform.

Intensive consultation with MINAGRI, the NAEB, women and men farmers and pluckers, and private sector tea processing owners and staff took place in Rwanda in early 2013. The research questions proposed in the study were developed as a result of the input of the private sector (from plucker to processor) and articulated and vetted with the key counterpart (NAEB) and the highest Ministerial level, respectively. Implementation risk of the study is therefore low and the relevance to key stakeholders is deemed to be high.
7. Work plan and deliverables (Timeline)

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<tr>
<td>Follow up data collection HH Survey</td>
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<td>Final data analysis</td>
<td>Technical note, Policy Note, Data File and Do files</td>
<td>December 1, 2015</td>
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<td>Dissemination of findings</td>
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8. Evaluation team and peer review process

WBG Team

<table>
<thead>
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Key Government Counterparts

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<tbody>
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## Peer Reviewers

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<td>Mr. Larson is Senior Economist for the agricultural and rural development unit of DEC (DECAR). He is one of the WBG’s leading specialists on agricultural commodity market reforms, co-authoring the Bank’s flagship publication on the topic (see Akyama et al, 2001).</td>
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<td>Ms. Kene Ezemenari</td>
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<td>Mr. Xavier Cirera</td>
<td>Research Fellow Institute of Development Studies (IDS)</td>
<td>Xavier Cirera is a trade economist with extensive experience working in Southern and Eastern Africa and Brazil. His research focus is on trade and development, including spatial price variations and the functioning of rural markets.</td>
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9. References


