United States Agency for International Development

Development Credit Authority

Tanzania Country Program Evaluaton

Sustainable Solutions to the Credit Supply Gap

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Abstract

Access to credit is a vital part of economic development for developing countries. It promotes sustainable financial growth, while at the same time minimizing inequality. Yet it is estimated that between 200 and 245 million businesses have inadequate access to capital. In order to bridge this credit gap, USAID has created the Development Credit Authority (DCA) program, which provides guarantees of up to 50% of loan portfolios. The goal is to lower financial institutions' risk thresholds, exposing them to new, underserved markets. This Sustainable Solutions impact evaluation design uses an econometric model called Regression Discontinuity Design to assess both the additionality and sustainability of the Tanzanian program at the margin of eligibility. Credit development programs can use results from this study to gage the marginal magnitude and longevity of temporary credit market interventions and their effects on lender behavior.

1 B. Thorston, P. Honohan, and A. DEmirguc-Kunt. New Research Shows Financial Development is not only Pro-Growth, but also Pro-Poor. World Bank. 2004.
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:20659376~pagePK:64165401~piPK:64165026~theSitePK:469382,00.html
2 International Financial Corporation. Access To Credit Among Micro, Small, And Medium Enterprises. IFC Advisory Services, Access to Finance.
http://www.ifc.org/wps/wcm/connect/1f2c968041689903950bb79e78015671/AccessCreditMSME-Brochure-Final.pdf?MOD=AJPERES

I. Intro

Financial services of Tanzania's small and inefficient formal banking sector reach only about one in six Tanzanians. This is largely a result of undeveloped infrastructure and high risk incurred by the lender during credit transactions.[3] The Village Land Act of 1999, for example, which recognizes under customary law villages' land rights shift the already disproportionate balance of protection toward borrower.[4] A 2004 amendment returned certain rights to lenders but creditors remain wary. Risk premiums resulting in inflated lending-to-deposit spreads of 7-12%,[5] as well as exorbitant collateral requirements, are based not only in credit history and income, but include factors out of borrowers' control, such as weak market structure and legal barriers for creditor rights enforcement.

Fortunately, this deficit is showing signs of improvement and development experts are speculating which is the most optimal way for the small-scale credit demand to be met.[6] While certain banks have expressed willingness and ability to lend in the retail microfinance sector,[7] others warn that aggressive, below-cost financial services could stunt the development of sustainable market innovations that will occur if the private sector is left to correct for this market failure.[8] At this critical point in the evolution of Tanzania's banking sector, DCA is in a powerful position to influence banks toward lending to underserved markets considered high-risk. If exposed to the benefits of this expansion, financial institutions (FIs) could decide to stay in the market, thus creating a long-term bridge to the Tanzanian credit gap.

II. Causal Chain and Hypothesis

Causal Chain:

In order to expose credit suppliers to underserved markets deemed too risky for lending to without hefty risk premiums, or at all, DCA absorbs up to 50%, the risk. Past evaluations of DCA programs have found statistical evidence that lenders are willing to test this new market in the safety of temporarily guaranteed loans. The ultimate goal, however, is for lenders to learn through this experience, that expansion into this market is safe, and even profitable. DCA provides technical assistance to ensure that markets operate efficiently and to optimize both lenders and borrowers experience. Lenders often decrease drop the risk premium, compelling borrowers to apply for a second loan, fusing the gap between credit supply and demand. However, this positive and sustainable effect of DCA on the credit supply is only valid if the market expansion is due to additionality. The concern is that lenders have incentive to transfer their credit supply from a safe market too a risky-but-guaranteed one, reverting to their original preferences when the program expires. In this case our positive effect is void. As such, this evaluation tests for additionality by looking at loan rejection rates in both the new and old markets both during and after the DCA program has ended.

inputs	activities	outputs	outcomes	final outcomes
DCA guarantees up to 50% of targeted loans	Fis reach new markets due to lower risk	Lenders maintain new risk assessment after DCA loan expires	Lenders increase portfolio volume to reach a new market	Credit gap between lender and borrower is closed
DCA provides technical assistance to both lenders and borrowers	Lenders' profits increase		Lenders drop risk premium for more favorable terms	

Figure 1: Tanzania Development Credit Authority Impact Causal Chain

3 Making Finance Work for Africa. Tanzania: Financial Sector Profile. 2008. https://www.mfw4a.org/tanzania/financial-sector-profile.html
4 World Bank and International Monetary Fund. Financial Sector Assessment, Tanzania. August 2003.
5 Daily News Reporter. Bank Lending Interest Rates Rise Slightly. 21 October 2015. http://www.dailynews.co.tz/index.php/business/43416-bank-lending-interest-rates-rise-slightly
6 World Bank and International Monetary Fund. Financial Sector Assessment, Tanzania. August 2003.
7 World Bank and International Monetary Fund. Financial Sector Assessment, Tanzania. August 2003.
8 World Bank and International Monetary Fund. Financial Sector Assessment, Tanzania. August 2003.

The hypothesis of this study is as follows: DCA-guarantees on loans given to marginalized borrowers increases FI risk threshold, resulting in lower collateral requirements, increased potential for repeat business, and higher lender and borrower profit margins; and rejection rates will not fluctuate due to the additionallity of the program.

III. Methodology and Implementation

Data Collection:

As part of an effort to promote sustainable practices in the collect and analysis of data, USAID has been investing in the building capacity of the National Bureau of Statistics (NBS). USAID will work with NBS to collect data for this DCA evaluation. To cut costs and efforts, baseline questionnaires will be built into FI loan applications, and will be given to DCA. Any further incoming financial information to the FI will be shared with DCA, and treatment and control surveys will be conducted of every year.

Methodology:

Banks that expand their credit market on the eligibility continuum do so by first entering new markets nearest existing ones. Regression Discontinuity Design (RD), an impact evaluation method that uses eligibility discontinuity to assign treatment and control, exploits this, by focusing the scope of subjects to local average treatment effect (LATE) on this policy-relevant margin of eligibility. Although DCA potentially has the power to influence FIs to lend to a lower tranche of the distribution, exposing FIs to lowest-risk borrowers' yields the highest likelihood for banks to profit, and therefore to continue lending in this market.

Of key interest to our study is additionality and sustainability. While additionality can be estimated in a cross-sectional model, sustainability requires the study of treatment effects after DCA is no longer backing loans in this program. To estimate longevity of FI behavior, this study will continue for 5 years after the DCA intervention has ended.

There are 36 FIs in Tanzania, all which will be asked to participate in our study. The unit of both treatment and analysis is the individual loan, and treatment and control groups will be determined using a distribution threshold of all applicants' credit scores (cs). Existing thresholds will be lowered or, if a continuous one is not used uniformly across FIs, an ad hoc one will be created using a formula detailed below. Banks will be highly involved in creating this scoring system and will be asked to use it in their criteria for loan eligibility. Applicants to the right of this threshold will receive DCA-backed loans, and applicants to the left will not. One treatment and two control groups will be assigned. Treatment will be a window containing x borrowers, described below, between the new and old discontinuities. Control Group A will be x borrowers eligible for a loan without a DCA-guarantee, and Control Group B will be x borrowers not eligible for any loan.

This model has four dependent and two independent variables. Dependents are: 1) loan term quality, measured through collateral requirement, 2) potential for repeat business, expressed as portion of borrowers that want a second loan, 3) lender and borrower profit margins, and 4) rejection rate, which measures additionality. Independent variables are: 1) the value that DCA is guaranteeing, so to capture the magnitude of the risk being mitigated, and 2) time since loan ended, to see lender behavior after DCA. Control Variables include household size, age, employment, rural/urban binary, number of employees, sector, number of previous successful/unsuccessful applications, types of technical support offered/taken, repayment status, country-level economic indicators, duration-in-program fixed effects and FI fixed effects. Our estimating equation is as follows:

$$Y_{it} = \beta_0 + \beta X_{it} + \beta X_{it}^2 + \beta X_{it}^3 + \theta_t + \alpha_i + \vartheta T_{it} + \varepsilon_{it}$$

i = Individual borrower
t = Time since loan ended
β_0 = Constant
βX = Vector of control variables
θ = Time fixed effects (duration in program)
α = Cross-sectional fixed effects (FI-level)
ϑT = Treatment effect (rejection rate, repeat business, profit margins, collateral requirement)
ε_{it} = Error

Credit Scoring System:

Credit scores must be continuous so that the difference between treatment and control groups are so small that the cutoff is considered arbitrary, with essentially no difference between the groups, other than the treatment. Unless FIs share a uniform, continuous loan eligibility credit scoring system with a hard cutoff, an ad hoc one will be created using completed loan history data for the Tanzanian population. A regression will be run to measure effect size of borrower characteristics (bc) on default rates in the sample population; for example, age, income, and number of past defaults.

$$\gamma = \beta_0 + \beta X_{age} + \beta X_{income} + \beta X_{defaults} + \mu$$

Each bc will be weighted as a percentage of total coefficient value, and will be normalized by standard deviation, so that high-value numbers such as income don't boost overall scoring parameter, which would decrease the relative importance of lower-value ones such as age. A progressive point system will be used for linear relationships and non-linear ones will be calculated accordingly to their functional form.

$$\gamma = \beta_0 + .12\beta X_{age} + 1.32\beta X_{income} + .87\beta X_{defaults} + \mu$$

$$\text{Total } \beta = .12 + .45 + 1.32 + .87 = 2.76$$

$$\beta X_{age} = .12/2.76 = 0.043$$
$$\beta X_{income} = 1.32/2.76 = 0.478$$
$$\beta X_{defaults} = .87/2.76 = 0.31$$

In a normally distributed sample with *parameters A*, a 21-year-old female with income \$20,000/year and 2 past defaults would be assigned a score of 2.2927, *score B*:

parameters A:

βX_{age}: $\mu = 40$, $\sigma^2 = 5$

βX_{income}: $\mu = 30{,}000$, $\sigma^2 = 5{,}000$

$\beta X_{defaults}$: $\mu = 4$, $\sigma^2 = 1$

score B:

βX_{age}: $0.043(40-21/(5)) = 0.1634$

βX_{income}: $0.478(30{,}000-20{,}000/(5{,}000)) = 0.9560$

$\beta X_{defaults}$: $0.315(4-2/(1)) = 0.6300$

Discontinuity Placement:

To place the cs discontinuity, a smoothed histogram will be created using cs of all applicants that will not receive a loan without a DCA guarantee. Discontinuity will be moved to the left from the observation with the highest cs until the total cost represented by N_b (number of borrowers) to the right of the threshold is equal to DCA's available funding for the project. The following formula will be used to calculate at what point on the histogram N_b is equal to the number of borrowers to the right of the discontinuity:

$N_b = TF_T/\mu_L (\mu_b)$, where N_b = number of borrowers granted DCA guarantee, TF_T = DCA's total funding for Tanzania, μ_L = average loan amount, and μ_b = average perentage of loan backed by DCA

If cs distribution were normal, for example, then the discontinuity would be calculated using the Z-score method: N_b will be assigned a Z-score using, $Z_b = x_b - (0.5(N_a))$, and cs will be calculated for that Z-score, using the following formula, $x_{cs} = Z_{cs} (\sigma_{cs}) + \mu_{cs}$. Note that N_b must represent total borrowers over the duration of our study. For example, if sample population consists of 1 month's applicant volume, and our study is 10 years, then we would multiply N_b(120 months).

x_{cs} = mean credit score

Z_{cs} = credit score Zscore

σ_{cs} = credit score standard deviation

μ_{cs} = mean credit score

Z_b = borrower Zscore

N_a = number of borrowers granted DCA guarantee

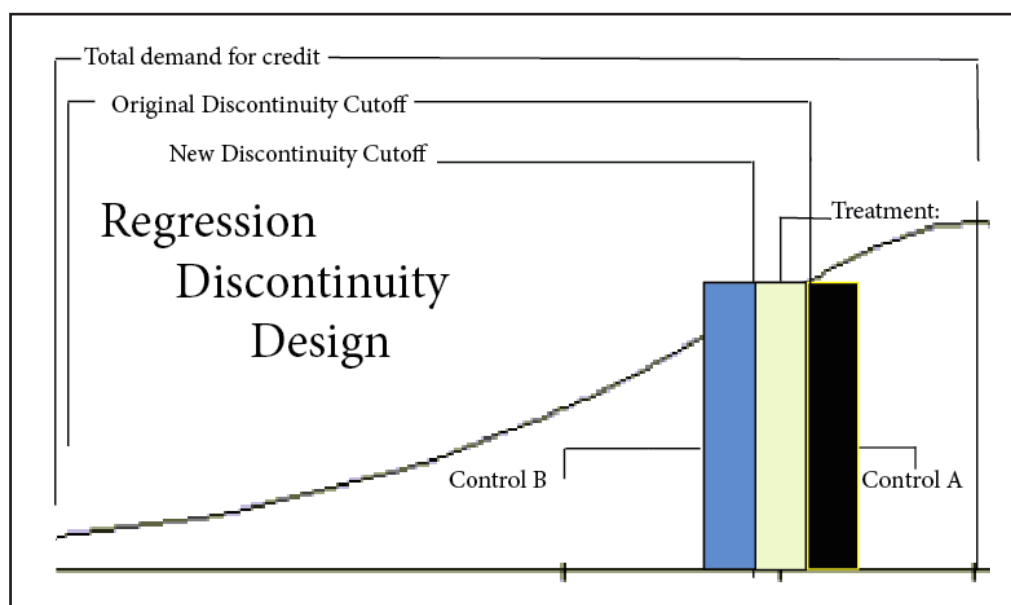x_b = mean/median borrower

Figure 2: Treatment and Control assignment fro Regression Discontinuity Design

IV. Treatment Effect and Power Calculations

<u>Estimated Treatment Effects</u>: Four treatment effects will be estimated in this study. All except rejection rates are concerned with changes over time, so that we can estimate whether or not DCA-induced behavioral changes in the lender are sustainable.

TE 1 estimates change in loan terms, using *collateral requirement* as a proxy. A will estimate DCA's effect within the bank, and B will estimate its effect within Tanzania. Based on DCA's Russia Impact Brief, a 26% decrease in average collateral requirement can be expected.[9]

TE 2 – Control A will measure DCA's ability to mobilize the credit sector by estimating change in *potential for repeat business*. Using the 2010 Kenya DCA evaluation as a proxy estimate we can expect 125% increase of interviewed subjects who wanted a second loan, in the first 4 years of the program.[10]

TE 3 - estimates the effect of DCA on *profit margins*. Lender profit margins will use Control A. Over the course of the Kenya program, banks' profit margins increased by 61%.[11] Borrower profit margins will use both Controls; A will compare backed with non-backed loans, and B will compare backed loans with no loan. Kenya's overall increase in borrower profit margins was 13%.[12]

TE 4 – will measure additionality by estimating the effect on *application rejections* in Control A. We expect no effect. This group is more qualified than the treatment group to receive a loan, so a negative treatment effect on rejection rates indicates that the banks are pulling credit from their original customers to lend to guaranteed ones. Time fixed effects will be used to knock out changes over time.

<u>Power Calculations</u>:

Assuming that both FICO's and our cs scoring systems accurately reflect respective population borrower risk, we can use FICO data to predict the shape of the Tanzanian cs distribution. A twoway line graph created using 2015 FICO data on US cs shows a hard left skew with almost 20% of scores in the top 5 percentile (Figure 3).[13] Power calculations using this distribution will strike a balance between preference for a smaller window to increase accuracy of functional form against ensuring an adequate number of observations to get statistical power.
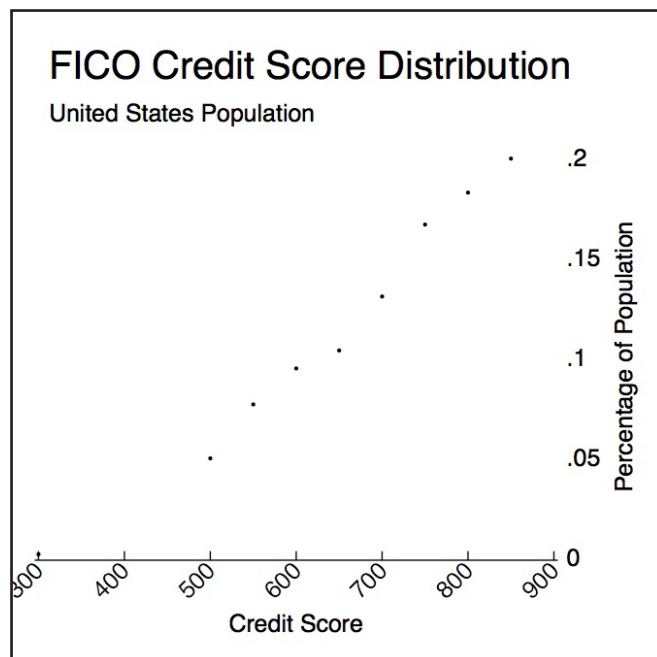

Figure 3: Fair Isaac Corporation US credit score distribution

9 United States Agency for International Development. DCA Loan Guarantee Russia Impact Brief. https://www.usaid.gov/sites/default/files/documents/2151/Russia_impactbrief.pdf
10 United States Agency for International Development. Kenya-DCA Loan Guarantees Impact Brief. https://www.usaid.gov/sites/default/files/documents/2151/Kenya_DCA_Impact_Brief_final.pdf
11 United States Agency for International Development. Kenya-DCA Loan Guarantees Impact Brief. https://www.usaid.gov/sites/default/files/documents/2151/Kenya_DCA_Impact_Brief_final.pdf
12 United States Agency for International Development. Kenya-DCA Loan Guarantees Impact Brief. https://www.usaid.gov/sites/default/files/documents/2151/Kenya_DCA_Impact_Brief_final.pdf
13 L. Arnold. Credit Score Statistics. Card Hub.
http://www.cardhub.com/edu/average-credit-scores/

2015 program data yielding 623 borrowers per country per year was pulled from DCA's official website for use in Single Level Trial Power vs. N power calculations. To put these numbers into the context of our cs distribution, an estimate that Tanzanian service providers' 500,000-client combined portfolio constitutes 5% of total demand was taken from mfTransparency.org.[14] Under this assumption, a Z-score for the new discontinuity with 623 people left of the old one can be calculated, and the cs Z-score can be derived from this.
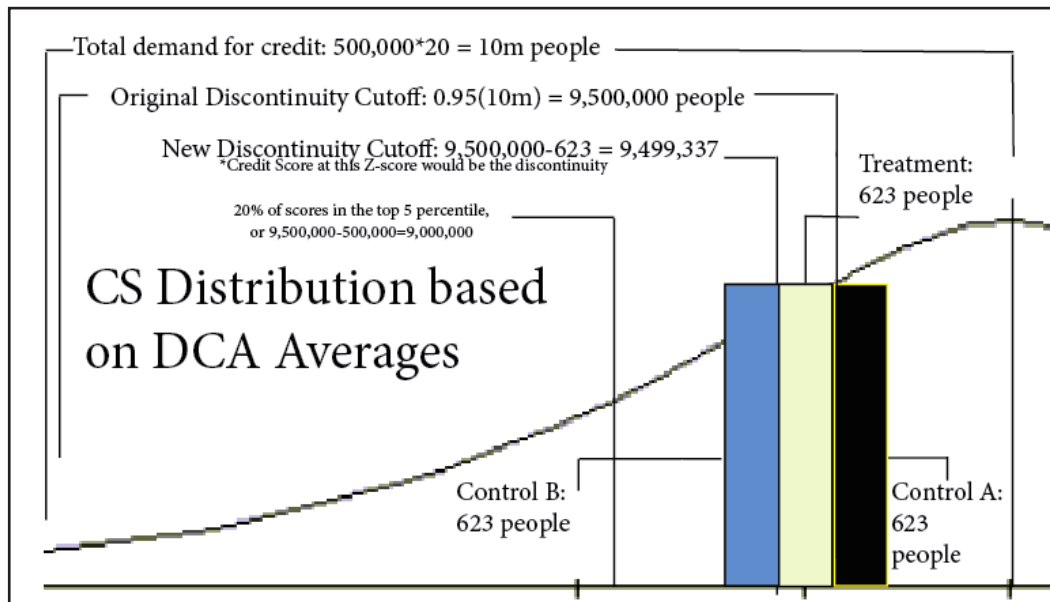

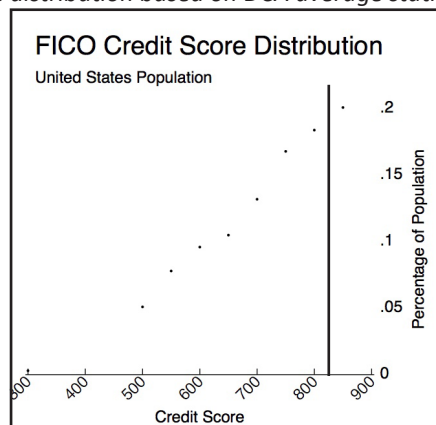Figure 4: Ad hoc credit score distribution based on DCA average statistics

Figure 5: Credit Score Distribution with Discontinuity

The following are results of power calculations using 0.8 power and our estimated treatment effects, all which show that our study is feasible at our current number of observations (N) = 1,246:

        collateral requirement: N=460
        potential for repeat business: N=24
        lender Profit margins: N=85
        borrower Profit margins: N=1,818
        rejection rate: not calculated*

V. Shortcomings

Data: Difficulties in obtaining data will come mainly from surveying applicants and borrowers whose loans have expired or whose applications have been rejected, especially over the duration of this study. Undeveloped road and institutional infrastructure, especially during the rainy season will further drive up these data collection costs, and using FI applications as a mechanism for data collection will substantially offset them.

Ethics: Ethical considerations may prohibit FIs from granting DCA financial information from their customers.

Methodology and Statistical Identification: Additionality is difficult to identify. We use rejection rate as a proxy, but there is not estimated effect size because we are simply looking for the presence of any negative effect from the existing credit market to the new one.

External Validity: Because FIs have similar reasoning processes in granting loans, this study can be used to evaluate credit service sectors of other FIs or countries. However, FIs that are more willing to accommodate DCA partnerships are predisposed to have an interest in lending to new markets. Therefore, the validity of their results may not apply to other FIs. To check for this we can run a robustness check for parallel trends. If we have parallel trends, then we can assume there is no time-variant endogeneity, and we can test for time-invariant endogeneity by running a regression between some of the time-invariant attributes of the borrowers and the time of entry into the program. If there is significance then we may have cross-sectional endogeneity.

Causality: Loans that show up in statistical analysis as an outcome of a guarantee may just be a wealth transfer from other loans the institution would have made if they hadn't made this one. Accounting for additionality in our regressions ensure that total investment in loans is increasing.

Spillover Effects: People in rural villages that have a strong sense of pooling resources will share the money from their loans with family members, friends, and other villagers. Even in the absence of this spillover, money from loans will inevitably have an effect on the economics of the village in which the loan is given, as borrowers will spend that money near where they live. This is especially true in rural Tanzania, where the transportation is primitive and people have to rely on resources in close proximity to where they live.

VI. Conclusion

Past evaluations of USAID's DCA programs have recorded positive effects of the credit supply intervention. None, however, have focused on the programs' effects on lender behavior after DCA's loan tenors are completed and the treatment group is no longer guaranteed. The Sustainable Solutions impact evaluation design presents an econometric model to evaluate whether DCA is changing the calculations by which lenders perceive risk, or if risk is temporarily being discounted by the rate of the guarantee.