Can Warm Glow Alleviate Credit Market Failures? Evidence from Online Peer-to-Peer Lenders

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I. Introduction

Between 50% and 80% of adults in many developing countries still have inadequate access to financial services (Demirgüç-Kunt, Beck, and Honohan 2007), which translates into approximately 3 billion individuals worldwide. Because credit markets suffer from asymmetric information and limited liability (Stiglitz and Weiss 1981), potential entrepreneurs with low collateral may not be able to borrow funds for start-up capital or to increase the liquidity of their businesses or can only do so at very high interest rates. As a consequence, they are left to opt for other less rewarding occupations or operate their businesses at inefficiently low levels, thus creating "poverty traps" (Banerjee and Newman 1993).

To overcome these information and liability constraints, banks and microfinance institutions (MFIs) have traditionally focused on a variety of instruments ranging from down payments and joint liability lending to reliance on credit agencies. This article focuses on the existence of a different phenomenon that may increase outreach: lenders' warm glow. If lenders add to their utility by the mere fact of giving a loan to a project that may potentially reduce poverty or child mortality, promote gender equality, or generate education or health spillovers for the community, they should then be willing to decrease interest rates for these pro-poor, socially responsible (SR), and pro-female projects, thus increasing the outreach of credit markets.

Of course, not all economic agents enjoy warm glow. Traditional banks have a profit-only motivation, while aid agencies, which may increase their utility from the mere act of giving, generally incur very high transaction costs in reaching small-scale entrepreneurs. Further, MFIs, which face lower transaction costs due to their proximity and scale, are moving toward an increasingly competitive model of for-profit lending, as policy makers and donors encourage them to reduce their reliance on subsidies (Morduch 2000). As of 2006, MFIs had reached 113 million clients, much fewer than the billions of individuals still without access to banking services (Microcredit Summit Campaign 2006).

In this article, we turn to an institutional innovation, a new online Danish lending platform called MYC4 (http://www.myc4.com), that may be able to exploit the warm glow enjoyed by individual investors to increase credit outreach. On any given day on the MYC4 website, individual investors are given a menu of potential loans. Some projects are pro-poor (i.e., they are small, lack collateral, or recently launched), some others are SR (i.e., they provide employee training or are deemed by MYC4 to address the UN Millennium Development Goals), and some are pro-female (e.g., undertaken by a female). Multiple investors can provide financing to one loan, with the final interest rate a weighted average of the successful bids, which are determined through a competitive Dutch auction bidding process. Investors must decide carefully how to allocate their loan portfolio: in the case of default, MYC4 clearly states that investors may lose their investments.[1]

We collect a unique data set of 8,163 individual investors bidding to invest small amounts with varying interest rates on 4,057 different business projects in six African countries. We codify all the information that is available to investors, including text descriptions and pictures, and carry out a two-step procedure to test whether some investors enjoy warm glow. First, we explore which business characteristics command lower interest rates through the bidding process. Holding everything else equal, we find that pro-poor, SR, or pro-female projects command significantly lower interest rates on the MYC4 platform. Second, we estimate loan repayment rates as a function of these characteristics conditional on the interest rate.

Several identification issues arise when relating interest rates to repayment. First, despite our best efforts to capture all the information available on the website, it might be that investors "read between the lines" and discern information from the website that cannot be easily captured by our methodology.

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[1] "What is my guarantee that I will see a return on my loan investment? All investments are potentially risky, and there is no guarantee that you will see a return on your investment" (http://myc4.com /Portal/WebForms/About/Default.aspx?NameKey=MAIN_FAQ).

Unobservables may drive both interest rates and repayment and bias the results. Another possible source of simultaneity would arise if entrepreneurs realize that SR projects get more favorable interest rates—and thus respond by changing the nature of their project (or representing it as more SR than it really is)—and if this response is correlated with repayment behavior. Finally, MYC4 may strategically manipulate the bidding time to favor some projects in particular.

To address these identification issues, we use exogenous changes in the supply of investors caused by newspaper articles featuring the website to isolate the causal impact of variations in interest rates on loan repayments by African entrepreneurs. These newspapers were not prompted by the repayment performance of African entrepreneurs but by prizes received by MYC4 or legislative delays over government foreign aid that could be given to MYC4. As such, these newspaper articles affect the supply of investors exogenously from the repayment performance of African entrepreneurs and, thus, represent a valid instrumental variable. This approach is unique in the sense that it is the first to use peer-to-peer features to identify the impact of interest rates on repayment.

Consistent with a moral hazard model whereby lower interest rates allow the entrepreneur to appropriate more of the business' profits and thus increase effort and chances of success, we find relatively large repayment elasticities with respect to the (instrumented) interest rate. As a result, the impact of these interest rate reductions on the success of the businesses is substantial. The sample average default rate is 11.3%; however, the default rate for businesses with discounted interest rates was drastically reduced. For example, default rates of businesses providing employee training, those related to health, and those related to school are reduced by 35%, 54%, and 60%, respectively.[2] Conditional on this effect through the interest rate, we find that pro-poor, SR, and pro-female projects do not have better repayment per se. The net effect on return for lenders of decreased interest rates and increased repayment is negative, indicating that these discounts do not reflect profit-maximizing behavior. We thus conclude that investors are also pro-social. As such, this feature of peer-to-peer lending increases the chances of success for pro-poor, SR, and pro-female entrepreneurs, while borrowing from a profit-maximizing lender would not.

The overall potential of this institutional innovation is an open question. However, there are some indications that it is large. As shown in figure 1,

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[2] It is later shown that school projects get a 0.76 percentage point discount in their interest rates and that a 1 percentage point decrease is associated with an 8.9 percentage point decrease in default. School projects thus enjoy a $0.76 \times 8.9/11.3 \times 100 = 60\%$ decrease in the default rate.
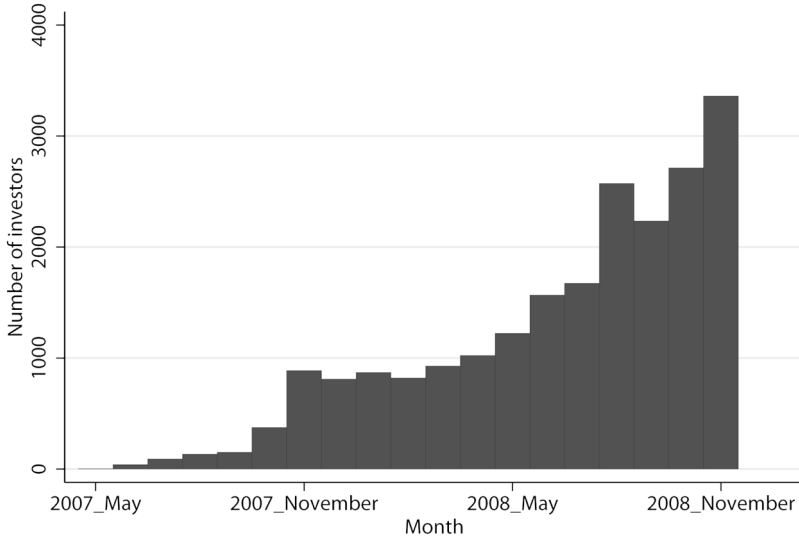
Figure 1. Number of active investors per month on the MYC4 website platform

MYC4 has experienced rapid growth (an average of a 15% per month increase in the number of investors on the platform in 2008), and while nearly three-quarters of its investors still come from Denmark, 88 nationalities are already represented. Individuals may also find it an attractive alternative to private charitable giving, a market that in 2010 totaled US$291 billion in the United States alone.[3]

Section II reviews the literature. Section III presents the implications of the canonical moral hazard model applied to credit markets, with the added assumption that projects generate a warm glow for lenders. Section IV summarizes the MYC4 data. Section V analyzes the determinants of interest rates. Section VI relates project characteristics and interest rates to repayment, and Section VII concludes.

II. Literature

This analysis contributes to the growing literature that seeks to understand the motivations underlying pro-social behavior, which is difficult to reconcile with the precept of self-interested behavior that underlies much of economic theory (Andreoni 2006). Andreoni (2006) defines "warm glow" as the added utility from the mere fact of giving. As such, it is complementary to altruism. Laboratory experiments have found strong evidence in support of a warm-

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[3] Charitable-giving data are from the Giving USA Foundation (2011).

glow term in preferences (Andreoni 1993, 1995; Palfrey and Prisbrey 1997; Andreoni and Miller 2002). However, Andreoni (2006) argues that warm-glow giving only provides a partial answer to the question, why do people give? In this article, we fine-tune this model by providing a reason as to why investors make a gift (in the form of discounted interest rates) to only some projects: their pro-poor, SR, or pro-female nature. Our findings also lend support to other recent evidence that people are willing to pay more for private goods if there is a public goods component added (so-called impure public goods). For example, Elfenbein and McManus (2010) compare items sold on eBay's Giving Works charity auction program with similar objects offered contemporaneously in noncharity eBay auctions and find that consumers pay about 6% more, on average, for items when some or all of their payment goes to a charitable auction.

Our article also relates to several recent papers using a US online peer-to-peer lending website called Prosper.com, which focuses mainly on consumer loans. For example, Duarte, Siegel, and Young (2009) find that people perceived as trustworthy on the basis of their appearance in a photograph receive lower interest rates, conditional on funding of the loan, and have lower default rates, also accounting for credit scores. While they do not seek to disentangle investors' profit motives from their pro-social motives, their findings do support the idea that private investors use other signals apart from business characteristics to make their decision. More closely related is the paper by Pope and Sydnor (2008), which also relies on Prosper.com and finds some evidence that would be consistent with pro-social behavior by investors toward blacks. In particular, while they find that black entrepreneurs' projects fetch higher interest rates than white entrepreneurs with similar credit profiles, and indeed have higher default rates, the higher interest rate does not sufficiently offset the greater default (i.e., a lower overall return relative to whites). The authors interpret these findings as evidence of a combination of accurate statistical discrimination against blacks coupled with taste-based discrimination against whites. However, unlike MYC4, where 93% of the loans get funded and disbursed (an even higher percentage gets funded, but not everyone takes up the loan), only 8% of loans on Prosper.com get funded, raising an obvious concern of sample selection when analyzing repayment data. In addition, as Prosper.com borrowers and lenders reside in the same geographical location (the United States), it is difficult to identify instruments for the interest rate that would provide the exogenous source of variation needed in order to test whether signals, such as race or trustworthiness, affect repayment. In contrast to the purely reduced-form approach of the existing

literature, we analyze the mechanisms through which project characteristics affect interest rates, which in turn affect repayment rates.

Finally, our article relates to the literature analyzing the impact of interest rates on repayment for poor individuals. Due to the endogeneity of the interest rate to repayment, this literature is very small. In a randomized experiment with a for-profit South African lender focusing on consumer loans among a pool of 50,000 former clients, Karlan and Zinman (2008) find that higher interest rates decrease take-up and repayment rates. Further, Dehejia, Montgomery, and Morduch (2005) exploit quasi-experimental evidence from a traditional microlender operating in the slums of Dhaka that increased the interest rate at a later time in two of its three branches to equal that offered at a newly opened third branch. Their difference-in-differences approach finds that the increase in interest rates resulted in borrowers taking smaller, more frequent loans and repaying more quickly. We are not aware of any other developing country evidence. Our article differs from this literature in two major ways. First, we focus on the investors' perspective, as opposed to the borrowers' perspective. Thus, we extend the analysis by endogenizing interest rates and focusing on characteristics of the projects that might explain lower interest rates, which in turn affect repayment. Second, we use an instrumental variable strategy to identify the causal impact of interest rates on repayment. While this strategy has a potentially lower internal validity than randomized experiments, it nonetheless has greater external validity as our results apply to the many countries (six in total) currently served by MYC4.

III. Theory

The possibility for investors to enjoy warm glow from certain projects may have three basic effects: changing the interest rates, changing the nature of the projects proposed by entrepreneurs, and reaching previously unfunded entrepreneurs. First, to understand more clearly the effect of warm glow G enjoyed by an investor when giving a loan to a certain project on the interest rate r offered, we turn to the canonical moral hazard model in a partial equilibrium setting. Second, we analyze the choice of projects of entrepreneurs with respect to G. Finally, we look at access to credit for previously unfunded entrepreneurs.

A. Impact on the Interest Rate

Suppose a borrower chooses $e \in [0, 1]$ (effort), which costs him $c(e) = (1/2)ce^2$. A project return can take on two values, R (high or success) and 0 (low or failure), with probability e and $1 - e$, respectively. The opportunity cost of funds is ρ on the principal plus interest rate. The opportunity cost of

labor is u. The borrower has no cash but some illiquid assets worth w. The lender faces a limited liability constraint and obtains a return r when the project return is high, w when the project return is low. The borrower's payoff π^b is thus

$$\pi^b = e(R - r) - (1 - e)w - \frac{1}{2}ce^2 - u.$$

While the lender's expected payoff π^l is

$$\pi^l = er + (1 - e)w - \rho + G.$$

Note that warm glow G is received from the mere act of giving a loan, whether the project succeeds or fails. Effort e is unobservable. The borrower chooses e so as to maximize his private payoff. The incentive-compatibility constraint (ICC) is thus

$$e = \arg\max_{e \in [0,1]} \left\{ e(R - r) - (1 - e)w - \frac{1}{2}ce^2 - u \right\},$$

which yields $e = (R - r + w)/c \in [0, 1]$. The ICC can be rewritten as

$$r = w + R - ce.$$

The underlying environment is that of competition: lenders compete for borrowers, which drives lenders' profits toward zero.[4] The optimal contracting problem is

$$\max_{e,r} \left\{ e(R - r) - (1 - e)w - \frac{1}{2}ce^2 - u \right\}$$

subject to

$$er + (1 - e)w - \rho + G \geq 0,$$
$$r = w + R - ce.$$

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[4] We base this assumption on the fact that such a high share of loans is ultimately funded, competition between investors consistently drives the interest rate below the desired rate, and according to table 1, on the last day of bidding there is still an average of six bids per day. However, if there is still an average of six bids per day when the auction closes, it is possible that interest rates could go even lower as more potential lenders compete to offer the lowest interest rates. Instead of zero profit for the lenders, this premature closing of the bidding by MYC4 may generate positive profits for the lenders. The comparative statics of the model with positive profits for the lender are unchanged. It might also be that the closing time is not exogenous but depends on the nature of the business plan. For example, if MYC4 is socially minded, "deserving" projects, i.e., projects that generate a high warm glow, might benefit from an extended period on the website and fetch lower interest rates. The comparative statics of the model are also unchanged if one assumes a positive profit function decreasing with G. Results available on request.

Combining the ICC and the zero-profit constraint yields $er + (1 - e)w - \rho + G = e(R - ce) + w - \rho + G = 0$. This yields a quadratic equation in e: $ce^2 - eR + (\rho - w - G) = 0$. The solution is the bigger root, $e^* = [R + \sqrt{R^2 - 4c(\rho - w - G)}]/2c$. Corresponding to e^*, the equilibrium interest rate is $r^* = w + \{[R - \sqrt{R^2 - 4c(\rho - w - G)}]/2\}$. The borrower's equilibrium payoff is $\pi^{b*} = \{[R + \sqrt{R^2 - 4c(\rho - w - G)}]^2/8c\} - w - u$.

Two testable predictions may be derived from this model. First, $(\partial r^*/\partial G) < 0$; lenders lower the equilibrium interest rates for projects generating warm glow. The intuition of this prediction is that the presence of warm glow loosens the zero-profit constraint. Lenders enjoy this warm glow G and are, thus, willing to lower interest rates. For the same reason, $(\partial r^*/\partial R) < 0$; the standard prediction that projects that have a higher return fetch a lower interest rate. Second, $(\partial e^*/\partial G) > 0$; borrowers whose projects generate warm glow G will, in equilibrium, exert greater effort. This is an immediate consequence of a moral hazard situation in which the presence of warm glow lowers the interest rate. As borrowers feel confident that they will retain more of their profits, they exert more effort. We test the two predictions of this model using the investment and repayment data from MYC4.

B. *Impact on the Nature of the Projects*

This partial equilibrium setting assumes that the warm glow G is exogenous. However, entrepreneurs may choose their projects from many business plans with differing levels of warm glow G. Thus, the MYC4 platform may influence the choice of the projects. For example, assume that an entrepreneur has the choice between a profit-focused project with return R, with no warm glow generated, and a SR project with lower return R_{SR} (as warm glow might be costly to produce) and warm glow G. The comparison of the profits π^{b*} generated with the profit-focused or SR projects yields the following condition on G for a SR project to be chosen: $G > (R^2 - R_{SR}^2)/4c$. This means that if the returns R_{SR} of a SR project are significantly lower than a profit-focused project, it will take a relatively high warm glow G (translating into a high interest rate cut) for the entrepreneur to choose a SR project over a profit-focused project. The distribution of warm glow G in the market will have an impact on the number of SR projects, and thus the behavior of investors, in a general equilibrium setting. Besley and Ghatak (2007, 1659) explicitly prove the existence of an equilibrium in a market in which neutral and caring agents interact with neutral and SR firms. While they develop the analysis in terms of the product market, the basic tenet of their model also applies to capital markets.

Moreover, if entrepreneurs realize that SR projects get more favorable interest rates and respond by changing the nature of their project (or representing it as more SR than it really is), and if this response is correlated with repayment behavior, then this introduces a simultaneity bias between interest rates and repayment. The bias could go either way—"savvy" entrepreneurs might respond more and have higher repayment, or "unscrupulous" entrepreneurs respond more and have lower repayment.

In the data that we later describe, we see no significant change in the nature of the projects over time. This might be due to the small time frame in which MYC4 has been operating (since May 2007). It will be interesting to look at the changing nature of the projects in the future. We also adopt an instrumental variable strategy when relating interest rates to repayment to address this simultaneity bias.

C. Impact on the Previously Unfunded Entrepreneurs

A further result from the model is that the warm glow G is observationally equivalent to the collateral w in the above equations. In other words, it is as if the warm glow enjoyed by the lenders brings a social collateral to the borrower, which increases the equilibrium effort level. Also note that there exists a solution to the quadratic equation if and only if the discriminant is positive (i.e., $R^2 - 4c(\rho - w - G) \geq 0$). In the absence of a warm glow G and a low collateral w, a solution might not exist if potential returns are low and the cost of effort, as well as the opportunity cost of funds, is high. In other words, investors might not fund projects with low collateral, as the losses associated with default are too high. The presence of a warm glow G may modify this conclusion. This indicates that projects that may not be funded by traditional financial service providers will be funded by peer-to-peer lending if lenders enjoy warm glow from the mere act of giving discounted interest rates to some projects. In this way, warm glow may extend the reach of credit markets. We now describe the data and attempt to test the two predictions of this model concerning the impact of project characteristics, which may generate warm glow, on interest rates and repayment.

IV. MYC4

To participate as a borrower, an entrepreneur must first apply to a designated "provider" in his or her respective country. After an initial screening, this provider will upload the loan application to the MYC4 website. After being granted approval by the MYC4 staff, this submission will then be posted in the public domain as a loan application for lenders to bid on. To inform their investment decisions, investors are provided with information about each busi-

ness plan, including the business' profitability and risk, a description of the business' activities, estimates of revenue generation, number of employees, and the presence of different kinds of collateral.[5] In addition, each business description contains information on a number of direct and subtle indicators that may be valued by investors. For example, MYC4 and its local country partner organizations can assign different icons to business plans that indicate whether the business will contribute to one or more of the UN Millennium Development Goals. More subtle clues may include a text description that mentions that the profits will be used to provide children with schooling or a picture that shows that the employees are predominantly female.

We collected all the information on business plans, bids, interest rates, and repayment histories that is publicly available on the MYC4 website (http://www.myc4.com). Table 1 shows descriptive statistics on MYC4 borrowers, loans, and bids. There are a total of 4,057 business plans on the website (as of January 6, 2009), originating equally from men and women. The predominant activity is to open or develop a shop. Most of the borrowers are self-employed (52%) and have an address. MYC4 borrowers are relatively rich, with average previous year earnings equal to €16,602 (although it is not clear what the net earnings are). Earnings are €6,545 at the median and €1,800 at the first quartile ($6/day). Borrowers come from Uganda (53%), Kenya (32%), Ivory Coast (14%), Senegal (0.5%), Rwanda (0.4%), and Ghana (0.3%).

Loans can range from €100 to €25,000, with a mean of €1,885. Loans are generally repaid over 12 months, and almost all of the MYC4 borrowers provide collateral that, in theory, covers a large part of the loan. Overall, more than 93% of the projects are ultimately funded and taken up. A higher percentage are fully funded but MYC4, the provider, or the borrower can deny taking up the loan, even if it is fully funded. Investors are then reimbursed.

MYC4 investors, in a Dutch auction system, bid to invest and compete on how low of an interest rate they are prepared to accept. For example, suppose investor A bids €10 at 20%, and investor B bids €10 at 10%. The overall interest rate will thus be a weighted average of the two interest rates, in this case 15%. However, if the loan amount desired by the entrepreneur was only €10, investor B will outbid investor A and fund the opportunity at an interest rate of 10%. The final loan is often a combination of several investors.

Bids range from €0.01 to €21,866.65, with an average of €57.56. On average, it takes 11 days and 32 bids to gather the required loan amount.

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[5] See http://matthieuchemin-research.mcgill.ca/ for an example of a business plan.

TABLE 1
DESCRIPTIVE STATISTICS OF MYC4 BORROWERS, LOANS, AND BIDS

Variable	Observations	Mean	SE	Min	Max
MYC4 borrowers:					
Sex (0 = female, 1 = male)	4,057	.46	.55	0	1
Activity:					
Farming	4,057	.14	.35	0	1
Shop	4,057	.38	.49	0	1
Salon	4,057	.05	.21	0	1
Hotel restaurant	4,057	.09	.29	0	1
Manufacturing	4,057	.08	.28	0	1
Health	4,057	.09	.28	0	1
School	4,057	.02	.13	0	1
Other	4,057	.22	.41	0	1
No. of employees	3,940	2.71	3.37	0	53
Address (0 = no, 1 = yes)	4,057	.97	.17	0	1
Income previous year					
(euros)*	3,925	16,602.8	39,429.3	4	1,057,896
Bidding time (days)	4,057	11.38	10.68	0	45
No. of bids per plan	4,057	32.10	35.90	1	364
No. of bids per plan on					
final day	4,057	6.40	8.21	1	116
MYC4 loans:					
Loan amount	4,057	1,884.7	2,450.59	100	25,000
Wanted interest rate	4,057	13.66	2.29	8	24
Payback period	4,057	11.43	4.1	3	36
Collateral (0 = no, 1 = yes)	4,055	.93	.26	0	1
Value collateral					
(percent of loan)	4,055	83.56	58.84	0	1,600
Current interest rate	4,057	11.52	2.73	0	22.78
Transaction costs rate	4,056	32.31	12.88	4.42	75.29
Annual percentage rate	4,056	43.83	11.94	13.53	79.59
MYC4 bids:					
Amount of bid	130,227	57.56	211.62	.01	21,866.65
Interest rate	130,227	12.56	3.14	0	50

	Matrix of Correlation between the Project Scores of SR, Gender, Environment, Collateral, Quality				
	Score SR	Score Gender	Score Environment	Score Collateral	Score Quality Project
Score SR investment	1				
Score gender	−.0023	1			
Score environment	.0859	−.1094	1		
Score collateral	−.0089	.1048	−.2592	1	
Score quality project	.1489	−.1002	.1588	−.3196	1

Note. SR = socially responsible. Source: MYC4 website.
* Median: €6,545; first quartile: €1,800 ($6/day).

As investors outbid one another, the final interest rate is often lower than the borrower's desired interest rate. The average final interest rate is 12.6%, lower than the average 13.7% requested. Once a loan is fully funded, MYC4 has the discretion to stop the auction at any time. Once the auction is closed, MYC4 coordinates with the local lender, a MFI in charge of channeling

the funds and collecting repayments (usually the same institution as the provider). Investors can then track the repayments of their loans on the MYC4 website.

The agents involved in this transaction (MYC4, provider, lender) get interest commissions and loan closing fees, which increase transaction costs. For comparability purposes, MYC4 publishes the annual percentage rate for each loan, which represents the "true" cost of borrowing. As seen in table 1, the average annual percentage rate is 43.8%.

In the case that a borrower does not fulfill the payback agreement with MYC4, the local lender contacts the business. In general, text message reminders will first be sent to the business before calls or personal visits. Borrowers who default are not permitted to apply for new loans. Providers also have a strong incentive to seek repayments and maintain a reputation since they compete with other providers. In certain circumstances, the collateral can be seized.

V. Determinants of Interest Rates

A. Methodology

In the empirical section, we follow the theoretical model explained in Section III.A. We found that the equilibrium interest rate is $r^* = w + \left\{\left[R - \sqrt{R^2 - 4c(\rho - w - G)}\right]/2\right\}$. Thus, we relate the interest rate given by MYC4 investors to a proxy of the warm glow generated by the project and also to other characteristics of the business plans that may influence the interest rate. We perform regressions of the following form:

$$\text{interest\_rate}_i = X_i'\alpha + \varepsilon_i,$$

where i denotes a particular business plan and interest_rate$_i$ is the interest rate given by investors to project i. We use the total bid time necessary to fully fund project i as another dependent variable measuring investors reaction, and X_i are characteristics of the business plans. We go to great lengths to collect all of the information about these business plans present on the MYC4 website. There are four kinds of information controlled for in the estimations. First, we include standard business characteristics, such as the amount of the loan, income in the previous year, size of business, value of collateral, type of business (shop, school, etc.), and the desired interest rate. Second, information is gathered from text that is provided by entrepreneurs and describes their businesses. We develop an algorithm that searches for keywords corresponding to the MYC4 "Triple Bottom Line" ("We strive to be economically viable

(profit), socially responsible (people), and environmentally sound (planet)").[6] Third, small icons describing the accordance of the business plan with UN Millennium Development Goals are also quantitatively coded according to the number of icons present. Fourth, each business plan is allowed a maximum of three pictures on the MYC4 site, which are analyzed and coded by research assistants along 10 dimensions.[7] These 10 dimensions include business characteristics (e.g., "Are the people on the pictures professionally dressed?") and elements likely to be valued by investors (e.g., "Is the project good for the environment?"), as well as certain stereotypes that have been found to be important determinants of performance in the literature. For example, in a field experiment, Landry et al. (2006) find that a 1 standard deviation increase in physical attractiveness among women solicitors increases the average gift substantially. Similarly, in a public goods experiment, Andreoni and Petrie (2008) find that in the absence of information on actual contributions, beauty carries a premium, even though beautiful people do not contribute more on average. To capture these phenomena, we include, for example, "Is the entrepreneur attractive?" Moreover, to capture the impact of skin color as in Pope and Sydnor (2008), we include "Is the entrepreneur less or more black?"[8]

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[6] Words such as "business," "income," "expenditure," "records," "documentation," "log," "pay slip," "profit," "sale," "sell," "buy," "purchase," "trade," and "retail" are searched for to quantify the profit bottom line. Words like those included in the UN Millennium Development Goals are searched for to quantify the SR bottom line (e.g., "poverty," "hunger," "primary," "education," "gender," "equality," "empower," "women," "woman," "child," "mortality," "maternal," "health," "HIV," "AIDS," "malaria," "diseases," "global," "partnership," "development," "school," "secondary," "education," "training," "health," "clinic," "hospital," "herbal," "pharmacy," "medical," "nurse," "chemist," and "drug"). Words such as "environment," "sustainable," "sustainability," "tree," and "green" are looked after to quantify the environmental bottom line. Of course, this classification may seem arbitrary at times. Moreover, MYC4 investors are more sophisticated than this algorithm and can more accurately detect a profit from project types. In other words, MYC4 investors might read between the lines. We address this concern in this article by following an instrumental variable strategy, when we relate interest to repayment rates.

[7] One dimension is a yes/no answer ("Is there a woman on the pictures?"), while the nine other dimensions are rated on a 1–5 scale, with 1 indicating less, and 5 indicating more. These dimensions are assessed by the following questions: "Do the people on the pictures appear rich?" "Are the people on the pictures dressed in a professional manner?" "Is the project traditional or modern?" "Is the business plan self-explanatory (i.e., do I understand what the project is about by only looking at the pictures)?" "Is the project serious?" "Does the entrepreneur on the pictures smile?" "Is the project good for women?" "Is the project good for the environment?" "Does the entrepreneur seem friendly?" "Is the entrepreneur attractive?" and "Is the entrepreneur more or less black?" Some business plans were randomly asked to be coded twice by different research assistants to obtain a measure of interrater reliability. The correlation between the ratings of the research assistants is 0.8, which confirms the homogeneity of the codings.

[8] See http://matthieuchemin-research.mcgill.ca/ for examples of pictures.

Finally, country dummies are included to control for the potentially diverse nature of projects and economic conditions in different countries. Basic characteristics are also included to compare similar business plans (e.g., the size of the loan, the payback period), as are year fixed effects to control for common macroeconomic shocks. The average number of opportunities over the bidding days and controls for the supply of business plans, which may affect investors' reaction, are included. The disturbance term is ε_i. Robust standard errors are presented in brackets in the regression results.

The strategy presented in this article allows us to capture most of the information that is accessible to investors on the MYC4 website. However, it could be that investors read between the lines and judge the quality of a business plan on unobserved variables; we test this hypothesis by examining the explanatory power of the regressions performed.

B. Results

We first test whether business characteristics that likely generate warm glow command lower interest rates. Table 2 presents the results and includes the interest rate (cols. 1) and the total bid time (cols. 2). Below, we discuss the most relevant findings from this table.

The first indication that investors may be giving interest discounts motivated by warm glow, rather than profit maximization in a competitive market, is that relative to farming business plans, health- and school-based business plans attract lower interest rates, by 69 and 76 hundredths of a percentage point (i.e., basis points). In turn, farming attracts a lower interest rate than shops, hotels, restaurants, and manufacturing. Our model predicts that these results reflect the fact that health- and school-based business plans acquire lower interest rates either because of their higher returns R or because of the greater warm glow G they generate. A priori, one would expect health- and school-related businesses to generate lower returns than farming-, retail-, manufacturing-, and hospitality-related businesses. The repayment analysis will investigate this in detail.

In terms of basic business characteristics, larger loans are assigned higher interest rates, suggesting that either the returns to larger loans are smaller or smaller loans generate warm glow. A surprising result that exemplifies the presence of warm glow in this type of lending is that previous-year income is not associated with lower interest rates, which typical loaning institutions would certainly take into consideration.

An even more surprising result, relative to the practices of typical banking, concerns the collateral, whose presence actually increases the interest rate. However, this result may be qualified, depending on the type of collat-

eral. Having as collateral a guarantee by an individual, by a "provider," or by a "lender" institution decreases the interest rate, while more typical collateral, such as personal or business assets, has no effect.

Unexpectedly, variables measuring the quality of the project have a limited impact on interest rates. Some variables indicating project quality even have a negative impact on interest rate. For example, the length of the text description, the presence of a business website, being a profit-focused or established business, and appearing to be a serious business (estimated from the pictures) all increase the interest rate. These businesses pay an interest premium of between 3 (for a profit-focused business) and 312 basis points (for an established business).

We further examine variables that capture the SR nature of the project. For example, the fact that the project includes a training dimension appears to be important for MYC4 investors, as it reduces the interest rate by 44 basis points. We also include dichotomous variables indicating the presence of icons related to the UN Millennium Development Goals. While each icon is not individually significant, when grouped these variables become highly significant (F-test statistic $= 4.12$). This might indicate a problem of multicollinearity, which we address below.

Variables measuring the extent to which a project is geared toward women are also included in the regressions and find positive effects. For example, the presence of an icon that indicates that the project will improve maternal health significantly reduces the interest rate by 292 basis points, while each female employee in the business reduces the interest rate by 3 basis points.

Findings regarding environmental variables are mixed. On the one hand, a business plan indicating that the project is good for the environment decreases the interest rate by 22 basis points. On the other hand, the mention of the environment in the project description raises the interest rate by 19 basis points. However, these discrepancies may be attributable to a problem of multicollinearity.

Variables measuring the size of the firm show that MYC4 investors act more favorably toward smaller firms. Dichotomous variables measuring the nature of MYC4 borrowers are also included in the regressions. For example, a dummy indicates whether a large organization (e.g., the Danish Ministry) invests in a particular opportunity. The presence of a large organization increases the interest rate by 1.5 percentage points. This likely reflects that these large organizations offer significantly higher interest rates since, as mentioned above, there is no evidence that these investments crowd out private investors.

Finally, four variables are included that may reflect the previously mentioned possible stereotypes. A smile on the pictures is correlated with lower

TABLE 2
DETERMINANTS OF INVESTORS' REACTIONS

	Interest Rate (1)	Total Bid Time (2)
Activity:		
Farming	. . .	. . .
Shop	.270	1.871
	(.078)***	(.418)***
Salon	.079	1.759
	(.163)	(.786)**
Hotel restaurant	.403	2.391
	(.108)***	(.645)***
Manufacturing	.190	.910
	(.112)*	(.591)
Health	−.692	−1.042
	(.290)**	(1.006)
School	−.756	−1.326
	(.264)***	(1.211)
Other	.073	.447
	(.089)	(.464)
Country:		
Ivory Coast	3.872	4.217
	(.622)***	(3.544)
Ghana	.000	.000
	(.000)	(.000)
Kenya	3.131	−2.641
	(.601)***	(3.430)
Rwanda	3.478	2.950
	(.826)***	(4.246)
Senegal	2.394	−15.586
	(.684)***	(4.818)***
Basic characteristics:		
Loan amount (in thousand euros)	.332	4.383
	(.046)***	(.532)***
Wanted interest rate	.756	−.521
	(.025)***	(.115)***
Transaction costs percentage	.060	−.049
	(.005)***	(.021)**
Transaction costs amount	−.001	−.009
	(.000)***	(.001)***
Payback period	.151	.478
	(.019)***	(.090)***
Income previous year (in million euros)	.851	4.535
	(.784)	(5.221)
2007 year fixed effect	. . .	. . .
2008 year fixed effect	.339	−.920
	(.133)**	(.600)
2009 year fixed effect	1.350	.702
	(.306)***	(1.240)
Average no. of opportunities over the bidding days	.010	.084
	(.001)***	(.006)***
Quality project:		
Length of summary	−.002	.001
	(.001)***	(.004)
Length of text (in thousand characters)	.587	1.822
	(.123)***	(.655)***
Local currency (0 = euros, 1 = local currency)	−.094	3.472
	(.097)	(.733)***

Variable		
Uganda	2.636 (.605)***	−.722 (3.375)
Collateral:		
Collateral (0 = no, 1 = yes)	.866 (.210)***	−1.783 (1.087)
Collateral: guarantor	−.348 (.165)**	.190 (1.164)
Collateral: land	−.109 (.153)	−2.781 (1.204)**
Collateral: personal assets (car, house, furniture)	−.183 (.160)	−3.166 (1.200)***
Collateral: business assets (stock, equipment)	.008 (.161)	−2.614 (1.167)**
Collateral: organization collateral (provider or lender)	−.623 (.205)***	−1.887 (1.500)
Collateral: logbooks	.000 (.000)	.000 (.000)
Collateral: other	.107 (.227)	−3.525 (1.474)**
Value collateral	−.002 (.001)***	−.001 (.002)
Collateral more than 100% of the loan (0 = no, 1 = yes)	.400 (.197)**	−4.091 (1.081)***
Will the borrower agree to let the bank use loan funds to pay suppliers directly?	−.046 (.095)	.767 (.526)
Address (0 = no, 1 = yes)	.171 (.335)	−.516 (1.859)
E-mail (0 = no, 1 = yes)	−.018 (.055)	−.388 (.341)
Website (0 = no, 1 = yes)	.169 (.102)*	−.022 (.533)
Name of business (0 = no, 1 = yes)	−.054 (.039)	−.772 (.237)***
Access to Internet (0 = no, 1 = yes)	.004 (.075)	−.499 (.588)
Icon: established business	3.123 (.532)***	−9.505 (3.214)***
Icon: growth	.147 (.278)	5.826 (2.052)***
Icon: focus on economic profit	.657 (1.624)	4.279 (3.966)
Keyword from the text: profit	.030 (.010)***	.014 (.052)
Pictures: self-explanatory (1–5)	−.012 (.025)	−.024 (.144)
Pictures: serious (1–5)	.078 (.035)**	.862 (.200)***
Pictures: professional dressing (1–5)	−.027 (.040)	−.018 (.248)
Pictures: traditional modern (1–5)	.080 (.037)**	.230 (.216)
Gender:		
Sex (0 = female, 1 = male)	.083 (.073)	.937 (.481)*
Female employees	−.029 (.018)*	−.084 (.068)

TABLE 2 (Continued)

	Interest Rate (1)	Total Bid Time (2)		Interest Rate (1)	Total Bid Time (2)
If yes, what share of the loan can the bank use to pay suppliers directly? (%)	.001 (.002)	−.010 (.009)	Icon: promote gender equality	−.144 (.255)	1.392 (1.565)
Icon: low risk	−2.014 (1.590)	.817 (5.529)	Improve maternal health	−2.924 (.565)***	2.184 (2.787)
SR investment:			Pictures: woman (0 = no, 1 = yes)	−.060 (.098)	−.137 (.567)
Training (0 = no, 1 = yes)	−.439 (.168)***	−2.240 (1.010)**	Pictures: good for women (1–5)	.117 (.073)	.122 (.389)
No. of icons on MYC4 website	.011 (.211)	−1.794 (1.282)	Environment:		
Icon: eradicate extreme poverty	.196 (.294)	3.497 (1.677)**	Keyword from the text: environment	.194 (.059)***	−.028 (.315)
Icon: achieve universal primary	.095 (.257)	2.212 (1.561)	Icon: ensure environmental sustainability	−.310 (.286)	.661 (1.679)
Icon: develop a global partnership	−.120 (.261)	−.535 (1.633)	Icon: environmental damages	−.235 (.520)	.741 (2.480)
Icon: reduce child mortality	.893 (.630)	−.339 (2.768)	Pictures: good for the environment (1–5)	−.220 (.070)***	−1.137 (.416)***
Icon: combat HIV/AIDS malaria	−.373 (.422)	−1.700 (1.908)	Signal from other investors:		
Icon: freedom of association	−1.946 (1.072)*	4.419 (4.399)	Presence of large organization (MYC4 holder's family, Danish ministry)	1.484 (.052)***	2.432 (.310)***
Icon: irresponsible working conditions	−.858 (1.875)	−5.335 (5.121)	Presence of frequent private investor	.491 (.055)***	2.134 (.325)***
Icon: irresponsible health and sanitation conditions	1.675 (.846)**	6.074 (4.267)	Presence of a big private investor (>€2,000)	−.194 (.120)	−3.247 (.961)***
			Presence of a medium investor (>€1,000, <€2,000)	−.069 (.080)	.849 (.655)

	(1)	(2)
Icon: forced labor	.000	.000
	(.000)	(.000)
Keyword from text: SR investment	.029	−.047
	(.011)***	(.067)
Pictures: rich (1–5)	.069	.216
	(.033)**	(.198)
Size of firm:		
Employees	.026	.006
	(.013)*	(.079)
Payroll (in thousand euros)	.002	.017
	(.001)	(.009)**
Icon: no. of employees = 0	−.399	5.296
	(.587)	(3.005)*
Icon: no. of employees = 1–10	−.600	5.194
	(.555)	(2.788)*
Icon: no. of employees = 11–50	−1.257	2.915
	(.609)**	(3.046)
Icon: no. of employees = 51–100	.385	9.594
	(.847)	(4.774)**
Icon: no. of employees = 201–500	−.160	.940
	(.735)	(3.146)
Icon: microinvestment opportunity	.094	−1.098
	(.310)	(2.076)
Icon: macroinvestment opportunity	.294	−3.071
	(.446)	(2.664)
Unclassifiable:		
Pictures: smile (1–5)	−.037	.273
	(.020)*	(.124)**
Pictures: sympathetic (1–5)	.027	−.028
	(.031)	(.183)
Pictures: degrees of blackness (1–5)	−.078	−.325
	(.034)**	(.183)
Pictures: attractiveness (1–5)	−.039	−.518
	(.053)	(.336)
Constant	−12.109	9.849
	(1.304)***	(7.029)
R^2	.71	.45

Note. $N = 3{,}673$; SR = socially responsible. Ordinary least squares regressions; robust standard errors in parentheses.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

interest rates, with results showing that a business with pictures indicating people who are "smiling a lot" (coded 5) has an interest rate decreased by almost 19 basis points compared to a business with pictures of individuals who are "not at all smiling" (1). Looking more friendly or being attractive does not seem to have an impact on interest rates. However, having a darker skin color does decrease the interest rate, with results showing that a business with pictures indicating people who have a "dark skin color" (5) has an interest rate decreased by 39 basis points compared to a business with pictures of individuals who have a "light skin color" (1). This might be evidence of positive discrimination in favor of darker-skinned people, unless darker-skinned people have better repayment rates.

Thus far, results suggest that MYC4 investors derive warm glow from various business characteristics such as being pro-poor, SR, and pro-women. Furthermore, the high R^2 of the regressions (0.71 and 0.45 in table 2, cols. 1 and 2) indicate that our methodology captures most, but not all, of the information on the MYC4 website.

However, these results are subject to multicollinearity. As multicollinearity reduces the significance of coefficients, the insignificant effect of most variables on interest rates might mean that they are truly insignificant or that they are collinear with other variables. For example, the correlation between the sex of the entrepreneur and the fact that there is a woman on the picture is -0.73. For this reason, we aggregate the variables that are classified as being in the same category. Our method of aggregation is a principal components analysis (PCA). A PCA reduces the number of dimensions (variables), without losing much information, by diagonalizing the variance-covariance matrix of the variables in each category and selecting the eigenvector associated with the highest eigenvalue, as the first principal component accounts for as much of the variability in the data as possible. However, this reduction in dimensionality comes at a cost of interpretation, as an eigenvector does not have a natural interpretation.

We construct a score for each of the seven variable categories: SR investment, gender, environment, collateral, quality of project, size of firm, and signal from other investors. In table 3, we present regressions of the following form:

$$\text{interest\_rate}_i = \alpha_1 \text{score\_SRI}_i + \alpha_2 \text{score\_gender}_i + \alpha_3 \text{score\_green}_i$$

$$+ X_i' \alpha + \varepsilon_i.$$

Column 1 presents the results. The scores for SR investment and gender (a higher score indicates pro-female) are significantly related to lower interest

TABLE 3
DETERMINANTS OF INVESTORS' REACTION USING PRINCIPAL COMPONENTS ANALYSIS

	Interest Rate						Total Bid Time
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Score SR investment (SD = 1.44)	−.108 (.026)***			−.094 (.026)***	−.080 (.027)***	−.084 (.030)***	−.465 (.108)***
Score gender (SD = 1.77)		−.071 (.016)***		−.057	−.063	−.081 (.016)***	−.411 (.087)***
Score environment (SD = 1.12)			.034 (.024)	.042 (.024)*	−.005 (.024)	.018 (.024)	−.345 (.123)***
Basic loan characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Collateral variables	No	No	No	No	Yes	No	No
Quality of the project variables	No	No	No	No	Yes	No	No
Size of the firm variables	No	No	No	No	Yes	No	No
Signal from other investors variables	No	No	No	No	Yes	No	No
Unclassifiable variables	No	No	No	No	Yes	Yes	Yes
Score collateral (SD = 1.57)						.098 (.023)***	.693 (.100)***
Score quality project (SD = 1.55)						.041 (.021)*	−.162 (.125)
Score size of firm (SD = 1.50)						.668 (.028)***	.764 (.188)***
Score signal other investors (SD = 1.17)						−.007 (.023)	−.176 (.126)
Observations	4,030	4,025	4,054	4,024	3,673	3,673	3,673
R^2	.55	.55	.54	.52	.67	.60	.38

Note. SR = socially responsible. Ordinary least squares regressions; robust standard errors in parentheses. In cols. 1–6, the dependent variable is the interest rate, and in col. 7, the total bid time. The explanatory variable in col. 1 is a score coming from the principal components analysis. "Score SR investment" is the eigenvector associated with the highest eigenvalue of the diagonalized variance-covariance matrix of the variables related to SR investments. The other scores (for gender, environment, collateral, quality of project, and signal other investors) are built similarly. See table 2 for detailed components comprising each of the seven variable categories, with the following exceptions. First, "income previous year" is included within collateral variables here, not basic loan characteristics, since "income previous year" can be viewed by an investor as a type of guarantee for repayment of the loan. Second, "transaction costs percent" is dropped from table 3 due to high collinearity with "transactions costs amount." Results are similar when adding "transaction costs percent," as in table 2, and available upon request.

* Significant at 10%.

*** Significant at 1%.

rates. One may interpret the results using the standard deviation of the scores. The standard deviation of the SR score is 1.44, while the coefficient is −0.108. Thus, a project 2 standard deviations "more SR" (moving from the mean to the top 2% of the distribution of the SR score) will get a 31 basis point reduction in the interest rate. Similarly, column 2 shows that the standard deviation of the gender score is 1.77, while the coefficient is −0.071. Thus, a project 2 standard deviations "more female" (moving from the mean to the top 2% of the distribution of the gender score) will get a 25 basis point reduction in interest rate. No significant effect of the environment score is found in column 3.

A concern might be that these three scores are also collinear. For instance, a SR project might also be more likely to be undertaken by a woman. Table 3, column 4, addresses this concern by including the three scores together. The magnitude of the coefficients, as well as their significance, remains stable, indicating that the identification of the impact of these scores is not affected by multicollinearity. As additional robustness checks, we then include incrementally more control variables. In column 5, we include the full set of control variables from table 2. In table 3, column 6, instead of including each variable one by one, we include the other scores. The coefficients of the SR and gender score remain significant, and of the same magnitude, independently of the set of controls used. Column 6 presents the preferred parsimonious specification and still explains much of the variation in the interest rate. Column 7 repeats the exercise with the total bid time as a dependent variable and finds similar results for the coefficients of the SR and gender score. Finally, note that in column 6 the collateralized projects, high-quality projects, and projects carried out by larger businesses all command higher interest rates. This raises the question of whether MYC4 allocates funds efficiently. If investors subsidize projects with attributes that are poorly (or negatively) correlated with the project's quality and social value, then peer-to-peer lending may cause capital to be allocated less efficiently. In fact, this investment behavior may provide an incentive for more established entrepreneurs to either (1) move into more traditional enterprises or (2) pretend that their businesses are actually less established, less collateralized, and of a lesser quality. The former may hurt overall economic growth performance; the latter will most likely dilute the ability of real pro-poor, less collateralized projects to signal these characteristics effectively and command lower interest rates. Whether this will happen will depend primarily on the availability of credit alternatives for such established and modern enterprises.

Overall, the results presented in this section indicate that projects that are pro-poor, SR, and pro-female get a significant reduction in the interest

rate. We now turn to repayment and test whether these reductions reflect the fact that these projects generate higher returns or that investors experience warm glow from the mere act of giving discounted rates to these projects.

VI. Determinants of Repayment

A. Methodology

We turn to the determinants of repayment. We estimate the ICC $e = (1/c)(r - R - w)$, where e is effort and, in this particular model, the probability of repayment. We thus relate the repayment probability to the interest rate. Note that warm glow G does not enter as a direct determinant e, as it is internalized through the determination of r: $r^* = w + \{[R - \sqrt{R^2 - 4c(\rho - w - G)}]/2\}$. We include the scores from table 3 to proxy for potentially heterogeneous returns R across projects. This model will measure the elasticity of repayment to interest rates of different projects, as well as repayment performance, net of the interest rate.

We perform regressions of the following form:

$$\text{repayment}_i = \beta_0 + \beta_1 \text{interest\_rate}_i + \delta_1 \text{score\_SRI}_i$$
$$+ \delta_2 \text{score\_gender}_i + \delta_3 \text{score\_green}_i + X_i' \gamma + \varepsilon_i.$$

We use two measures of repayment. The first measure of repayment is the amount that the borrower is in *arrears* as a proportion of the total amount that was owed (principal and interest) when the loan was signed. This enables us to include the approximately two-thirds (67%) of borrowers in our sample who are still in the process of repaying. The second measure will be the *default* among the borrowers whose loan cycle was complete. The average proportion owed for the full sample (including defaulters and borrowers still in their repayment cycle) was 0.093, with the lowest value being −0.91 (someone who was repaying early) and the highest value, 1.16.[9] In the sample of completed loans, the average figure was similar: 0.097. Default, as decided on by MYC4 and the local partners, stood at 11.3%.

The full set of controls from table 3 is included in X_i. However, despite our best efforts, it might be that investors read between the lines and discern information from the website that cannot be easily captured by our methodology. The bias could go either way. "Good" (on unobserved dimensions) business plans might fetch lower interest rates on the website and have higher repayment, introducing a negative bias. However, if Danish investors are socially minded, "deserving" (on unobserved dimensions) business plans might fetch lower interest rates but also have lower repayment, introducing a positive bias.

[9] Because of interest accrual on the late amount, it is possible to have a value greater than one.

Moreover, if entrepreneurs realize that SR projects get more favorable interest rates and respond by changing the nature of their project (or representing it as more SR than it really is) and if this response is correlated with repayment behavior, this could also bias the results. Once again, the bias could go either way—"savvy" entrepreneurs might respond more and have higher repayment, or "unscrupulous" entrepreneurs might respond more and have lower repayment.

Another source of simultaneity arises if MYC4 strategically manipulates the bidding time for some projects. If MYC4 is socially minded, the "deserving" business plans might benefit from an extended period on the website and fetch lower interest rates. As these projects also have lower repayment, this may introduce a positive bias.

A final identification threat comes from the fact that not all borrowers decide to take up their loans, in which case accepted interest rates may not be exogenous, even if offered interest rates are. The take-up decision is likely related to the interest rate and the entrepreneur's private information about her repayment probability.

In order to address reading between the lines, strategic choice of SR characteristics, manipulation of bidding time, or endogenous take-up decisions, we use exogenous changes in the supply of investors caused by newspaper articles featuring the website, to isolate the causal impact of variations in interest rates on loan repayments by African entrepreneurs. Between November 2007 and December 2008, we found 30 newspaper articles (an average of approximately one article every 3 weeks) in seven mainstream Danish newspapers, which may increase the number of investors on the MYC4 website. Out of the 30 articles in total, 12 referred to legislative delays over government foreign aid that could be given as microloans, 11 were prompted by two prizes received by MYC4 (Liberal Freedom Award and Iværkstprisen idealist prize for Mads Kjaer), six explained the government plans to give aid through microloans to MYC4, and one gave a general introduction on Internet microfinance websites (without any quotes by MYC4 employees or mention of the repayment performance of African entrepreneurs).[10]

It is unclear how an increased number of investors affects interest rates. A standard argument predicts that more investors would increase the funds

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[10] Translations of these Danish articles into English are available on request. On the basis of a referee's comments, we exclude from our instrumental variable other newspaper articles that may have been directly prompted by lobbying by MYC4 and that may be directly related to the repayment performance of African entrepreneurs. We exclude one article by Mads Kjaer, MYC4's founder, on his ideology, one article on Mads Kjaer' life history, one article that explained how women may benefit from MYC4, and five articles that contains quotes by MYC4 employees or direct mention of the repayment performance of entrepreneurs.

available and result in higher competition and lower interest rates. However, according to the law of large numbers, an increase in investors should also more accurately predict the true default rate. Thus, if the business plans' risks are overestimated by a small number of investors, then interest rates will fall when more investors join. If, however, the business plans' risks are underestimated, interest rates will increase with more investors. As it is impossible to disentangle these mechanisms, we can only measure the net effect in practice. Finally, this instrument may also affect the interest rates differently on different projects. For example, a newspaper article may attract certain types of investors to the MYC4 website, which may benefit some projects but not others.

B. Results

Table 4 presents the results pertaining to the determinants of repayment. Column 1 estimates repayment as a function of the interest rate, as well as of the variables included in the preferred specification from column 6 of table 3, in a simple ordinary least squares (OLS) framework. As shown in table 4, column 1, a 1 percentage point increase in the interest rate is associated with a 0.7 percentage point increase in the arrears as a proportion of the total loan amount that was due at the signing of the loan.

Table 4, column 2, presents the first stage of the instrumental variable strategy. Interest rate is regressed on the proportion of bidding days in which MYC4 appeared in a newspaper article and on the variables included in the preferred specification from column 6 of table 3. We find that the interest rate is significantly lower for plans with bidding days coinciding with the presence of a newspaper article mentioning MYC4. This is consistent with the hypothesis that more investors are attracted to the MYC4 website when it receives publicity, which in turn increases competition and reduces the interest rates.

Table 4, column 3, presents the second stage of the instrumental variable strategy, where the interest rate is instrumented with the proportion of bidding days in which MYC4 appeared in a newspaper article. The interest rate is negatively related to the probability of repayment, confirming the theoretical predictions. As shown in column 3, a 1 percentage point increase in the interest rate is associated with a 2.4 percentage point increase in the arrears as a proportion of the total loan amount that was due at the signing of the loan. This increase is very large, considering that the average arrears stood at 9.3%.

The instrumental variable coefficient is significantly larger than the OLS coefficient. This points to the presence of endogeneity concerns, such as the ability of investors to read between the lines or the strategic manipulation of

TABLE 4
EFFECTS OF INTEREST RATES AND CHARACTERISTICS OF PROJECTS ON REPAYMENT

| | Full Sample | | | Loans Fully Repaid or Defaulted: Default (1 or 0) | |
	Arrears as % of Total Loan (1)	Interest Rate (2)	Arrears as % of Total Loan (3)	(4)	(5)
Interest rate	.007		.024	.142	.089
	(.002)***		(.014)*	(.065)**	(.044)**
Proportion of bidding days in which MYC4 appeared in a newspaper article		−2.905			
		(.377)***			
Score SR investment	−.003	−.078	−.002	.021	.003
	(.003)	(.029)***	(.003)	(.012)*	(.007)
Score gender	−.000	−.082	.001	.022	.014
	(.002)	(.016)***	(.002)	(.01)**	(.008)
Score environment	−.002	.012	−.002	−.044	−.100
	(.003)	(.023)	(.003)	(.021)**	(.030)***
Score collateral	.007	.068	.006	.000	.006
	(.002)***	(.022)***	(.002)**	(.022)	(.017)
Score quality project	−.004	.038	−.004	−.037	−.013
	(.003)	(.021)*	(.003)	(.016)**	(.012)
Pictures: smile (1–5)	−.011	−.042	−.010	−.029	−.033
	(.004)***	(.023)*	(.004)***	(.01)***	(.008)***
Pictures: friendly (1–5)	.003	.018	.002	.011	.008
	(.005)	(.035)	(.005)	(.014)	(.011)
Pictures: degrees of blackness (1–5)	−.006	−.175	−.003	.010	.012
	(.005)	(.039)***	(.006)	(.017)	(.015)
Pictures: attractiveness (1–5)	.005	−.021	.006	.017	−.008
	(.009)	(.061)	(.009)	(.027)	(.021)
Other control variable from table 3, col. 6	Yes	Yes	Yes	Yes	Yes
Month fixed effects	No	No	No	No	Yes
Observations	3,417	3,673	3,417	1,008	1,008

Note. Cragg-Donald F-statistic = 23.35; SR = socially responsible. Robust standard errors in parentheses. Ordinary least squares regression in cols. 1 and 2; instrumental variable (IV) regression in col. 3; IV probit regression in cols. 4 and 5 (marginal effects at the mean are reported). In col. 1, the dependent variable is the amount that the borrower is in arrears as a proportion of the total amount that was owed (principal and interest) when the loan was signed. The explanatory variable of interest is the interest rate. Column 2 is the first stage of the IV strategy, where "proportion of bidding days in which MYC4 appeared in a newspaper article" is the IV. Column 3 is the second stage. Column 4 restricts the sample to loans fully repaid or classified as defaulted (no further repayments are expected). The dependent variable is thus a dichotomous variable, taking the value one if the loan is in default, zero if it is fully repaid. Column 5 adds month fixed effects.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

SR characteristics of projects. For example, if Danish investors are socially minded and grant lower interest rates to "deserving" (on unobserved dimensions) business plans that also have lower repayment (and more arrears), then an OLS regression of arrears on interest rate is negatively biased. Moreover, if "unscrupulous" entrepreneurs change the nature of their project (or represent it as more SR than it really is) to fetch lower interest rates and have lower

repayment (and more arrears), then an OLS regression of arrears on interest rate is negatively biased. The difference in OLS and instrumental variable coefficients may also be due to the fact that the instrumental variable results identify a local average treatment effect for those businesses that receive a lower interest rate in response to higher website traffic due to these articles. As a newspaper article may attract certain types of investors to the MYC4 website, which may benefit some projects but not others, this may explain why the instrumental variable estimate of the arrears interest rate elasticity is much larger than OLS.

The results presented in table 4 might be sensitive to the definition of repayment used. To test this hypothesis, we use another measure of repayment. Column 4 restricts the sample to loans fully repaid or classified as defaulted (no further repayments are expected). The dependent variable is a dichotomous variable, taking the value one if the loan is in default, or zero if it is fully repaid. The estimation is an instrumental variable probit regression.[11] Results are similar when using this alternate measure of repayment. Again, default is very sensitive to exogenous increases in the interest rate; a 1 percentage point increase raises the default probability (evaluated at the average estimated default of 11.3%) by 14.2 percentage points.

Table 4, column 5, adds month fixed effects (on top of year effects), which helps eliminate any possibility that the timing of the articles was correlated with other factors that predict loan repayment (e.g., perhaps businesses started in the fall tend to have the best repayment, and for some reason articles about MYC4 tend to appear then). Column 5 shows that a 1 percentage point increase raises the default probability by 8.9 percentage points.

To test whether characteristics that commanded lower rates in the bidding reflect improved repayment, we must look at the other explanatory variables that measure the potentially different returns across projects, net of the interest rate. As shown in table 4, column 5, the coefficients on the scores for SR investment, collateral, and gender (developed in table 3) are insignificantly positive. This shows that SR, pro-poor, and gender-focused projects do not have greater returns. Table 3 shows that these projects command lower interest rates. MYC4 investors do not offer lower interest rates to these projects because they repay more but because they generate warm glow enjoyed by MYC4 investors. Similarly, darker-skinned borrowers are no less likely to have arrears. The one exception to this is the variable "smile," which both commands a lower interest rate and is significantly less likely to be associated with either arrears or default.

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[11] Marginal effects at the mean are presented.

C. Discussion

Our results indicate that lenders enjoy warm glow. However, an important question that remains is by how much. As our analysis translates project characteristics into interest rate reductions and variations in interest rates into repayment performance, we can measure the value of different business characteristics.

Recall that the lender's expected payoff π^l is $\pi^l = er + (1 - e)w - \rho + G$. Therefore, if it is not possible to retrieve the collateral, $w = 0$, then the expected payoff is $er - \rho + G$.

Now, take an individual investor i considering to raise the interest rate offered on loan j by 1 percentage point. To determine whether the return to the investor will be positive, let e_j be the proportion of the loan j that will be repaid (which stands at 90.7% since arrears are 9.3%) and $r_{i,j}$ be the interest rate this investor charges; then, $\pi^l_{i,j} = e_j r_{i,j}$. Further, let $\omega_{i,j}$ be the weight (proportion) that investor i contributes to loan j and $\bar{r}_j$ be the final interest rate that the borrower j must pay; then, $\bar{r}_j = \sum_i^n \omega_{i,j} r_{i,j}$. Recall that the average final interest rate $\bar{r}_j$ was 12.6%, and since there are on average 32 bids that fund a loan, the average weight per loan is $\overline{\omega}_j = (1/32)$. Finally, because repayment e_j depends on the final interest rate, not the individual one, the relationship between repayment and an individual interest charge is $e_j = f(\bar{r}_j) = f(\sum_i^n \omega_{i,j} r_{i,j})$, where f' gives us the elasticity of repayment with respect to the final interest rate, which is -2.4, as shown in column 3 of table 4.

Under the assumption that investors do not behave cooperatively, the marginal benefit (in percentage terms) for an investor considering charging loan j a 1 percentage point higher interest rate than the average rate is given by

$$\frac{\partial \pi^l_{i,j}}{\partial r_{i,j}} = r_{i,j} \frac{\partial e_j}{\partial r_{i,j}} + e_j = r_{i,j} \times f' \times \omega_{i,j} + e_j$$

$$= (1.126) \times (1/32) \times -2.4 + 0.907 = 0.82 > 0.$$

In other words, each 1 percentage point increase in the interest rate charged translates into a 0.82% increase in the return received. Hence, the observation that pro-poor, SR, or pro-female projects receive interest rate discounts reflects a negative return to the average investor and is not consistent with profit-maximizing behavior.[12]

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[12] Note that if $\partial e_j / \partial r_{i,j} \simeq 0$ because $\omega_{i,j} \simeq 0$ or $f' \simeq 0$, then an individual investor is always strictly better off seeking the highest possible interest rate while still remaining part of the group of successful bidders. However, given the empirically large repayment elasticity with respect to the inter-

We can use this same calculation to estimate the overall warm-glow value of a given characteristic for a given project j. If, for the average investor, an increase by 1 percentage point in the interest rate raises the effective return by 0.82 percentage points and the average loan size is €1,885, then this 1% increase has a value to this investor of $0.0082 \times (1/32) \times 1,885 = €0.48$. Since there are 32 such investment bids per loan, the combined value of a 1 percentage point change for a given project is $32 \times 0.48 = €15.46$. We find that a project 2 standard deviations more SR (moving from the mean to the top 2% of the distribution of the SR score) will get a 31 basis point reduction in the interest rate and a 25 basis point reduction in the case of female focus. Hence, this reflects a value of €4.79 and €3.86, respectively. Similarly, the results from table 3 suggest that MYC4 investors value a school project at €11.69 and a health project at €10.70 relative to hotels or restaurants. Lending to a business that MYC4 indicates will improve maternal health is valued by as much as €45.20, and the warm-glow value of a starting business is €48.28. These represent substantial amounts, in light of average incomes in these countries.

On the basis of the results from column 4 in table 4, we can also evaluate the impact of these interest rate discounts on the success of the projects. As school projects get a 0.76 percentage point discount in their interest rates (table 2, col. 1) and a 1 percentage point decrease is associated with an 8.9 percentage point decrease in default, then school projects enjoy a $0.76 \times 8.9 = 6.8$ percentage point decrease in their default rate. Recall that the sample average default rate is 11.3%. This is thus equivalent to a 60% decrease in the default rate. Similarly, businesses related to health or providing employee training experience a 54% and 35% decrease in the default rate, respectively ($0.69 \times 8.9/11.3 \times 100$ and $0.44 \times 8.9/11.3 \times 100$). This suggests that warm glow is a key determinant enabling pro-poor, SR, and pro-female projects to succeed.

The total potential for the global efficiency gains is difficult to estimate and depends on the size of the market, in terms of both the overall size of the supply of these characteristics by entrepreneurs in poor countries and the potential size of the group of MYC4 investors. We perform three tests to determine whether the current pool of MYC4 investors provides any indication of the constraints on the size of the market. These tests use the individual bid level information merged in with the business characteristics. First, we investigate whether there are types of investors (who invest in certain types of projects) or whether investors bid on all types of projects but

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est rate, f', investors whose share $\omega_{i,j}$ of a given loan is larger than 19.3% will see a negative marginal benefit to raising interest rates; their optimal strategy should be to reduce interest rates until the repayment level will statistically be equal to 100%.

give interest rate discounts to projects that are pro-poor, SR, or pro-female. We thus consider the decision to invest or not on a particular business plan. In column 1 of table 5, the dependent variable is a dummy equal to one if the investor is bidding a positive amount on a certain business plan, zero otherwise. Thus, the observations for a certain investor, on a certain day, are the menu of projects open for funding. Controlling for investor fixed effects, we still find a significant positive impact of SR and pro-female projects and a negative impact of collateral on the decision to invest. Thus, it does not appear that there are different types of investors; instead these results indicate that investors bid on many projects and prefer projects that generate a warm glow. Second, we provide an additional test to determine whether the sample of investors can be split into a profit-maximizing group and a pro-social group, which would provide some indication that not every investor that joins MYC4 enjoys warm glow. We do so by splitting the investors into two groups: those whose average interest rate offered is above the median and those whose average interest rate offered is below the median. We estimate the same model as in table 4 but this time use the individual bid level information merged in with the business characteristics. Results are presented in table 5, columns 2 and 3, and show that the bid-level analysis generates very similar results. These results also show that both groups of investors value SR and gender nearly the same on the margin. Finally, we test whether new investors are driven more by profit motives than are the earlier investors, as one might expect if the pro-social group is more likely to select in first. We test for this by including a variable that indicates the order in which the investors first participated on the MYC4 website, with higher values representing more recent investors. We then interact this variable with the different controls and similarly add a time trend and interactions between the time trend and the controls. Results are reported in column 4. We find no evidence that newer investors value these project characteristics less. In fact, new investors are more likely to give interest rate discounts to SR projects, gender projects, and environmental projects and higher interest rates to more established projects.

VII. Conclusion

In this article, we seek to answer a very basic question: Do people enjoy warm glow, net of loan repayments, when they lend to poor country enterprises? We find that MYC4 investors do: they give discounted interest rates to pro-poor, SR, and pro-female projects, which we find is not a profit-maximizing strategy. However, these discounted interest rates are causally associated with better repayment from these projects, thus increasing the outreach of microfinance for these projects.

TABLE 5
TYPES OF INVESTORS

	Invest? (0 = No, 1 = Yes) (1)	Interest Rate Bid		
		High Rate Investors (2)	Low Rate Investors (3)	Full Sample (4)
Score SR investment	.0017 (.00023)***	−.078 (.024)***	−.081 (.029)***	.000 (.030)
Score gender	.0004 (.000067)***	−.082 (.019)***	−.094 (.020)***	−.061 (.026)**
Score environment	.002 (.00019)***	−.027 (.026)	−.005 (.025)	.014 (.028)
Score collateral	−.00033 (.00014)**	.024 (.022)	.083 (.028)***	.013 (.030)
Score quality project	.0007 (.000096)***	.073 (.022)***	.096 (.026)***	.007 (.032)
New investor trend				−.054 (.004)***
Score SR investment × new investor trend				−.013 (.005)**
Score gender × new investor trend				−.012 (.002)***
Score environment × new investor trend				−.017 (.004)***
Score collateral × new investor trend				−.001 (.002)
Score quality × new investor trend				.009 (.003)***
Control variables of table 3, col. 6	Yes	Yes	Yes	Yes
Observations		79,603	39,357	118,960
R^2		.73	.59	.71

Note. SR = socially responsible. In col. 1, the dependent variable is a dummy variable equal to one if the investor is bidding a positive amount on a certain business plan, zero otherwise. Thus, the observations for a certain investor, on a certain day, are the menu of projects open for funding. As the size of the full sample is too large to be handled computationally, we performed 100 ordinary least squares (OLS) regressions on a random sample of 500 investors, with replacement. The reported coefficient is the average of the coefficients obtained in each regression. The significance level is obtained by counting the number of regressions in which the coefficient was of the opposite sign as the average coefficient. The explanatory variables in col. 1 are the scores from table 3. Other control variables from the preferred specification of col. 6 of table 3 are included. In cols. 2–4, the database is the individual bid level information merged in with the business characteristics. OLS regressions are performed in cols. 2–4, with robust standard errors in parentheses (clustered on project loan). In col. 2, the sample is restricted to the group of investors whose average interest rate offered is above the median. In col. 3, the sample is restricted to the group of investors whose average interest rate offered is below the median. In col. 4, "new investor trend" is a variable that indicates the order at which the investors first started participating on MYC4, with higher values representing more recent investors. We also interact this variable with the different controls and, similarly, add a time trend and interactions between the time trend and the controls.
** Significant at 5%.
*** Significant at 1%.

To establish this, we use the unique features of this lending platform to follow a two-step procedure. First, we relate project characteristics to interest rates offered. We develop a methodology that attempts to capture all of the information present in the business plans (quantitative data, text, icons,

pictures). We find that pro-poor, SR, and pro-female projects receive significant interest rate discounts from investors. Second, we verify whether these projects are also performing better, on purely financial grounds, in order to explore the profit-maximizing behavior of MYC4 investors. We do this by relating project characteristics and interest rates to loan repayment. Despite our efforts to collect all data from the website, investors may read between the lines and base their decision on unobservables. Moreover, entrepreneurs may strategically manipulate their observable characteristics to get access to loans. To estimate the causal impact of interest rates on repayment, we thus use exogenous shocks to the supply of investors (newspaper articles featuring the website), which are likely to influence interest rates but not the repayment performance of African entrepreneurs.

Consistent with a moral hazard model, we find relatively large repayment elasticities with respect to the (instrumented) interest rate. The net effect on return for lenders of decreased interest rates and increased repayment is negative, indicating that these discounts do not reflect profit-maximizing behavior. This feature of peer-to-peer lending increases the chances of success for pro-poor, SR, and pro-female entrepreneurs, while borrowing from a profit-maximizing lender would not. The policy implication of this article is straightforward: there exist investors willing to subsidize pro-poor, SR, and pro-female projects. The presence of warm glow helps credit markets reach projects that might not be funded by more traditional banks and enables these projects to succeed.

There are two caveats to these otherwise positive findings. First, while the investors offer relatively higher interest rates to, for example, established enterprises or modern businesses, these may in fact be greater drivers of employment than small-scale traditional enterprises such as chicken rearing. This investment behavior therefore provides an incentive for such more established entrepreneurs to either (1) move into more traditional enterprises or (2) pretend that their businesses are actually less established, less modern, more pro-female, and more pro-SR than they really are. The former may hurt overall economic growth performance; the latter will most likely dilute the ability of real pro-poor, SR, and female-focused projects to signal these characteristics effectively and command lower interest rates. Whether this will happen depends primarily on the availability of credit alternatives for such established and modern enterprises. In a market where there is competition between formal banks, such enterprises are likely to have access to alternative sources of credit at favorable rates, thus pushing these borrowers into this market rather than undertaking alternative "traditional" enterprises or cheating on the sig-

nals given. In fact, to avoid an influx of established businesses cheating on signals, pro-poor, SR, and female-focused projects may actually benefit from a certain interest rate buffer between formal banks and rates offered on the MYC4 website. Finally, whether peer-to-peer microfinance lending will extend outreach depends on the presence of substitution effects between traditional avenues for charitable giving that, in turn, provide loans to the poor (perhaps even at lower interest rates) and peer-to-peer lending. This empirical question is beyond the scope of this article but an important one to answer in considering its impact on outreach.

References

Andreoni, James. 1993. "An Experimental Test of the Public-Goods Crowding-Out Hypothesis." *American Economic Review* 83, no. 5:1317–27.

———. 1995. "Cooperation in Public Goods Experiments: Kindness or Confusion?" *American Economic Review* 85, no. 4:891–904.

———. 2006. "Philanthropy." In *Handbook of Giving, Reciprocity, and Altruism*, ed. Serge-Christophe Kolm and Jean Mercier Ythier, 1201–69. Amsterdam: North-Holland.

Andreoni, James, and John Miller. 2002. "Giving according to GARP: An Experimental Test of the Consistency of Preferences for Altruism." *Econometrica* 70, no. 2:737–53.

Andreoni, James, and Ragan Petrie. 2008. "Beauty, Gender, and Stereotypes: Evidence from Laboratory Experiments." *Journal of Economic Psychology* 28, no. 1:73–93.

Banerjee, Abhijit V., and Andrew F. Newman. 1993. "Occupational Choice and the Process of Development." *Journal of Political Economy* 101, no. 2:274–98.

Besley, Timothy, and Maitreesh Ghatak. 2007. "Retailing Public Goods: The Economics of Corporate Social Responsibility." *Journal of Public Economics* 91, no. 9:1645–63.

Dehejia, Rajeev, Heather Montgomery, and Jonathan Morduch. 2005. "Do Interest Rates Matter? Credit Demand in the Dhaka Slums." ADBI Discussion Paper no. 37, Asian Development Bank Institute, Tokyo.

Demirgüç-Kunt, Asli, Thorsten Beck, and Patrick Honohan. 2007. "Finance for All? Policies and Pitfalls in Expanding Access." World Bank policy research report, World Bank, Washington, DC. http://siteresources.worldbank.org/INTFINFORALL/Resources/4099583-1194373512632/FFA_book.pdf.

Duarte, Jefferson, Stephan Siegel, and Lance Young. 2009. "Trust and Credit." American Finance Association 2010 Atlanta Meetings Paper, Social Science Research Network. http://ssrn.com/abstract=1343275.

Elfenbein, Daniel, and Brian McManus. 2010. "A Greater Price for a Greater Good? Evidence That Consumers Pay More for Charity-Linked Products." *American Economic Journal: Economic Policy* 2, no. 2:28–60.

Giving USA Foundation. 2011. *The Annual Report on Philanthropy for the Year 2010.* Chicago: Giving USA Foundation.

Karlan, Dean, and Jonathan Zinman. 2008. "Credit Elasticities in Less Developed Countries: Implications for Microfinance." *American Economic Review* 98, no. 3: 1040–68.

Landry, Craig, Andreas Lange, John List, Michael Price, and Nicholas Rupp. 2006. "Toward an Understanding of the Economics of Charity: Evidence from a Field Experiment." *Quarterly Journal of Economics* 121, no. 2:747–82.

Microcredit Summit Campaign. 2006. State of the Microcredit Summit Campaign Report, Microcredit Summit Campaign, Washington, DC. http://www.microcredit summit.org.

Morduch, Jonathan. 2000. "The Microfinance Schism." *World Development* 28, no. 4:617–29.

Palfrey, Thomas R., and Jeffrey E. Prisbrey. 1997. "Anomalous Behavior in Public Goods Experiments: How Much and Why?" *American Economic Review* 87, no. 5:829–46.

Pope, Devin G., and Justin Sydnor. 2008. "What's in a Picture? Evidence of Discrimination from Prosper.com." Working paper, Social Science Research Network. http://ssrn.com/abstract=1220902.

Stiglitz, Joseph E., and Andrew Weiss. 1981. "Credit Rationing in Markets with Imperfect Information." *American Economic Review* 71, no. 3:393–410.