A Comment on Meza and Webb: *Too Much Investment - A Problem of Asymmetric Information*

Manuela Hungerbuhler Lopes

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1 Introduction

2 The Basic Model

3 Comparison with the Stiglitz-Weiss Model

4 The Form of Contracts

5 Conclusion
The Paper

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Outline
Introduction
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Too Much Investment: A Problem of Asymmetric Information
David De Meza and David C. Webb
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Aim

- Investigate how asymmetric information affects aggregate investment and the financial structure of firms.
- Propose a simple competitive model and compare the results obtained with a simplified version of the model in Stiglitz and Weiss (1981).
Asymmetric information may give rise to an adverse selection problem that causes "poor" projects to drive out "good ones" (like Arkelof’s *lemons’ principle*).

On the other hand, in the model presented in the paper, asymmetric information implies that good projects draw in bad.
The Basic Model
Entrepreneurs

- Continuum of risk-neutral entrepreneurs, each endowed with a project.
- Initial wealth of $W < K$.
- Projects:
  - Initial investment of $K$.
  - Yield the same return of $R^s$ if successful and $R^f$ if a failure. With $R^s > R^f > 0$.
  - Differ in their success probabilities, $p_i(R^s) \in [0, 1]$.
  - Project $i$ is ”better” than project $j$ if $p_i(R^s) > p_j(R^s)$. 
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- Entrepreneurs either invest $W$ entirely on their project, or in a safe asset.
- External finance is raised by issuing debt: $B = K - W$. 
Project Financing

Definition (Debt Contract)

A pair \((B, r_i)\) in which \(B\) is the amount loaned and \(r_i\) is the interest rate charged to entrepreneur \(i\). It establishes repayment of:

- \(B(1 + r_i)\) in non-bankruptcy states
- \(R^f\) in case of bankruptcy (maximum recovery by banks)

Assumption

- \(R^s > (1 + r_i)B > R^f\)
- Limited liability.

Entrepreneur \(i\)’s return on his project:

\[
\pi_i = \max[R^s - (1 + r_i)B, 0]
\]
Entrepreneurs’ Decision-Making

Definition

Let $\rho$ be the safe rate of interest.

- Each entrepreneur wishes to maximize expected profit:
  \[ E\pi_i = p_i(R^s)(R^s - (1 + r_i)B) \]  
  \[ (2) \]

- Entrepreneur will want to take on his project if:
  \[ E\pi_i \geq (1 + \rho)W \]  
  \[ (3) \]

Remark

The entrepreneur’s expected profit is increasing in $p_i(R^s)$. 

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- Entrepreneur will want to take on his project if:
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Identical, competitive, risk-neutral (expected) profit maximizers.

Obtain funds from depositors at the rate $\rho$.

Have no prior information on the characteristics of individual entrepreneurs.

However, they do know the distribution of success probabilities $F(p_i(R^s))$, with density function $f(p_i(R^s))$. 
The Asymmetric Information Problem

Entrepreneurs hold private information on their success probabilities. But after a project has been undertaken, its outcome (success or failure) is known by both the entrepreneur and the bank.
Remark

Only pooling equilibria are considered.

Definition (Marginal Project)

- The *marginal project* is the one for which (3) holds with equality. In other words, it is the project that earns the entrepreneur a zero expected profit.
- Let $\bar{p}$ be its success probability.
In a pooling equilibrium the loan contract \((B, r)\) earns the bank expected profit of:

\[
E\pi_B = (1 + r)B \int_{\bar{p}}^{1} p_i(R^s)f(p_i)dp_i \\
+ R^f \int_{\bar{p}}^{1} (1 - p_i(R^s))f(p_i)dp_i - (1 + \rho)B(4)
\]
Assumption

$\rho$ is not decreasing in the volume of bank borrowing.
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Supply of Credit equals Demand for Credit

Proposition 1
An equilibrium must be market clearing.
Reasoning

- If the equilibrium were characterized by credit rationing, a bank could make a small rise in the interest rate it charges its borrowers without reducing its volume of loans. When \( r \) rises, \( \bar{p} \) also rises and so not only does the bank’s revenue from successful projects rise, as does the average success probability. If so, the banks would expect to profit from a rise in the interest rate.

- If the interest rate were above the market clearing level so as to entail excess supply of credit, banks would be making positive expected profits. Competitiveness would lead banks to take small cuts in their interest rate to try and expand their volume of loans, until it reached its market clearing value.
The Socially Efficient Solution

First-best

All projects that satisfy

\[ p_i(R^s)R^s + (1 - p_i(R^s))R^f \geq (1 + \rho)K \]  

should be undertaken.

All projects whose expected returns are at least as high as their opportunity cost should be undertaken.
The Overinvestment Result

Proposition 2

At the competitive equilibrium investment exceeds the first-best level.
Reasoning

If investment were less or equal to the first-best level, less deposits would be need, meaning that rate payed by banks on deposits would not exceed its first-best value. The marginal project’s success probability would be higher than at the first-best solution and so, for this marginal project:

\[ \bar{p} R^s + (1 - \bar{p}) R^f \geq (1 + \rho) K \]
and
\[ \bar{p}(R^s - (1 + r)B) = (1 + \rho)W \]

But \( B = K - W \) thus:

\[ \bar{p}(1 + r)B + (1 - \bar{p})R^f \geq (1 + \rho)B \]

Since the marginal project happens have the lowest success probability among the financed projects, the banks would expect to make positive profits on all projects, which is inconsistent with a zero-profit equilibrium.
Proposition 3

A tax on interest income can achieve social efficiency.
Comparison With The Stiglitz-Weiss Model
Stiglitz and Weiss (1981) aim to show that *in equilibrium* credit rationing may arise in the loan market.

The authors propose a simplified version of the Stiglitz-Weiss model and use it to compare results, in an attempt to establish how different assumptions on the distribution of project returns affect the loan market.

The main difference between the models is that in Stiglitz and Weiss all projects have the same expected return but differ in their dispersion, whereas in Meza and Webb the projects have different expected returns.
Entrepreneurs

- Continuum of risk-neutral entrepreneurs, each endowed with a project.
- Initial wealth of $W < K$.
- Projects:
  - Initial investment of $K$.
  - Yield $R_i^s$ if successful and $R_i^f$ if a failure. With $R_i^s > R_i^f > 0$.
  - Yield the same expected return, such that for all $i$:
    \[
    p_i(R_i^s)R_i^s + (1 - p_i(R_i^s))R_i^f = \text{constant}
    \]  
    (6)
  - Assume $R_i^f = R^f$, for all $i$. 

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- \(R^f\) in case of bankruptcy (maximum recovery by banks)

Assumption

- \(R^s_i > (1 + r_i)B > R^f\)
- Limited liability.

Entrepreneur \(i\)’s return on his project:

\[
\pi_i = \max[R^s_i - (1 + r_i)B, 0]
\]
Entrepreneurs’ Decision-Making

- Entrepreneur will want to take on his project if:

\[ E \pi_i = p_i(R_i^s)(R_i^s - (1 + r_i)B) \geq (1 + \rho)W \]  

\[ (8) \]

**Remark**

- From (6), \( p_i(R_i^s) \) is inversely proportional to \( R_i^s \).
- The entrepreneur’s expected profit is decreasing in \( p_i(R_i^s) \):

\[ \frac{dE_{\pi_i}}{dp_i(R_i^s)} = R_i^s - (1 + r_i)B + p_i(R_i^s) \frac{dR_i^s}{dp_i(R_i^s)} = R^f - (1 + r_i)B < 0 \]
Banks

- Identical, competitive, risk-neutral (expected) profit maximizers.
- Have no prior information on the characteristics of individual entrepreneurs.
- However, they do know the distribution of success probabilities $G(p_i(R_i^s))$, with density function $g(p_i(R_i^s))$. 
In a competitive pooling equilibrium, the debt contract \((B, r)\) earns the bank an expected profit of

\[
E\pi_B = (1 + r)B \int_{0}^{\bar{p}} p_i(R_i^s)g(p_i)dp_i + R^f \int_{0}^{\bar{p}} (1 - p_i(R_i^s))g(p_i)dp_i - (1 + \rho)B(9)
\]

**Remark**

In the first model, the limits of integration were \(\bar{p}\) and 1, since the entrepreneurs’ expected profits were increasing in \(p_i(R_i^s)\). However, in this second model, the relationship is inverted and so, given the interest rate \(r\), it is the lower success probability projects that yield the entrepreneurs the highest expected profits.
Stiglitz and Weiss’ Main Result

Proposition 4

A credit rationing equilibrium may exist.
The inverse relationship between the interest rate charged and the marginal project success probability $\bar{p}$ implies that when raising the interest rate, banks face a trade-off:

- A higher revenue in case of success
- A lower average probability of success of their pool of loans, brought about by the change in the mix of applicants (the adverse selection effect)

The adverse selection effect may outweigh the revenue effect.
The Socially Efficient Investment Level

First-best

Projects should be financed if and only if their expected gross return is at least as high as the safe return.

Hence, all projects that are financed should satisfy:

\[ p_i(R_i^s)R_i^s + (1 - p_i(R_i^s))R^f - (1 + \rho)K \geq 0 \]  (10)
Proposition 5

At the competitive equilibrium investment falls short of the first-best level.

Remark

This proposition holds true whether the market clears or not.
Reasoning

- If in equilibrium investment equals or exceeds its socially efficient level, then:
  \[ p_i(R^s_i)R^s_i + (1 - p_i(R^s_i))R^f - (1 + \rho)K < 0 \]
  for every project financed, since their expected returns are all equal.

- The marginal project applying for credit is such that:
  \[ p_i(R^s_i)(R^s_i - (1 + r)B) = (1 + \rho)W \]

- Implying that the banks would expect to break even or suffer loss on the marginal project:
  \[ p_i(R^s_i)(1 + r)B + (1 - p_i(R^s_i))R^f \leq (1 + \rho)B \]

- But in this model the marginal project is the one that has the highest success probability out of those applying for loans.

- Therefore banks expect losses on the intramarginal projects.
Subsidy as a Solution

Proposition 6

A subsidy on interest income can achieve social efficiency.
The possibility that there may be credit rationing in the Stiglitz-Weiss model is not the reason for the difference in results yielded by the models under comparison. In fact, this is established by the proposition that follows.
Credit Rationing Actually Softens the Underinvestment Problem

Proposition 7

If $\rho$ is increasing in the volume of bank borrowing, then investment is higher in a credit-rationing equilibrium than at the market-clearing interest rate.
Propositions (5) and (7) imply

Corollary 1

Prohibiting credit rationing yields an efficiency loss.
In both models, in equilibrium, high-success probability entrepreneurs subsidize low-success probability investments.

In the model proposed by the authors, the marginal project financed has the lowest success probability, whereas in the Stiglitz-Weiss model it has the highest.
The Form of Contracts
As a result of asymmetric information, cross-subsidization takes place in both models. Therefore entrepreneurs with higher than average success probabilities will put up $W$ to finance their projects. Banks know this and will require maximum self-finance in the contracts. Entrepreneurs who do not invest $W$ in their projects will signal to the banks that their projects are worse than average.
Proposition 8

For the first model, equilibrium requires that all firms are debt financed.
Proposition 9

For the second model, the equilibrium method of finance is an equity contract.
In the Stiglitz-Weiss model the first-best solution can be achieved if all equity finance obtains, since all projects have the same expected returns and are thus equally attractive to investors, which eliminates the adverse selection problem.
Conclusion

With asymmetric information, the financial structures of firms and the efficiency properties of the equilibrium level of investment depend upon the distribution of project returns. When projects have the same expected return (Stiglitz and Weiss):

- Equity finance can achieve social efficiency.
- If only debt is feasible, the competitive equilibrium yields too little investment. Subsidy on the interest rate as a solution.
- Underinvestment problem is less severe under credit rationing.
Conclusion

When projects have different expected returns:

- Debt is the equilibrium financial contract.
- Overinvestment results.
- A tax on the interest rate would restore efficiency.
- The overinvestment result as a novelty.