MIT 14.76/760: Firms, Markets, Trade and Growth
Sp 2026, Lectures 9-10: Credit

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Firms and their input choices

- We have been studying misallocation via the wedges (in the case of two types of inputs, capital K and labor L):

$$\mu_{Ki} \equiv \frac{VMPK_i}{r} \equiv \frac{p_i}{r}\frac{\partial F_i(K_i, L_i)}{\partial K_i} \quad \text{and} \quad \mu_{Li} \equiv \frac{VMPL_i}{w} \equiv \frac{p_i}{w}\frac{\partial F_i(K_i, L_i)}{\partial L_i}$$

- Today we will look at the case of capital in more depth
- Is a "lack" of capital holding some firms back?

A simple model of firms and their demand for inputs

- Consider a firm that produces its good using K and L, via the production function $Q_i = F_i(K_i, L_i)$
- For simplicity, imagine it takes the output price p_i as given (i.e. competitive output market)
- For both inputs, imagine that (e.g. for case of capital that the firm buys, by borrowing the money to do so) the input costs the firm $r(1 + \tau_{Ki})$ to use.
  - The r part is what the lender gets. This firm takes r as given (i.e. competitive capital market – this firm getting a larger loan won't affect r).
  - The τ_{Ki} is an "as-if" tax (or subsidy, if τ_{Ki} is negative) that allows for the possibility that getting a loan actually costs more (or less, if negative) per unit than r. Since we are treating this value as arbitrary it doesn't matter (for our goals) whether the firm takes it as given or can affect it.
- So the firms's effective profits are:

$$p_i Q_i - w(1 + \tau_{Li})L_i - r(1 + \tau_{Ki})K_i$$

A simple model of firms and their demand for inputs

- If the firm maximizes these profits, its choices will follow the FOCs

$$(1+\tau_{Ki})r = p_i \frac{\partial F_i(K_i, L_i)}{\partial K_i} \quad \text{and} \quad (1+\tau_{Li})w = p_i \frac{\partial F_i(K_i, L_i)}{\partial L_i}$$

- Comparing to the definition of wedges earlier, we see that

$$\mu_{Ki} = (1+\tau_{Ki}) \quad \text{and} \quad \mu_{Li} = (1+\tau_{Li})$$

- So the fact that firms pay different "as-if" prices for inputs (i.e. dispersion in τ_{iL} and/or τ_{iL} across i) is the underlying source of misallocation (i.e. dispersion in μ_{Ki} and/or μ_{Li})

What about capital in particular?

- We will look briefly at firms' choices about labor inputs (and what this reveals about μ_{Li})
- But main goal today is to look at firms' choices about capital (and thereby μ_{Ki}) in particular
- What might make capital different from labor?

What makes credit markets unique?

- 2 fundamental challenges:
  1. *Asymmetric information* in borrower-lender relationship
  2. *Limited liability* of borrowers (so lender will have to bear some of borrowers' downside risk)

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- These two features will typically combine to cause 2 different reasons (not mutually exclusive) for borrowers to default on loans:
  1. *Adverse selection:* Borrower's type not known to lender.
  2. *Moral hazard:* Borrower's actions not known to lender.
- (See optional appendix slides for a few simple examples of models with AS and MH.)

- If either problem arises, end result is that theory predicts we would see a *credit constraint*: lenders will offer a contract of form: "The interest rate is r but you can only borrow up to the limit of $K_i^{\max}$."

Why might credit markets be different in poorer settings?

- First, imagine that lenders' technologies and borrowers' investment opportunities (ideas, skills, product markets, etc) are the same in all countries.
- Poor borrowers (i.e. ones with little of their own wealth) can't post as much *collateral* to overcome the challenge posed by limited liability
- Poor countries may also have features that hinder markets for even similarly collateralized loans:
  - Weaker legal institutions
  - Weaker administrative capabilities for formalizing asset ownership ("title")
  - Weaker administrative capabilities for solutions such as credit registries
  - (?) Greater ability for delinquent borrowers to run and hide
- Finally, technology of lending may have IRTS to it. This could make it harder to profitably lend to poor borrowers. (May even exacerbate problems of AS/MH.)

Credit Access and Growth: The Macro Perspective

- 3 important studies aim to estimate aggregate ("economy-wide") impacts of better developed financial systems and/or deeper access to credit:
  1. King and Levine (1993): cross-country correlations between growth and level of financial development during 1960-89
  2. Rajan and Zingales (1998): comparisons of financial development across country-industry pairs
  3. Burgess and Pande (2005): evaluation of rural bank expansion program by drawing comparisons across Indian states and over time (see optional appendix slides if interested in this paper).
- Main finding is that there do appear to be large estimated effects of financial development/access on aggregate productivity—see the appendix slides for (optional) details on these papers

How costly are credit market failures (in theory)?

- As discussed above, AS/MH (+LL) can lead to a *credit constraint*: bank will lend at rate r but will only lend this firm a max of $K_i^{\max}$.
- P-set exercise: if this credit constraint binds, show that such a firm will act as if it has some value of $\tau_{Ki} > 0$...
- So the severity ("tightness") of the credit constraint ends up driving $\tau_{Ki} > 0$ and hence the wedge $\mu_{Ki} = (1 + \tau_{Ki})$

How costly are credit market failures (in the data)?

- How could we empirically evaluate the size of the wedge $\mu_{Ki} \equiv \frac{VMPK_i}{r} = (1 + \tau_{Ki})$?

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- ...Simply measure $VMPK_i$ and r (the interest rate received by the lender on the marginal unit borrowed)... but how?
- Measuring $VMPK$ is a challenging problem. Could we just regress (value of) output on capital?
  - No. Inputs (e.g., capital) are endogenously chosen by firms that know more than the econometrician about their productivity $\implies$ error term is correlated with dependent variables. (E.g. firm that gets positive productivity shock may follow it up with capital investment.)
- Idea in de Mel, McKenzie, and Woodruff (2008): use an RCT to exogenously shift capital! (But as we shall see, even then it's not quite so easy.)

Sri Lankan Microenterprises

de Mel, Mckenzie, Woodruff (2008)

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  - 205 retail sales establishments (generally grocery-type stores)
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- Firms given an unanticipated shock:
  - Either in cash or materials/capital
  - Either $\sim$ \$100 or $\sim$ \$200 value

Effect of Shock on Input Use and Profits

TABLE II
EFFECT OF TREATMENTS ON OUTCOMES

Impact of treatment amount on:	Capital stock (1)	Log capital stock (2)	Real profits (3)	Log real profits (4)	Owner hours worked (5)
10,000 LKR in-kind	4,793*	0.40***	186	0.10	6.06**
	(2,714)	(0.077)	(387)	(0.089)	(2.86)
20,000 LKR in-kind	13,167***	0.71***	1,022*	0.21*	−0.57
	(3,773)	(0.169)	(592)	(0.115)	(3.41)
10,000 LKR cash	10,781**	0.23**	1,421***	0.15*	4.52*
	(5,139)	(0.103)	(493)	(0.080)	(2.54)
20,000 LKR cash	23,431***	0.53***	775*	0.21*	2.37
	(6,686)	(0.111)	(643)	(0.109)	(3.26)
Number of enterprises	385	385	385	385	385
Number of observations	3,155	3,155	3,248	3,248	3,378

Notes: Data from quarterly surveys conducted by the authors reflecting nine survey waves of data from March 2005 through March 2007. Capital stock and profits are measured in Sri Lankan rupees, deflated by the Sri Lankan CPI to reflect March 2005 price levels. Columns (2) and (4) use the log of capital stock and profits, respectively. Profits are measured monthly and hours worked are measured weekly. All regressions include enterprise and period (wave) fixed effects. Standard errors, clustered at the enterprise level, are shown in parentheses. Sample is trimmed for top 0.5% of changes in profits.
$^{***}p < .01$, $^{**}p < .05$, $^{*}p < .1$

Reduced Form vs. IV

- So far have seen the “reduced form" or “intent-to-treat" (ITT) results: effect of the *treatment* (e.g. cash grant) on profits. Does this estimate the VMPK?

Reduced Form vs. IV

- So far have seen the “reduced form" or “intent-to-treat" (ITT) results: effect of the *treatment* (e.g. cash grant) on profits. Does this estimate the VMPK?
- No! Estimates are (at best) the marginal product of a cash grant, but to get to VMPK have to correct for fact that the cash grant is unlikely to be simply added to firm's capital stock.
- This calls for an IV estimation approach. Can use the treatment assignment (or LKR amount) as an IV in a regression of profits on capital stock:

$$\Pi_i = \alpha + \beta K_i + \varepsilon_i \tag{1}$$

- But what conditions do we need to hold for this to be a valid IV?

3 Further Issues

1. Theory wants $p\frac{\partial Q}{\partial K}$ but IV regression estimates $p\frac{dQ}{dK}$. Authors therefore: (i) subtract off guesstimate of value of owner's applied labor and (ii) demonstrate that effect on hired labor is not statistically significant.

2. Need to assume that p doesn't respond to the treatment (want $p\frac{\partial Q}{\partial K}$ not $\frac{\partial(pQ)}{\partial K}$). Probably not a bad assumption in this context.

3. What if firms have different $VMPK_i$ values like in our model? Then coefficient in (1) is β_i not β. If assume that extent to which a firm responds to the treatment is independent of its β_i, then IV regression identifies average β_i. But this is a strong assumption.

IV results (for 100 Rupee increase in K)

TABLE IV
INSTRUMENTAL VARIABLE REGRESSIONS MEASURING RETURN TO CAPITAL FROM EXPERIMENT

	Real profits IV-FE (1)	Log real profits IV-FE (2)	Real profits 4 instruments (3)	Real profits adjusted (1) IV-FE (4)	Real profits adjusted (2) IV-FE (5)
Capital stock/log capital stock (excluding land & buildings)	5.85** (2.34)	0.379*** (0.121)	5.16** (2.26)	5.29** (2.28)	4.59** (2.29)
First-stage					
Coefficient on treatment amount	0.91***	0.33***		0.91***	0.91***
F statistic	27.81	49.26	6.79	27.81	27.81
Observations	3,101	3,101	3,101	3,101	3,101
Number of enterprises	384	384	384	384	384

Notes: Data from quarterly surveys conducted by the authors reflecting nine waves of data from March 2005 through March 2007. Capital stock and profits are measured in Sri Lankan rupees, deflated by the Sri Lankan CPI to reflect March 2005 price levels. Profits are measured monthly. The estimated value of the owner's labor is subtracted from profits in columns (4) and (5), as described in the text. In column (4), the owner's time is valued by regression coefficients from a production function using baseline data; in column (5), we use the median hourly earnings in the baseline sample for each of six gender/education groups. A single variable measuring the rupee amount of the treatment is used as the instrument in columns (1) and (2) and (4) and (5). In column (3), we use four separate variables indicating receipt of each treatment type. Except in column (2), the coefficients show the effect of a 100-rupee increase in the capital stock. All regressions include enterprise and period (wave) fixed effects. Standard errors, clustered at the enterprise level, are shown in parentheses. The F statistic is the partial F statistic in the first-stage regression on the excluded instruments.
***$p < .01$, **$p < .05$, *$p < .1$.

Summary

- Find 5%-6% increase in profits per month: real annual return $> 60\%$
- This exceeds best guess of r: market interest rate on loans from MFIs (12%-20% per annum), from which these firms could presumably be borrowing (though 90% of firms had no form of loans outstanding at time of survey).
- So plausible evidence that $VMPK_i > r$ for these firms on average
- But is this credit constraints at work? Not necessarily. Paper discusses how lack of insurance markets could lead to something similar (household-firm doesn't want to borrow, even if $VMPK_i > r$, as worried about risk of failure).
- But pattern of heterogeneous treatment effects seems more consistent with credit constraints than insurance market failures...

Heterogeneity of Treatment Effects

TABLE V

TREATMENT EFFECT HETEROGENEITY (DEPENDENT VARIABLE: REAL PROFITS)

					Females	Males
	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE	(6) FE
Treatment amount	5.41***	7.35**	5.29***	4.96**	2.83	6.74**
	(2.09)	(2.86)	(2.15)	(2.19)	(2.39)	(3.09)
Interaction of treatment amount with:						
Female owner		−7.51*				
		(4.02)				
Number of wage workers			−3.69			
			(2.38)			
Household asset index			−2.43**		−2.88**	−3.05
			(1.14)		(1.35)	(2.06)
Years of education			1.56***		0.24	2.03**
			(0.59)		(0.78)	(0.82)
Digit Span Recall			3.80**		7.34***	1.84
			(1.88)		(2.32)	(2.80)
Risk aversion				0.54		
				(1.25)		
Uncertainty				−7.82		
				(7.31)		
Constant	3,824***	3,777***	3,823***	3,840***	2,860***	4,700
	(174)	(179)	(175)	(174)	(211)	(283)
Firm-period observations	3,248	3,084	3,149	3,218	1,484	1,510
Number of enterprises	385	365	369	381	174	176

One Puzzle...

- de Mel et al (2008) state that most of the capital that firms buy with their grants is actually *working capital*. Working capital is usually quite divisible/non-lumpy (unlike much fixed capital).
- If returns are truly as large as we have seen, a firm could use its profits to buy small amounts of working capital over time and thereby "save its way out" of the credit constraint over time.
- Why isn't this happening? (Some longer-run follow-up work, mentioned below, shows that there are persistent effects of the experiment. But nothing anywhere close to a "firm saves its way out of the problem" scenario.)

Related Work

- McKenzie and Woodruff (2008) conduct a similar exercise in Mexico
  - Provided cash and in-kind grants of US$140 to self-employed retailers generated returns of 20-33 percent per month one year later (three to five times higher than market interest rates)
- Fafchamps et al. (2014) in Ghana
  - Provided cash grants equivalent to US$120 to micro-enterprises generated returns of over 15 percent per month one year later
- Many other studies too. Seems to be robust evidence for high returns to cash/capital (and hence plausibly for credit constraints) among microenterprises (on average) in many contexts.

Longer-Term Outcomes

- De Mel et al. followed up 5 years later (Science, 2012)
  - Found 10-percentage-point-higher enterprise survival rates, and similar $\approx$5% higher (per month) profits for male-owned businesses that received the grants, even 5 years later.
  - This might sound surprising but it's exactly consistent with what we would expect from capital that doesn't depreciate (as working capital might not).
- Blattman & Dercon (2018): Business grant provided to unemployed youth raised earnings one year later
  - But five years later, there were no longer any effects on earnings, employment, or health.

What About Labor?

- We have studied de Mel et al's (2008) seminal "capital drop" experiments and seen evidence for average $VMPK_i$ well above r
- Would we expect a similar finding for the case of labor inputs?

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- Would we expect a similar finding for the case of labor inputs?
- de Mel et al. (2019) later did a "labor drop" experiment (large subsidies for hiring a new worker) on the same Sri Lankan microenterprise sector, so we can find out...

de Mel et al. (2019): impact on total employment

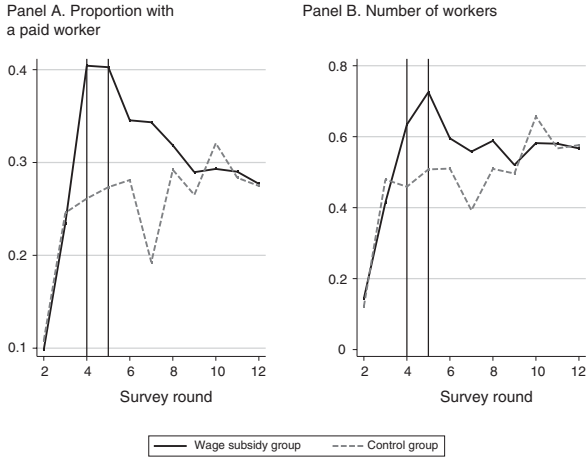


FIGURE 2. IMPACT ON EMPLOYMENT

Notes: The vertical lines show the intervention period. The number of workers truncated at five workers. Round 2 is the baseline for half the sample and first follow-up for the other half.

- So firms took advantage of the subsidized labor and hired more
- And continued to use this extra labor even after the subsidy was over, but eventually this died out (most survey rounds were 6 months apart, so this took a year or two)

de Mel et al. (2019): impact on profits?

TABLE 7—RETURN ON LABOR

	Level of profits				log of profits		
	Associations in control group		Treatment IV estimates		Associations in control group		
	Cross section (1)	Panel data (2)	Unconditional profits (3)	Conditional profits (4)	Cross section (5)	Panel data (6)	IV treatment effect (7)
Number of paid workers	6,214	4,903	2,586	3,270	0.198	0.127	0.131
	(748)	(696)	(6,358)	(5,974)	(0.021)	(0.023)	(0.295)
Sample size	2,670	2,670	959	913	2,320	2,320	892

Notes: Robust standard errors are in parentheses, clustered at the firm level. Regressions control for time fixed effects, randomization strata, and controls used in re-randomization. Columns 1, 2, 5, and 6 use control group only. Columns 3, 4, and 7 use wage subsidy only and control groups. The IV estimates instrument the number of paid workers with assignment to the wage subsidy treatment.

- Comments:
  - Column (3) implies (under the same IV exclusion restriction as the capital drop case) a causal impact of labor on profits of about 2,600 LKR per month.
  - But subsidy was 4,000 LKR per month in this time period.
  - So without the subsidy, profit-return to labor would have been negative. Exactly in line with the pre-existing amount of labor being profit-maximizing at $w(1 + \tau_{Li})$ but with $\tau_{LI} = 0$.
  - (But obviously there are big standard errors around these statements.)

Banerjee and Duflo (2014): Larger Firms

- Are the investment choices of large firms (at least, larger than those studied in de Mel et al.) constrained by a lack of access to credit?
- Idea of the paper: if they are, a shock to cash flow should affect investment decisions
- But problem is that shocks to cash flow may often be related to future profit flows. Why?
  - Shocks to cash flow may actually be correlated with productivity increase... e.g. a new product.
  - Banerjee and Duflo (2014) therefore look at a shock to supply of credit.

Institutional setting

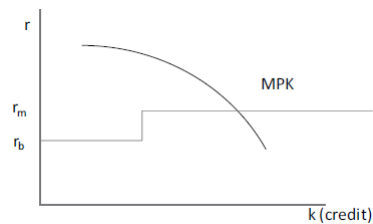
- Indian public banks must have 40% of lending to priority sector, which includes Small Scale Industry (SSI). And this constraint typically binds.
- B&D study changes in the definition of the priority sector (based on firms' capital stocks, at a time when 1 USD $\approx$ 45 Rs).
  - Pre Jan 1998: SSI firms $<$ Rs. 6.5 million [small]
  - Jan 1988-Dec 1999: SSI became $<$ Rs. 30 million [big]
  - Jan 2000: SSI became $<$ Rs. 10 million [medium]
- Banks in private sector can also lend to firms
  - But at a higher rate than the subsidized public banks rate

Data

- For one large bank, data on 253 SSI firms, including 93 with pre-1998 capital $>$ 6.5 million.
  - Data on firms from 1996 – 1999.
  - Data on lending, sales, interest rates
- So what do we expect to happen
  - to profits?
  - to sales?

Two Concepts

1. Credit rationing (with respect to the public/subsidizing bank)
   - The firm wants to borrow more from the public/subsidizing bank (at rate (r_b) but cannot)
2. Credit constraints (with respect to private/non-subsidizing market)
   - The firm wants to borrow more from the market as a whole (at rate (r_m) but cannot)



Impact of policy change on a credit rationed firm

An increase in bank credit for a firm that is credit rationed with respect to the public bank but not constrained with respect to the private market as a whole:

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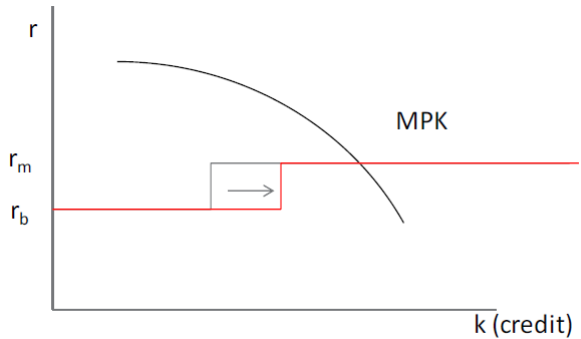

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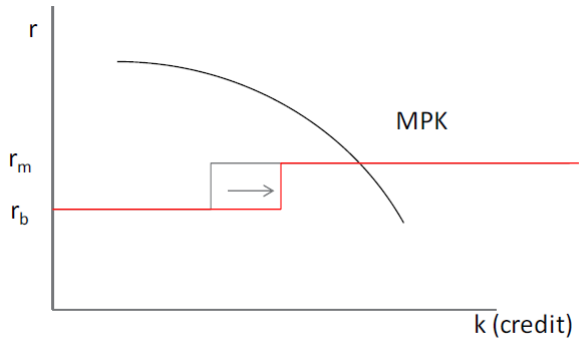

- Substitute public for private credit
- Leads to an increase in profits (cheaper credit!), but not an increase in total loans, investment, or output.

Impact of policy change on a credit constrained firm

An expansion of bank credit for firms that are credit constrained:

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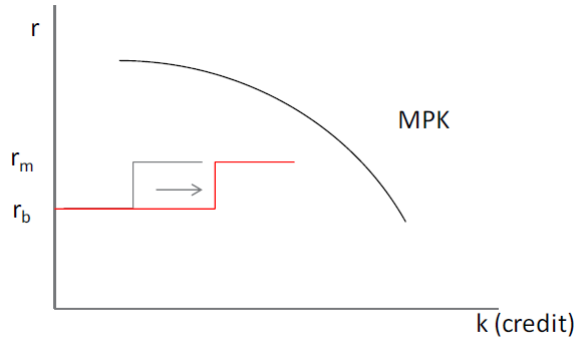

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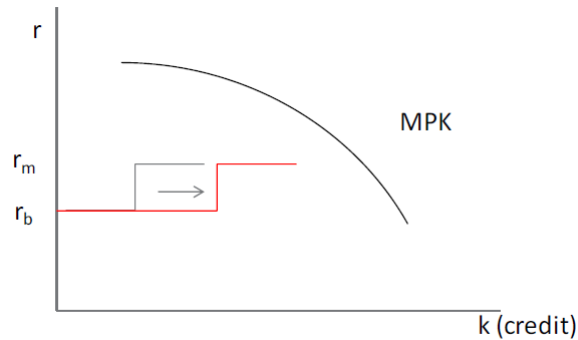


- Will lead to an increase in profit, but also total borrowing, investment, and output

Empirical Predictions

1. If there is credit rationing:
   - Banks should use the extra credit they receive, and profits should go up
2. But if there are credit constraints:
   - Banks should use the extra credit they receive, and profits should go up
   - And sales, investment, and total loans should go up

Results

- "First stage:" Did firms take out the cheaper loans once allowed to by the program?
  - Yes. So results are consistent with credit rationing
  - Also total loans increased, consistent with credit constraints
- "Reduced form": Did sales and profits appear to grow as a result of the program?
  - Yes (but results somewhat noisy)
  - So results are (somewhat tentatively) consistent with credit constraints
- "IV": How large is the implied return to capital (i.e. the effect of capital/loans on profits)?
  - Estimated return of 89.5%, though somewhat noisy of course (if RF is noisy then IV is too)
  - This is higher than typical interest rates, which is consistent with the idea of credit constraints (even for these much bigger firms than in de Mel et al (2008, 2019))

Conclusions

- Financial development seems likely to play a key role in generating firm growth
  - Macro evidence (discussed in optional appendix here) suggests sizable gains
  - Micro evidence (covered here) suggests both small and large firms credit constrained
  - But not always so clear why firms can't "save their way out" of a credit constraint situation
- Caveat: we haven't covered the results from a recent literature on giving microcredit to poor individuals
  - These results are quite mixed/disappointing in terms of generating firm growth
  - But could simply mean that microcredit is in high demand by individuals but mostly not for use in their businesses

Optional Appendix Slide Material Beyond Here...

Implications of limited liability and asymmetric information

- Changes who borrows: makes high interest rates less unappealing to bad borrowers, who don't plan on repaying (**adverse selection**)
- Changes what borrowers choose to do: alters poor borrower's incentives, making default more likely (**moral hazard**)

Adverse selection

An example:

- The bank has 1 unit of credit
- There are two potential borrowers, each need 1 unit of credit for an investment
- So, the bank can only lend to one of the two borrowers
- Assume both the borrowers and the bank are risk neutral
- They only care about the expected return or profit

Adverse selection

The two borrowers have different payoffs for their investments:

	Safe Borrower	**Risky Borrower**
With 50% chance, investment earns:	1.25	1.50
With 50% chance, investment earns:	1.25	0

- The borrowers want to borrow as long as they have a positive return from investment
- Assume the bank knows exactly which borrower is risky and which is safe
  - 1. If the bank lends to the safe borrower, what will be the interest rate, r?
  - 2. If the bank lends to the risky borrower, what will be the interest rate, r?
  - 3. Which borrower does the bank prefer?

Adverse selection

1. If the bank lends to the safe borrower, what will be the interest rate, r?
   - The bank knows the borrower will borrow as long as expected profits > 0
   - Expected Profit $=$
   - He is willing to borrow as long as profit > 0, or $r < 0.25$
   - So the bank can charge up to $r = 25\%$ for the safe borrower

Adverse selection

2. If the bank lends to the risky borrower, what will be the interest rate, r?
   - The bank knows the borrower will borrow as long as expected profits > 0
   - Expected Profit $=$
   - He is willing to borrow as long as profit > 0, or $r < .5$
   - So the bank can charge up to $r = 50\%$ for the risk borrower

Note that the risky borrower is willing to borrow at a higher interest rate than the safe borrower (even though his investment actually has a lower expected return). Why?

Adverse selection

3. Which borrower does the bank prefer?
   - If lending to the safe borrower:
     Profit $=$
   - If lending to the risky borrower:
     Profit $=$
   - So, the bank would prefer the safe borrower

Adverse selection

The two borrowers have different payoffs for their investments:

	Safe Borrower	**Risky Borrower**
With 50% chance, investment earns:	1.25	1.50
With 50% chance, investment earns:	1.25	0

- Now, assume the bank does **not** know which borrower is risky and which is safe
  - 4. Which borrower will receive the loan? At what interest rate, r?

Case 1: $r = 10\%$

Who is willing to borrow?

- The safe borrower: He is willing to borrow as long as the interest rate is less than 25%, because his investment can generate a safe return of 25%
- The risky borrower: He is willing to borrow as long as the interest rate is less than 50%, because:
  - His investment can generate a return of 50% in the good state
  - And he does not have to repay anything in the bad state

Case 1: $r = 10\%$

Is the bank willing to lend?

- Both borrowers will apply for the loan, and the bank cannot tell one borrower from the other, so the chance of lending to each is 50%
- The bank's expected return from lending:

$$\frac{1}{2}\Big\{\text{profits w/ safe borrower}\Big\} + \frac{1}{2}\Big\{\text{profits w/ risky borrower}\Big\} =$$

$$\frac{1}{2}\Big((1+r)-1\Big) + \frac{1}{2}\Bigg(\Big\{\frac{1}{2}\Big\}\Big\{(1+r)-1\Big\} + \Big\{\frac{1}{2}\Big\}\Big\{0-1\Big\}\Bigg) \leftarrow \text{limited liability!}$$

$$= \frac{1}{2}\Big(0.1\Big) + \frac{1}{2}\Bigg(\Big\{0.05\Big\} + \Big\{-0.5\Big\}\Bigg) = -0.175$$

- So, the bank won't lend at r=10%

Case 2: $r = 30\%$

Adverse selection: when r increases, who is willing to borrow?

- The safe borrower cannot make money, will withdraw the loan application
- Only the risky (bad) borrower will apply for the loan

Case 2: $r = 30\%$

Is the bank willing to lend?

- The bank's expected return from lending:

$$1 \cdot \Big\{\text{profits w/ risky borrower}\Big\} =$$

$$1 \cdot \left(\Big\{\frac{1}{2}\Big\}\Big\{(1+r)-1\Big\} + \Big\{\frac{1}{2}\Big\}\Big\{0-1\Big\}\right) \leftarrow \text{limited liability!}$$

$$= \Big\{0.15\Big\} + \Big\{-0.5\Big\} = -0.35$$

- So, the bank won't lend at r=30%
- In fact, even though the bank has raised its interest rates, it is now *worse* off! Why?
  - At high interest rates, only the risky buyer is willing to opt in to the market (because of limited liability)
  - But then the bank is then at greater risk (because of limited liability!)

Case 3: $r = 60\%$

When r increases even further, who is willing to borrow?

- Neither borrower wants to borrow: there's no credit market

Results of adverse selection

A missing credit market

- At a low interest rate, both the safe and the risky borrowers want to borrow; but the bank cannot make money at such a low interest rate
- When interest rate rises, the good (safe) borrower will withdraw, and the market is left with only the bad (risky) borrower; but the bank cannot make money either by lending only to the bad borrower
- When interest rate rises further, the risky borrower withdraw as well, so there is no credit market

Key: this could be alleviated if banks had better information and could distinguish between safe and risky borrowers!

Adverse selection vs. moral hazard

- Adverse selection: limited liability (plus banks' inability to screen) $\Rightarrow$ bad selection into *who* borrows
- Moral hazard: limited liability (plus banks' inability to monitor) $\Rightarrow$ bad *behavior* (effort, project choice) by borrowers

Moral hazard

An entrepreneur is choosing between two projects: low risk vs. high risk

- Each project succeed with some probability, $p \leqslant 1$
- Projects generate profits of Y if they succeed, 0 otherwise
- Average profits: $\text{E(profits)} = pY + (1-p)0 = pY$

	Low Risk	**High Risk**
Investment amount	X	X
Chance of success (percent)	100	50
Return if project succeeds	$1.5X$	$2X$
Return if project fails	–	0
Expected (average) return	$1.5X$	X

$\Rightarrow$ **You'd invest your own money in the low risk project**

Moral hazard

Consider a poor borrower who takes a loan of 10 dollars

- Lender can see whether project succeeds or fails
- Borrower must repay 12 dollars if project is successful
  - Doesn't (can't) repay loan if project fails (limited liability)
- Lender can't see which project was chosen (high vs. low risk)
  - Only observes whether a project succeeds or fails

Moral hazard

Borrower must choose between two projects:

	Low Risk	**High Risk**
Investment amount	10	10
Chance of success (percent)	100	50
Return if project succeeds	15	20
Repayment if project succeeds	12	12
Return if project fails	–	0
Repayment if project fails	–	0
Expected gross return	15	10
Expected net profits after repayment	?	?

Moral hazard

What is borrower's expected net profit?

- **Low risk project**: $1 \cdot [15 - 12] = 3$
- **High risk project**: $\frac{1}{2} \cdot [20 - 12] + \frac{1}{2} \cdot [0 - 0] = 4$

So which project would the borrower invest in?

Moral hazard

Borrower must choose between two projects:

	Low Risk	High Risk
Investment amount	10	10
Chance of success (percent)	100	50
Return if project succeeds	15	20
Repayment if project succeeds	12	12
Return if project fails	–	0
Repayment if project fails	–	0
Expected gross return	15	10
Expected net profits after repayment	3	4

Limited liability makes risky projects more attractive

- With the high risk project, borrowers cut their expected repayments
- Banks are forced to take on the downside risk, can't (costlessly) ensure borrowers choose safe projects

Moral hazard

Now consider a non-poor borrower with some of her own money to invest

- Invests 5 dollars of her own money, borrows (and invests) 5 dollars; must repay 6 dollars if project is successful, repays nothing if failure

	Low Risk	**High Risk**
Investment amount	10	10
Chance of success (percent)	100	50
Return if project succeeds	15	20
Repayment if project succeeds	6	6
Return if project fails	–	0
Repayment if project fails	–	0
Expected gross profits	15	10
Expected net profits after repayment		

Which project will the wealthier borrower choose?

Moral hazard

What is wealthier borrower's expected net profit?

- **Low risk project**: $1 \cdot [15 - 6 - 5] = 4$
- **High risk project**: $\frac{1}{2} \cdot [20 - 6 - 5] + \frac{1}{2} \cdot [0 - 0 - 5] = 2$

Wealthier borrowers borrow less and therefore have more of their own money on the line/less room to benefit from limited liability

Consequences of limited liability

Adverse selection

- Banks cannot easily screen out those borrowers likely to fail
- Raising the interest rate leads to a riskier pool of borrowers

Moral hazard

- Under limited liability, lender and borrower face different incentives.
- Borrowers may take on too much risk, exert too little effort
- When projects fail, bank cannot recover anything

Twin problems of lending to poor borrowers

- They do not have collateral
- Screening and monitoring loan applicants is extremely costly

King and Levine (1993)

- Estimate a cross-countries (c=country) OLS regression of:

$$g_c^{1960-1989} = \alpha + \beta LLY_c^{1960} + \varepsilon_c$$

  where g is the growth rate of GDP/cap and LLY is a measure of "financial depth" of the country (measured as the ratio of liquid liabilities of the financial system to GDP).

- Will this estimate the causal impact of financial development on growth?
  - *Post hoc ergo propter hoc*?
  - Financial markets may develop in anticipation of growth in the future
  - Unobservable country characteristics (e.g. saving propensity) may drive both financial development and growth

King and Levine (1993)

TABLE VIII
GROWTH AND INITIAL FINANCIAL DEPTH: 1960–1989

Independent variable	(1)	(2)	(3)	(4)
c	0.042***	0.035***	0.033***	0.035***
	(0.005)	(0.007)	(0.009)	(0.010)
LYO	−0.014***	−0.016***	−0.016***	−0.014***
	(0.003)	(0.003)	(0.003)	(0.003)
LSEC	0.013***	0.013***	0.013***	0.010***
	(0.002)	(0.002)	(0.002)	(0.003)
GOV in 1960		0.070*	0.072*	0.044
		(0.035)	(0.036)	(0.040)
PI in 1960		0.037	0.032	0.040
		(0.031)	(0.033)	(0.033)
TRD in 1960		−0.003	−0.004	0.001
		(0.006)	(0.006)	(0.001)
Index of civil liberties			0.001	0.001
			(0.002)	(0.002)
Number of revolutions			−0.010	−0.010
			(0.009)	(0.009)
Number of assassinations			−0.001	0.001
			(0.004)	(0.003)
Sub-Saharan Africa dummy				−0.011
				(0.007)
Latin American dummy				−0.010*
				(0.005)
LLY in 1960	0.030***	0.028***	0.028***	0.020**
	(0.007)	(0.007)	(0.008)	(0.009)
R^2	0.57	0.61	0.63	0.66
	(standard errors in parentheses)			

Dependent variable: *GYP* − Real per capita GDP growth, 1960–1989.
Observations: 57
* significant at 0.10 level, ** significant at 0.05 level, *** significant at 0.01 level.
LYO = log of initial real per capita GDP in 1960, *LSEC* = log of secondary school enrollment rate in 1960, *GOV* = government consumption/GDP, *PI* = inflation rate, *TRD* = (imports & exports)/GDP.

Rajan and Zingales (1998)

- Key Idea:
  - Measure growth (over 1980-1990) at country(c)-industry(i) level (with 36 industries and 41 countries): Y_{ic}
  - Financial development ($FDEV_c$) of a country: things like whether modern accounting standards are in use or not
  - Conjecture: in any country, FDEV matters more in industries that are "financially dependent" ($FDEP_i$)
  - How to measure $FDEP_i$? Conjecture that *listed* firms in the US get as much external financing as they want. So US extent of use of external finance reflects the industry's demand, not supply. So use of external finance (e.g. fraction of CAPEX not financed with cash flow from operations) in US is authors' proxy for $FDEP_i$.

- Then end up estimating (FE=fixed effect):

$$Y_{ic} = FE_i + FE_c + \beta(FDEV_c) \times (FDEP_i) + \varepsilon_{ic}$$

- Is this convincing?

Rajan and Zingales (1998)

TABLE 4—INDUSTRY GROWTH AND VARIOUS MEASURES OF DEVELOPMENT

	Financial development measured as					
Variable	Total capitalization	Bank debt	Accounting standards	Accounting standards in 1983	Accounting standards and capitalization	Instrumental variables
Industry's share of total value added in manufacturing in 1980	−0.912 (0.246)	−0.899 (0.245)	−0.643 (0.204)	−0.587 (0.223)	−0.443 (0.135)	−0.648 (0.203)
Interaction (external dependence × total capitalization)	0.069 (0.023)	—	—	—	0.012 (0.014)	—
Interaction (external dependence × domestic credit to private sector)	—	0.118 (0.037)	—	—	—	—
Interaction (external dependence × accounting standards)	—	—	0.155 (0.034)	—	0.133 (0.034)	0.165 (0.044)
Interaction (external dependence × accounting standards 1983)	—	—	—	0.099 (0.036)	—	—
R^2	0.290	0.290	0.346	0.239	0.419	0.346
Number of observations	1217	1217	1067	855	1042	1067
Differential in real growth rate	1.3	1.1	0.9	0.4	1.3	1.0

Rajan and Zingales (1998)

TABLE 8—GROWTH IN AVERAGE SIZE AND NUMBER OF ESTABLISHMENTS

	External dependence measured using					
	All firms		Young firms		Mature firms	
Variable	Growth average size	Growth number	Growth average size	Growth number	Growth average size	Growth number
Industry's share of total value added in manufacturing in 1980	−0.620 (0.217)	−0.312 (0.154)	−0.635 (0.256)	−0.252 (0.179)	−0.624 (0.220)	−0.282 (0.152)
Interaction (external dependence × accounting standards)	0.051 (0.043)	0.115 (0.037)	−0.021 (0.029)	0.078 (0.024)	0.125 (0.055)	0.131 (0.041)
R^2	0.498	0.314	0.500	0.302	0.492	0.310
Number of observations	951	975	899	922	923	947
Differential in real growth rate	0.3	0.7	−0.2	0.6	0.4	0.4

Burgess and Pande (2005)...

The Indian Branch Expansion Program

- Q: Do state interventions in credit markets alleviate financial constraints, and enable individuals to alter their production and employment choices?
  - Alternate possibility: many believe that subsidized credit typically does not reach the poor, and promotes inefficient rent seeking behavior
  - Could even harm poor if alters informal credit markets

- In general hard to see if credit expansion affects poverty:
  - Credit expansions typically driven by increased demand for credit (growing economic opportunities etc.)
  - Hard to find exogenous variation
    - Credit scoring or cutoff rules discontinuities (e.g. subprime, cash for clunkers etc—for US see Mian and Sufi (various)))
    - Roll out of micro finance

- Caveat: this is purely about the effect of bank branches, which presumably brought many things:
  - Ability to save, some jobs, credit, financial advice, spillovers from other clients (increased learning perhaps)

Identification Strategy

- Between bank nationalization in 1969 and financial liberalization in 1990/91 over 30,000 bank branches opened
  - But the placement of these banks was not random! Can't just regress poverty level on bank opening

- Instead will use an *instrument* for where banks opened:
  - Branch licensing rule (1977-1990): a bank must open four branches in un-banked locations to be able to open one in an already banked location (1:4 rule)

Rollout of rural banks

$$B_{it}^{R} = \alpha_i + \beta_t + \gamma_t \times B_{i,1961} + ... + \varepsilon_{it}$$

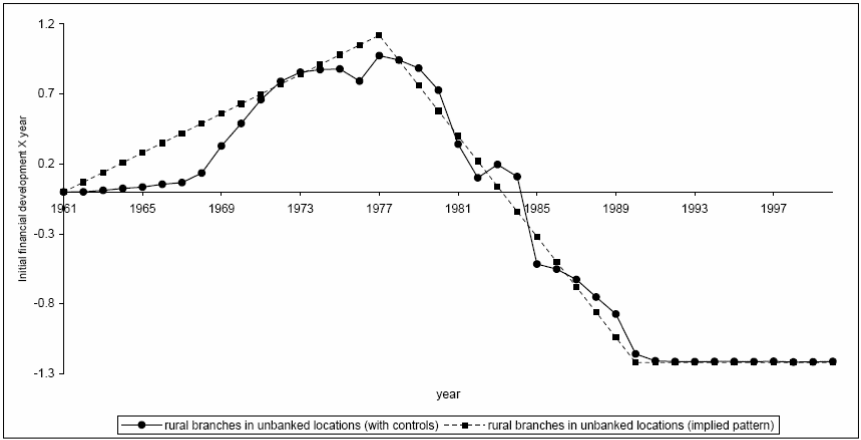


FIGURE 1: INITIAL FINANCIAL DEVELOPMENT AND BRANCH EXPANSION INTO RURAL UNBANKED LOCATIONS

Identification Strategy

- Idea is that this 4:1 policy drove a "quasi-random" (i.e. exogenous) shift in the placement of rural banks
- Then will use this exogenous shift in the placement of banks to look at what happens to poverty in places where these banks were opened

$$\text{4:1 policy} \Rightarrow$$

$$\text{Placement of banks} \Rightarrow$$

$$\text{Poverty reduction}$$

Instrumental variables (brief review)

- Want to regress Y on X, but facing omitted variable bias, i.e. X is an *endogenous regressor*
  - (In our case, want to regress poverty on bank openings, but bank openings are endogenous)
- Find a factor V (*instrumental variable*) that affects X, and only affects Y through its effect on X
  - (In our case, this 4:1 policy – or more specifically, the interaction of year FE x the number of banks in 1961 – which affects the placement of banks but has no direct effect on poverty, other than through the placement of banks)

Instrumental variables (brief review)

- How to calculate the IV effect?
  - First stage

$$X_i = \alpha' + \beta' \cdot V_i + \epsilon_i'$$

    (In our case: regress bank openings on the interaction of year FE x the number of banks in 1961)
  - Second stage

$$Y_i = \alpha + \beta \cdot \widehat{X}_i + \epsilon_i$$

    (In our case: regress poverty on *predicted* bank openings from the first stage

- Basic idea: can use just the part of X (bank openings) driven by V (the 4:1 policy) – i.e. just the exogenous bit of X

Two requirements for IV

There are two key requirements to use an instrumental variables approach:

1. Instrument (V) is correlated with the endogenous regressor (X) (called "first stage")
2. Only channel through which instrument (V) affects outcome (Y) is through the endogenous regressor (X) (called "exclusion restriction")

What does this mean applied to our example?

We can test the first requirement

1. Instrument (V) is correlated with the endogenous regressor (X) ("first stage")

$$B_{it}^{R} = \alpha_i + \beta_t + \gamma_t \, x \, B_{i,1961} + ... + \varepsilon_{it}$$

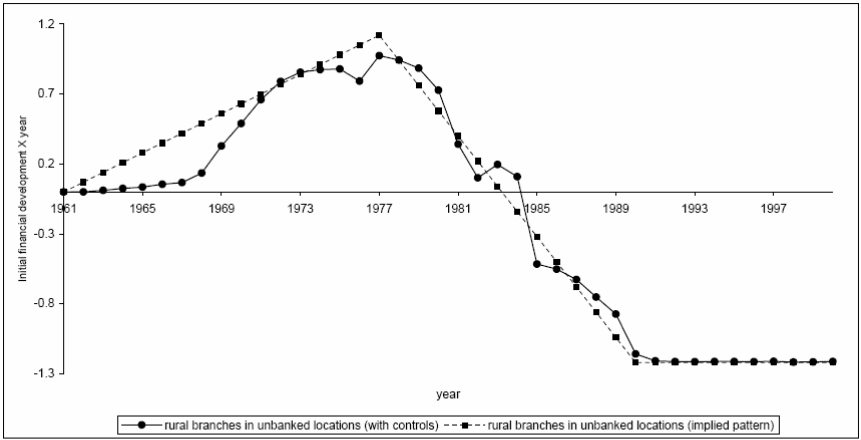


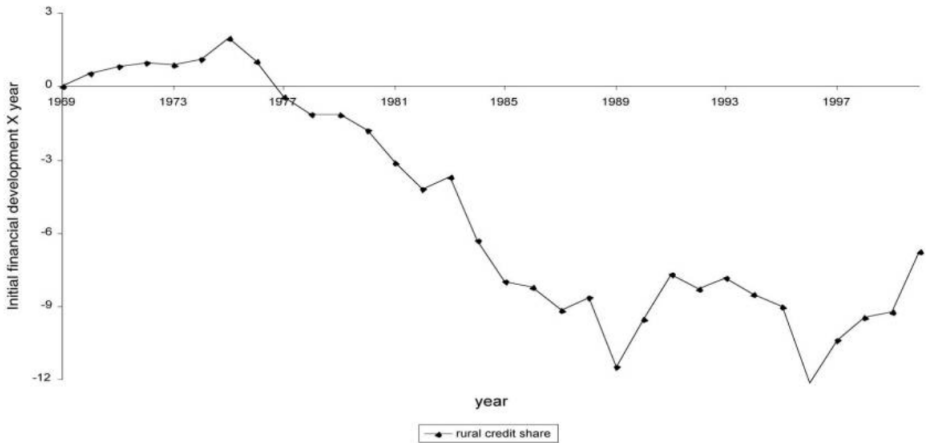
FIGURE 1: INITIAL FINANCIAL DEVELOPMENT AND BRANCH EXPANSION INTO RURAL UNBANKED LOCATIONS

Notes: The series "rural branches in unbanked locations (with controls)" graphs the yearwise coefficients on initial financial development (measured as number of bank branches in

We can test the first requirement

1. Instrument (V) is correlated with the endogenous regressor (X) ("first stage")

$$RuralCreditShare_{it} = \alpha_i + \beta_t + \gamma_t \times B_{i,1961} + ... + \varepsilon_{it}$$



We cannot directly test the second requirement

2. Only channel through which instrument (V) affects outcome (Y) is through the endogenous regressor (X) ("exclusion restriction")

But we can think of examples that might violate it and try to refute them:

- No trend reversals in other government policies (fraction of bank credits to priority sectors, fraction of credits by agricultural cooperatives)
- Pre and post-trends suggest not targeting high growth locations
- More branch expansion in already banked (unconstrained) locations in states with higher initial financial development throughout the sample period

Reduced Form Evidence

- Between 1977 and 1990 rural poverty fell more in financially less developed states
  - The opposite was true outside this period
- Similar patterns for total output per capita, non-primary output and employment, and agricultural wages
- Pattern not found for urban poverty

IV Estimates

- 2nd stage: regress outcomes on predicted rural bank branches
- Instrument bank branches with that sawtooth pattern we saw earlier
  - Deviations from linear state-specific trends due to 1:4 license rule

IV Estimates

TABLE 3: BANK BRANCH EXPANSION AND POVERTY -- INSTRUMENTAL VARIABLES EVIDENCE

	Headcount ratio								Wage	
	Rural			Urban	Aggregate	Rural			Agricultural	Factory
	OLS		IV	IV	IV	IV: 1961-1989	IV: 1977-2000	IV: survey years	IV	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Number branches opened in rural unbanked locations per capita	2.09** (0.79)	1.16 (1.02)	-4.74** (1.79)	-0.66 (1.07)	-4.10** (1.46)	-4.70** (1.82)	-6.84** (2.81)	-4.21* (2.26)	0.08* (0.04)	0.05 (0.08)
Number of bank branches in 1961 per capita * 1961-2000 trend		-0.43*** (0.17)	-0.48 (0.27)	-0.26* (0.13)	-0.46* (0.23)	-0.43 (0.26)	-0.79* (0.44)	-0.46 (0.28)	-0.01 (0.003)	0.01 (0.01)
Post-1976 dummy* (1977-2000) trend		-0.31 (1.23)	-1.42 (2.30)	-2.06 (1.65)	-1.39 (2.03)	-2.13 (2.59)		-1.31 (3.32)	0.04 (0.06)	0.03 (0.06)
Post-1989 dummy*(1990-2000) trend		5.38** (2.47)	-1.08 (2.33)	-0.47 (1.01)	-1.55 (1.75)		-0.45 (2.90)	-0.79 (2.61)	0.11 (0.07)	-0.05 (0.04)
State and year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Other controls	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES
Overidentification test p-value			0.99	0.98	0.99			1	0.98	0.99
R-squared	0.82	0.85	0.78	0.92	0.81	0.8	0.8	0.77	0.98	0.7
Number observations	627	627	627	627	627	460	375	375	545	553

Notes: Standard errors clustered by state are reported in parenthesis. See notes to Table 2 for variable and other controls description. In IV regressions instruments are the number of branches in 1961 per capita interacted with (i) a post-1976 time trend (ii) a post-1989 time trend respectively. Table 1, column (1) reports the corresponding first stage regression. The p-value for an overidentification test due to Sargan [1958] is reported -- number of observations times R-squared from the regression of stage two residuals on the instruments is distributed chi-squared (T+1) where T is the number of instruments.
* indicates significance at 10%, ** at 5% and *** at 1%.

Results

- IV estimate: one more branch per 100,000 people in unbanked rural locations $\implies$ headcount ratio declines by 4.7% pt in rural areas (17% of sample mean)
- No effect on urban poverty, formal (primarily urban) manufacturing
- Wage of agricultural laborers goes up by 8%. Non-primary output increased, agricultural output unaffected. Unregistered manufacturing goes up.
  - Consistent with rural banks helping to move people from primary to secondary sector. Ag. wages rise as supply declines.

Summary of Burgess-Pande

- Rural branch expansion had large negative impact on rural poverty
- Can account for roughly half of fall in rural poverty over the period
- 1:4 license rule helped increase and equalize access to banking services through both savings and credit
- Evidence that access to banking services $\Longrightarrow$ rural diversification $\Longrightarrow$ growth $\Longrightarrow$ poverty reduction