# The (mis)allocation of capital

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**Abstract**

Is capital allocated so that its marginal product is equated to the market interest rate? Is the marginal product of capital equalized across its alternative uses. This paper attempts to answer both of these questions using data from India, and concludes that both these standard properties fail by a wide margin.

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Well-functioning markets are supposed to allocate capital so as to equate its marginal product in all its uses to the interest rate that is paid to savers for their savings. While the prima facie evidence suggests that capital markets in most developing countries do not come close to this ideal, hard evidence is hard to come by, in part because the marginal product of capital is notoriously difficult to measure.

This paper argues that there is a lot that can be said about these issues without ever directly measuring the marginal product of capital: Our strategy makes use of some simple implications of the theory of credit markets, in combination with data that is expressly collected for this purpose. Here we present results from two recent studies based on Indian data, that together create a strong presumption that things on the ground are nowhere near the neoclassical ideal. These results are particularly striking since in both cases the firms in question are large, compared to most Indian firms, and, moreover, have access to credit from the formal banking sector.

# 1 Are firms credit constrained?

**The Strategy**: A firm is credit constrained if the marginal product of capital in the firm is higher than the rate of interest that firm is paying on its marginal rupee of borrowing. Our identification of credit constrained firms is based on the following simple observation:[1] If a firm that is *not* credit constrained is offered some extra credit at a rate below what it is paying on the market, then the best way to make use of the new loan must be to pay down the firm's current market borrowing, rather than to invest more. This is because, by the definition of not being credit constrained, any additional investment will drive the marginal product of capital below what the firm is paying on its market borrowing. It follows that a firm that is not facing any credit constraint will expand its investment in response to additional subsidized credit becoming available, only if it has no more market borrowing. By contrast, a firm that is credit constrained will always expand its investment to some extent.

A corollary to this prediction is that for unconstrained firms, growth in revenue should be slower than the growth in subsidized credit. This is a direct consequence of the fact that firms are substituting subsidized credit for market borrowing. Therefore, if we do not see a gap in these growth rates, the firm must credit constrained. Of course, revenue could increase slower than credit even for non-constrained firms, if the technology has declining marginal returns to capital.

Our test of these predictions takes advantage of a recent change in the so-called priority sector rules in India: All banks in India are required to lend at least 40% of their net credit to the "priority sector", which includes small scale industry (SSI), at an interest rate that is required to be no more than 4% above their prime lending rate. If banks do not satisfy the priority sector target, they are required to

[1] This is based on Banerjee-Duflo (2002).

lend money to specific government agencies at low rates of interest. In January, 1998, the limit on total investment in plants and machinery for a firm to be eligible for inclusion in the small scale industry category was raised from Rs. 6.5 million to Rs. 30 million. Our empirical strategy focuses on the firms that became newly eligible for credit in this period, and uses firms that were always eligible for priority sector credit as a control.

**Data:** The data we use were obtained from one of the better-performing Indian public sector banks. We have data, obtained from the loan folders maintained by the bank, on profit, sales, credit lines and utilization, and interest rates. We have data on 253 firms (including 93 newly eligible firms), which includes 175 firms for which we have data from 1997 to 1999.

**Specification** Through much of this section we will estimate an equation of the form

$$y_{it} - y_{it-1} = \alpha_y BIG_i + \beta_y POST_t + \gamma_y BIG_i * POST_t + \epsilon_{yit}, \tag{1}$$

with $y$ taking the role of the various outcomes of interest (credit, revenue, profits, etc.) and the dummy $POST$ representing the post January 1998 period. We are in effect comparing how the outcomes change for the big firms after 1998, with how they change for the small firms. Since $y$ is always a growth rate, this is, in effect, a triple difference—we can allow small firms and big firms to have different rates of growth, and the rate of growth to differ from year to year, but we assume that there would have been no differential changes in the rate of growth of small and large firms in 1998, absent the change in the priority sector regulation.

Using, respectively, the log of the credit limit and the log of next year's sale (or profit) in place of $y$ in Equation 1, we obtain the first stage and the reduced form of a regression of sales on credit, using the interaction $BIG * POST$ as an instrument for sales (or profit). We will present the corresponding instrumental variable regressions.

**Results**: The change in the regulation certainly had an impact on who received priority sector credit. The credit limited granted to firms below Rs. 6.5 million in plant in machinery (henceforth, small firms) grew by 11.1% during 1997, while that granted to firms between Rs.6.5 million and Rs. 30 million (henceforth, big firms), grew by 5.4%. In 1998, after the change in rules, small firms had 7.6% growth while the big firms had 11.3% growth. In 1999, both big and small firms had about the same growth, suggesting they had reached the new status quo.

This is confirmed when we estimate Equation 1 using bank credit as the outcome. The result is presented in column (2) of Table 1, for the sample of firms where there was a change in credit limit. The coefficient of the interaction $BIG * POST$ is 0.24, with a standard error of 0.09. In contrast, column (1) shows that the probability that the credit limit was changed is not affected by the reform (this corresponds to the general observations that whether or not a file is brought out for a change in limit has nothing to

do with the needs of the firm, but responds to internal dynamics of the bank). Therefore, partitioning the sample into two groups on the basis of whether there was a change in the credit limit does not introduce a sample selection bias, and the sample where there was no change in limit can be used as a "placebo" group, where we can test our identification assumption.

This increase in credit was not accompanied by a change in the rate of interest [column (3)]. It did not lead to reduction in the rate of utilization of the limits by the big firms [column (4)]: The ratio of total turnover (the sum of all debts incurred during the year) is not associated with the interaction $BIG * POST$. The additional credit limit thus resulted in an increase in bank credit utilization by the firms.

This additional credit in turn led to an increase in sales. The coefficient of the interaction $BIG*POST$ in the sales equation, in the sample where the limit was increased, is 0.21, with a standard error of 0.09 [column (5)]. By contrast, in the sample where there was no increase in limit, the interaction $BIG*POST$ is close to zero (0.05) and insignificant [column (8)], which suggests that the result in column (4) is not driven by a failure of the identification assumption. The coefficient of the interaction $BIG*POST$ is 0.24 in the credit regression, and 0.21 in the sales regression: Thus, sales increased almost as fast as loans in response to the reform. This is an indication that there was no substitution of bank credit for non-bank credit as a result of the reform, and that firms are credit constrained.

Additional evidence is provided in column (6). We restrict the sample to firms who have a positive amount of borrowing from the market both before and after the reform, and thus have not completely substituted bank borrowing for market borrowing. In this sample as well, we obtain a positive and significant effect of the interaction $BIG * POST$, indicating that these firms must be credit constrained.

In column (7), we present the effect of the reform on profit. The effect is even bigger than that of sales: 0.75, with a standard error of 0.38. Note that the effect of the reform on profit is due to the gap between the marginal product of capital and the *bank* interest rate: In other words, it combines the subsidy effect and the credit constraint effect. Even if firms were not credit constrained, their profit would still increase after the reform if more subsidized credit is made available to them, because they substitute cheaper capital for expensive capital. Here again, we see no effect of the interaction $BIG * POST$ in the sample without a change in limit [column (9)], which lends support to our identification assumption.

The IV estimate of the effect of loans on sales and profit implied by the reduced form and first stage estimates in columns (2), (5) and (7) are presented in columns (5) and (7) of panel B.[2] Note that the coefficient in column (5) is a lower bound of the effect of working capital on sales, because the reform should have led to some substitution of bank credit for market credit. The IV coefficient is 0.896, with a

[2]The regression presented in column (2) is not the actual first stage, because it uses the entire sample. The actual first stage is very similar: The coefficient of the interaction is 0.23 in the sample used in the sales equation.

standard error of 0.46. Note that it suggests that the effect of working capital on sales is very close to 1, a result which implies that there cannot be an equilibrium without credit constraint.

The IV estimate of the impact of bank credit on profit is 2.7. This is substantially greater than 1, which suggests that the technology has a strong fixed cost component. We can use this estimate to get a sense of the average increase in profit (net of interest) caused by every rupee in loan. The average loan is 96,000 Rupees. Therefore, and increase of Rs. 1,000 in the loan corresponds to a 1.04% increase. Using the coefficient of loans on profits, an increase of Rs. 1,000 in lending therefore causes a 2.7% increase in profit. At the mean profit (which is Rs. 37,000), this would correspond to an increase in profit (net of interest) of Rs. 999. Consistent with firms being credit constrained, this suggests a gap between the marginal product of capital and the interest rate of about 100%. Such a gap is too big to be explained as the subsidy impact of the loans. The average interest rate charged to these firms is about 16%. Given the cost of capital for the bank (no more than 12%), even with the extreme assumption that default (about 7% of the firms in our sample default) leads to total dissipation of the money and taking into account the administrative cost of lending to SSI clients (no more than 7% by our calculations), the break-even interest rate should be no higher 27%, which suggests a subsidy of at most 11%. Even if we use the rate on trade credit for medium-sized firms as the cost of capital, which is usually claimed to be on the order of 2-3% per month, the implied subsidy rate is no more than 30%.

This data does not tell us anything about the efficiency of allocation of capital across firms—it remains possible that capital does have the same marginal product in all its uses. Of course, the fact that savers get paid so much less than what their capital produces does suggest that the allocation of capital across firms is not going to be fully efficient: In this environment, people who have money should prefer to invest it in their own business rather than putting it in a bank. This ought to push the marginal product of capital in their firms below the marginal product in firms owned by people who do not have their own capital. The second study in this paper looks for evidence of this kind of distortion.

## 2 Is capital allocated efficiently across firms?

The previous study leans heavily on a 'natural experiment' generated by the change in the priority sector rules. Unfortunately, there is no natural experiment available to answer this particular question. We therefore, *faute de mieux*, take the strategy of presenting a sequence of facts and using them to eliminate a sequence of potentially competing explanations, and try to argue that the patterns we observe are most likely to reflect distortions in the allocation of capital.[3]

**The basic idea:** The basic idea is closely related to the discussion in the last paragraph of the

[3] This is based on Banerjee-Munshi (2002).

previous section: When what the market pays to savers is but a small fraction of the rate of return on investment, those who have money will prefer to put it directly into businesses owned by people they trust, i.e., their friends and relatives. As a result, those who have strong ties with people who have more money than good opportunities to invest, will enjoy easy access to capital and will invest more than others who have the same production function but not the same social connections. Our empirical strategy will therefore compare the investment behavior of two social groups who differ in the nature of their social connections.

**Background:** Tirupur is smallish town in Southern India which dominates the Indian knitted garment industry. Through a good part of the 1990s the industry in Tirupur was growing at 50% or more. The industry was traditionally dominated by a single local caste group, the Gounders, but, attracted by its success, people from all over India have set up shop in Tirupur over the last decade or so. Our basic strategy is to compare the investment behavior of these Outsiders with that of the Gounders.

If local lore is to be believed, the Gounder businessmen are typically flush with money. The Gounders are a small, wealthy, agriculturist community from the area around Tirupur who have moved into the local knitted garment industry over the last three decades because there is not much scope for more investment in agriculture. They have virtually no industrial presence outside Tirupur. Going into local knitted garment business, or helping a family member or friend get set up in the business, is therefore one of the best ways to use their considerable wealth. By contrast, the Outsiders have few strong ties in Tirupur being from hundreds and even thousands of miles away. Moreover, they are from communities that have many alternative opportunities for investing their money. For both these reasons, we would expect the Outsiders not to have the kind of capital access enjoyed by the Gounders.

**Data:** The main data source for this paper is a survey of a sample consisting of 147 exporters, carried out in 1995. Details of the entrepreneur's background, his access to bank financing, as well as production and fixed capital investment information over a four-year period, from 1991 to 1994, were collected from each firm. Some supplemental information was collected through a brief re-survey in 1997.

**Specification:** We wish to compare firms from the two communities after controlling for relevant observable differences between them, such as the length of time they have been in the export business. The basic regression that we estimate takes the form:

$$y_{it} = \alpha EXP_{it} + \beta EXP_{it} * GOUNDER_i + \gamma GOUNDER_i + f_i + \eta_{it}. \tag{2}$$

Here $y^c_{it}$ is either a measure of investment or output for firm $i$ in period $t$. $EXP_{it}$ refers to firm $i$'s experience in direct exporting (i.e., the number of years since their first export order). $GOUNDER_i$ is a community dummy which equals one if the firm's proprietor is a Gounder, zero if he is an Outsider. $f_i$ is a cohort dummy—it captures the fact that firms entering in different years may be quite different

(say because of selection effects), and $f_i$ is a cohort effect. The identifying assumption is that the time effects, arising for example from secular shifts in demand conditions over time, are common across communities. Under this assumption, the difference in the experience coefficients, measured by the $EXP_{it} * GOUNDER_i$ interaction term, correctly measures the difference in growth rates between the two communities.

**Results on investment:** We use two measures of investment in this section: The firm's capital stock and the capital-output ratio. Both these measures reflect the extent to which the firm must rely on sub-contracting in this industry. And in general, greater investment results in more in-house production and higher product quality, which in turn leads to faster growth.

Gounders own about twice as much capital stock and maintain capital-production and capital-export ratios that are 1.5 to 2.5 times as high as the Outsiders on average. To compare these investment levels at different levels of experience, we turn to the estimates of Equation (2) in columns (1) to (3) of Table 2 where the dependent variables are ln(*capitalstock*), ln(*capital/production*), and ln(*capital/exports*), respectively. The Gounder dummy is positive and significant in all these regressions, while the Gounder-experience interaction term is negative and significant in column (1), but insignificant in columns (2) and (3).

The estimates in columns (2) and (3) tell us that Gounders start with a higher capital-output ratio, and maintain that advantage at every level of experience. It is easier to visualize the trajectories described by the estimates in column (1) using a figure: Figure 1 shows the corresponding Kernel regression:[4] Gounders invest more and, though the Outsiders are catching up with them, the gap is always positive. Thus, Gounders maintain higher capital stock at every level of experience as well.

**Results on output:** The fact the Gounders invest more is clearly consistent with our view of a distorted capital market. However, an alternative possibility is that they simply make better use of capital.

The data on exports and production clearly rejects the possibility that the Gounders are more productive in general. Our estimate of equation 2 for *Ln*(*production*) is reported in column(4) of Table 2, while *Ln*(*exports)* is reported in column (5). The results are effectively summarized in Figure 2, which shows that the Outsiders start out producing and exporting less but grow faster and overtake the Gounders by the time they have been in business about five years. In fact, it is shown in Banerjee-Munshi (2002) that the average output for Outsiders who have six years or more of experience is significantly higher than that of the Gounders. This is despite the fact that their capital stock is always below that of the Gounders.

This shows that the Outsiders are clearly more able than the Gounders. They might still invest less,

[4] For details of how we control for cohort effects see Banerjee-Munshi (2002).

which is what would happen if ability were a substitute for capital, rather than a complement, which is the more standard assumption. However, if ability and capital were indeed substitutes, this would also affect the comparison of firms within each community. Firms that invest more would produce less and vice versa.

**Results on the comparison of firms within each community:** To check the relation between investment and output comparison within each community we estimate the following variant of Equation 2 separately for each community,

$$\ln(X_{it}) = \Pi_1 EXP_{it} + \Pi_2 \ln(K_i) EXP_{it} + \Pi_3 \ln(K_i) + f_i + \eta_{it}, \tag{3}$$

with $X_{it}$ being the firm's output in period $t$ and $K_i$ being the initial capital stock, a measure of the firm's investment, which has not been influenced by shocks to the firm's output.[5]

Our estimate of Equation 3 is reported in columns (6) and (7) of Table 2, respectively for the Gounders and the Outsiders. In both communities, firms that invest more start out producing significantly more and remain ahead. Indeed, they appear to grow faster, though this effect is not significant. The within-community comparison is thus sharply against capital and ability being substitutes.

**Is it access to capital?** The fact that the Outsiders are more productive also suggests the source of the inter-community difference in investment patterns lies in the capital market: If Gounder firms were different for other reasons, for example because Gounders have better access to labor or sub-contracting or politically provided inputs, we would have expected the Gounders to be more productive than the Outsiders.

# 3 Conclusion

Our data suggests that capital markets in India are very far from the neoclassical ideal. The gap between the marginal product of capital and the market interest rate seems to be at least 70 percentage points, and the gap between the marginal product of capital and the rate paid to savers is even larger. Investors who on average are less productive may invest as much as three times more than their more productive counterparts. All this is not necessarily surprising given that the legal system is slow, inefficient and sometimes corrupt, and defaulters usually get off lightly. But it does raise questions about the usefulness of the neo-classical benchmark.

[5] We get very similar results using the firm's average capital stock.

# References

Banerjee, A. and E. Duflo (2002), "Do firms want to borrow more? Testing credit constraints using a directed lending program," mimeo, MIT.

Banerjee, A. and K. Munshi (2002), "How efficiently is capital allocated? Evidence from the knitted garment industry in Tirupur," mimeo, MIT

**Table 1: Are firms credit constrained?**

| Sample: | Complete sample | Sample with change in limit | | | | | | No change in limit | |
|---|---|---|---|---|---|---|---|---|---|
| Dependent variables: | Any change in limit | $Log(loan_t)$ -Log(loant-1) | Log( interest rate)$_t$ -Log(interest rate)$_{t-1}$ | $Log(turnover/limit)_{t+1}$ Log(turnover/limit)$_t$ | $Log(sales)_{t+1}$-log(sales)$_t$ all firms | no substitution | $Log(profit)_{t+1}$ -log(profit)$_t$ | $Log(sales)_{t+1}$ -log(sales)t | $Log(profit)_{t+1}$ -log(profit)$_t$ |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| **PANEL A: OLS** | | | | | | | | | |
| post | -0.003 | -0.115 | -0.008 | -0.115 | 0.021 | 0.005 | 0.172 | 0.030 | -0.035 |
| | (.049) | (.069) | (.014) | (.366) | (.093) | (.096) | (.201) | (.047) | (.024) |
| big | -0.043 | -0.218 | -0.002 | -0.105 | -0.199 | -0.191 | -0.645 | 0.077 | -0.009 |
| | (.053) | (.079) | (.014) | (.147) | (.094) | (.101) | (.219) | (.063) | (.045) |
| post*big | -0.008 | 0.244 | 0.012 | 0.267 | 0.209 | 0.184 | 0.752 | 0.052 | 0.023 |
| | (.078) | (.099) | (.019) | (.355) | (.095) | (.099) | (.387) | (.109) | (.036) |
| # Observations | 489 | 155 | 141 | 39 | 116 | 105 | 107 | 253 | 432 |
| **PANEL B: TWO STAGE LEAST SQUARES** | | | | | | | | | |
| $Log(loan_t)$-Log(loant-1) | | | | | 0.896 | | 2.713 | | |
| | | | | | (.463) | | (1.29) | | |
| # Observations | | | | | 116 | | 107 | | |

Note
1-OLS regressions in panel A, 2SLS regressions using BIG*POST in panel B. The regression in panel B controls for BIG and POST dummies.
2- Standard errors (corrected for heteroskedasticy and clustering at the sector level) in parentheses below the coefficients

**Table 2: Is Capital Allocated Efficiently?**

| Dependent variable : | ln(capital) | ln(cap-prod ratio) | ln(cap-exp ratio) | ln(production) | ln(exports) | ln(production) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Gounders | Outsiders |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Experience | 0.165 | -0.165 | -0.247 | 0.330 | 0.416 | 0.055 | 0.235 |
| | (0.034) | (0.047) | (0.048) | (0.036) | (0.043) | (0.169) | (0.121) |
| Experience*Gounder | -0.111 | 0.034 | -0.005 | -0.146 | -0.103 | | |
| | (0.050) | (0.070) | (0.076) | (0.055) | (0.064) | | |
| Gounder Dummy | 0.918 | 0.258 | 0.512 | 0.656 | 0.378 | | |
| | (0.063) | (0.072) | (0.078) | (0.052) | (0.066) | | |
| Experience*capital | | | | | | 0.062 | 0.048 |
| | | | | | | (0.062) | (0.069) |
| capital | | | | | | 0.221 | 0.308 |
| | | | | | | (0.092) | (0.101) |
| Constant | 2.047 | -1.869 | -1.414 | 3.923 | 3.478 | 2.475 | 1.421 |
| | (0.039) | (0.053) | (0.055) | (0.046) | (0.054) | (0.306) | (0.179) |
| R-squared | 0.865 | 0.782 | 0.704 | 0.975 | 0.958 | 0.974 | 0.979 |
| Box-Pearson Q Statistic | 1.654 | 1.350 | 1.155 | 1.127 | 1.054 | 0.266 | 0.371 |
| Number of observations | 434 | 430 | 421 | 432 | 423 | 120 | 80 |

Note: Robust standard errors in parentheses.
$Q \sim X_1^2$ under $H_0$: no serial correlation. The critical value above which the null is rejected at the 5 percent level is 3.84.
Entry dummies are constructed using all the possible years of entry.
Columns 1 - 3: Capital stock regressed on experience.
Column 4: Capital-Production ratio regressed on experience.
Column 5: Capital-Export ratio regressed on experience.

Figure 1: Capital Stock - net cohort effects

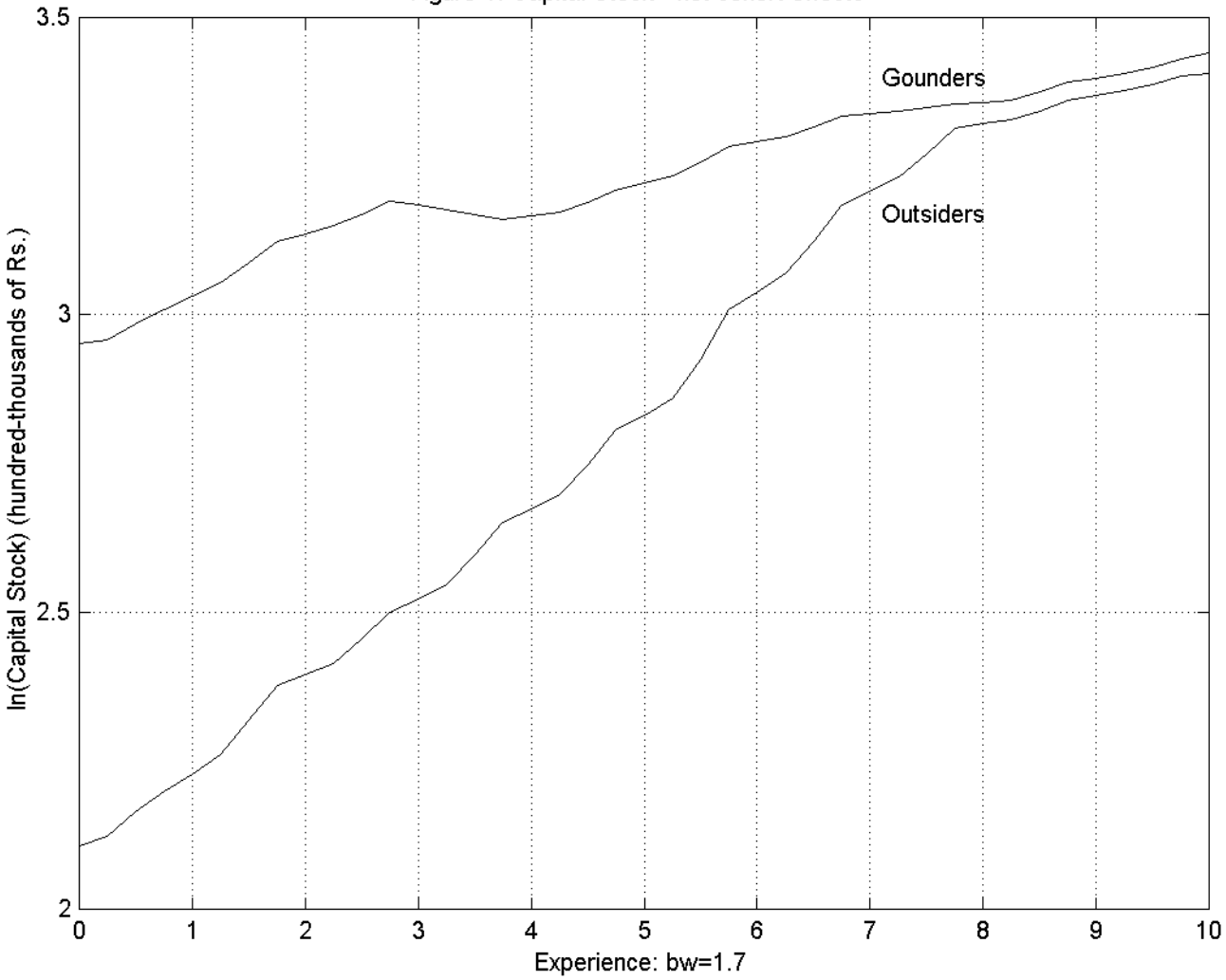

Figure 2: Production - net cohort effects