THE EFFECTS ON PEASANT HOUSEHOLDS
OF ACCESS TO FORMAL DEPOSITS AND LOANS

by

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ABSTRACT

A dynamic, stochastic, rational expectations model of a peasant household with access to deposits and loans (up to a credit limit) is solved and simulated. If formal contracts offer more favorable rates than informal contracts, then access to formal contracts increases average consumption and decreases its standard deviation.

I. Introduction

The financial contracts available to peasant households have five essential characteristics. First, both borrowing and saving are possible; if formal deposits and loans from banks are not available, households may save in real goods or borrow informally. Second, borrowing is constrained by a credit limit. Third, financial contracts are inherently intertemporal. Resources are lent in the present for the promise to repay in the future, and saving/borrowing in the present affects consumption possibilities in the future. Fourth, financial contracts are affected by the possibility of default and by its prevention and punishment. Fifth, the rate of return on savings is less than the rate of interest on borrowings. The households themselves are characterized by low, highly variable incomes (Besley).

Because of algebraic complexity, no single analytic model has captured more than a couple of these characteristics.[1] Analytic models often ignore the ubiquitous availability of informal financial contracts. Credit limits are often omitted, but without explicit restrictions on the utility function, the optimal decision for a household without a credit limit is to play a Ponzi game. The qualitative results of two-period models match those of multi-period models only by ignoring default. Finally, few analytic models incorporate the fact that, for peasant households, borrowing costs more than lending pays.

This study uses orthogonal polynomial projection to solve and simulate a dynamic model of optimal decisions by a peasant household with an infinite horizon and with rational expectations over its uncertain future income. The household faces a credit limit and may

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[1] See, for example, Helpman or Mendelson and Amihud.

access either formal or informal financial contracts. The lending and borrowing interest rates are not equal. Default and possibilities for income-smoothing (Morduch) are ignored.

The results complement and extend those of Deaton (1991, 1992). Simulations suggest that formal financial contracts, if they offer more favorable rates than informal contracts, are more useful for smoothing consumption than are informal contracts. In particular, access to formal deposits and loans increases the mean of consumption and decreases its standard deviation, compared with access to only informal contracts.

There are four more sections. Section II formulates and parameterizes a model. Section III discusses the optimal decision rules, and Section IV examines the properties of the long-run distribution of consumption. Section V concludes.

II. The Model

The household's decision problem is formulated as a Bellman equation. Time is indexed by t, and the household has an infinite horizon.[2] The household has rational expectations over labor income $\tilde{y}_t$, an i.i.d. random variable realized at the beginning of each period. The per-period discount rate is δ. The time-separable, time-invariant, per-period utility function $U(\cdot)$ is defined over a single composite consumption good c_t whose price is unity. More consumption increases utility but at a decreasing rate, implying that the household is risk-averse.

The household chooses a level of net saving s_t. Borrowing is negative net saving. If formal financial contracts are available (e.g., from banks or credit unions), then deposits earn

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[2] If the household lives 40 years and makes financial decisions weekly or monthly, the horizon is effectively infinite.

d_f and loans cost l_f, whereas the rates available in the informal sector are d_i and l_i. The key assumption of this paper is that formal deposits earn more than informal savings and that formal loans cost less than informal loans:

$$r(s_t) = \begin{Bmatrix} d \ if \ s_t > 0 \\ l \ if \ s_t \leq 0 \end{Bmatrix}, \ where$$

$$d = \begin{Bmatrix} d_f \ with \ formal \ deposits \\ d_i \ with \ informal \ savings \end{Bmatrix},$$

$$l = \begin{Bmatrix} l_f \ with \ formal \ loans \\ l_i \ with \ informal \ loans \end{Bmatrix},$$

$$d_f > d_i, l_f < l_i, \ and \ d_k < l_k, \ k = i, f.$$

(1)

On the savings side, there are several reasons why the return to informal saving is low and usually even negative: households lend informally not as usurers but as low-interest (or no-interest) lenders for friends or relatives; stocks of grain or building materials depreciate; inflation erodes cash balances; and relatives seek gifts from liquid households (Binswanger and Rosenweig; Besley). Formal deposits hide wealth from mooching relatives and provide safe, relatively high returns.

On the borrowing side, formal loans should be cheaper than informal ones: moneylenders charge astronomical rates, and the opportunity cost of not changing residences, operating in an economy where transactions depend on the seller and buyer's knowing each other, and maintaining social ties more than overcome the reduced transactions costs implicit in loans from moneylenders or from friends or relatives. The revealed preference of borrowers and savers in developed economies for formal financial contracts is the final

evidence that, at least in well-functioning financial markets, formal contracts offer more favorable terms than do informal contracts.

The household begins each period with assets a_t, defined as the sum of labor income, net saving from the previous period, and any interest from net saving in the previous period:

$$a_t = y_t + s_{t-1} \cdot [1 + r(s_{t-1})] . \tag{2}$$

Assets are allocated to consumption and savings:

$$a_t = c_t + s_t . \tag{3}$$

New households have no savings. Borrowing cannot exceed the credit limit k, and savings cannot exceed assets:[3]

$$k \le s_t \le a_t . \tag{4}$$

The value function $V(s_t; a_t)$ is defined as the sum of current and discounted expected future utility, given current assets and that optimal decisions are made in all periods. The Bellman equation representing the household's maximization problem is:

$$V(a_t) = \max_{k \le s_t \le a_t} U(a_t - s_t) + \left(\frac{1}{1+\delta} \right) \cdot E_t V\{ \tilde{y}_{t+1} + s_t \cdot [1 + r(s_t)] \} , \tag{5}$$

$$\tilde{y}_t \sim i.i.d.$$

with $r(s_t)$ defined as in (1).

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[3] This constraint will not bind if the marginal utility of consumption goes to negative infinity as consumption goes to zero.

This is a functional equation in $V(\cdot)$. Because a_t is continuous, the solution function $V(\cdot)$ must be such that (5) holds at the infinite number of values that a_t could take on. Savings is a function $f(a_t)$ where $f(\cdot)$ is the argument that maximizes (5). Given assets and savings, (3) gives consumption.

The parameterization of (5) was based on Deaton (1992). Utility is CARA with a coefficient of 2. Income is distributed as Normal with mean 100 and standard deviation 10. The discount rate δ was set at 10 percent. Formal deposits earn 5 percent, and informal savings earn -5 percent; formal loans cost 25 percent, and informal loans cost 50 percent. The credit limit is 10 units.

Numerical solutions of (5) by orthogonal polynomial projection (Miranda, 1994) are more accurate, elegant, and quick than the grid techniques of Deaton (1991, 1992). The value function is represented by a polynomial with nice approximation properties. Given an initial guess for $V(\cdot)$, the first-order conditions implied by (5) are solved for the level of savings which maximizes $V(\cdot)$ for a few well-chosen levels of assets, taking the current approximation to $V(\cdot)$ as given when evaluating the right-hand side of (5). The distribution of the income shock is approximated using Gaussian quadrature. This process iterates until $V(\cdot)$ converges.

III. Optimal Decisions

Figure 1 illustrates optimal savings as a function of assets. Consumption is the difference between assets and savings. The solid line represents decisions when a household has access to formal financial contracts, and the dashed line represents decisions without such access. The slight waves in the figure reflect approximation error.

At least four insights may be gleaned from Figure 1. First, low levels of assets lead to borrowing (net savings is negative). In fact, a household may borrow so much that the credit limit binds, as happens below 75 units of assets for households with access to formal loans. Households borrow more readily (at higher levels of assets) when loans are cheaper.

Second, sometimes households consume all their assets and neither save nor borrow (net saving is zero).[4] For intermediate levels of assets, a unit increase in present consumption is worth more than the discounted expected value of having another unit plus interest available to consume in the next period, but less than the discounted expected value of not having to repay an extra unit plus interest in the next period. The range over which households disintermediate shrinks as access to formal financial contracts decreases the spread between what savings earn and what borrowings cost.

Third, the household saves at higher levels of assets (net savings are positive). The interest elasticity of saving increases as the return to saving increases; not only does the household begin saving at lower levels of assets, but the rate at which the household increases savings increases for a given level of assets, even if informal savings would be positive.[5]

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[4] This flat stretch of the net savings function is a direct consequence of unequal interest rates for saving and borrowing. It disappears if, as analytical models have assumed, the two rates are identical.

[5] For this parameterization, increasing the return to savings increases savings more than decreasing the cost of borrowing decreases savings. It can be shown that if loans were to become cheaper and the rate of return on savings were unchanged, then deposits would decrease as the need to self-insure decreased.

Fourth, the value of avoiding episodes of very low consumption is so high that households save even if they earn negative returns and borrow even if they pay exorbitant rates.

Figure 1 depicts decision rules, savings as a function of assets so as to maximize the sum of current and discounted expected future utility over an infinite horizon. The decision rules themselves do not reveal, however, the levels of savings (and thus consumption) that will actually obtain when the rules are used. In particular, they do not reveal how well access to formal financial contracts facilitates smoothing consumption.

IV. The Long-run Distribution of Consumption

Simulations of 20,000,000 periods using the decision rules in Figure 1 were used to generate the approximate long-run distributions of consumption with and without access to formal financial contracts that appear in Figure 2. Without access to formal financial contracts (dashed line), the mean of consumption was 99.88, and the standard deviation was 8.34. With access (solid line), the mean was 100.14, and the standard deviation was 6.02 (solid line).[6] Access to formal financial contracts increases average consumption and also decreases its variability.

More favorable rates on financial contracts smooths consumption for two reasons. First, cheaper loans facilitate the avoidance of episodes of very low consumption. The extreme left tail of the distribution of consumption with access is much thinner than the extreme left tail of the distribution without access.

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[6] The mean of income is 100, and its standard deviation is 10.

Second, more remunerative savings decrease episodes of high consumption. The extreme right tail of the distribution of consumption with access lies inside the extreme right tail of the distribution without access. Increased savings (and higher interest earnings) pad the household's buffer against unusually poor income draws.

Figure 2 provides at least two other insights. First, consumption is skewed to the left because financial contracts buffer consumption asymmetrically. Gluts are easier to avoid than famines because although there is a credit limit, there is no deposit limit and because loans cost more than savings pay.

Second, the distribution of consumption is trimodal. Roughly speaking, this results from the overall distribution's being an amalgamation of the various distributions of current assets that correspond to various levels of net savings in the previous period. Only the tail modes require explanation, and the modes in the left tail (82 units without access and 91 units with access) are the most interesting. With or without access, these peaks come about because, when assets are near the range where borrowing begins, similar levels of consumption could result from consuming all assets (if assets are in the range where nothing is saved or borrowed) or from consuming slightly more than current assets (if assets are in the borrowing range). The need to repay old debt and interest means that the conditional mean of assets is lower if net savings in the previous period were negative, increasing the likelihood of having assets in the range where nothing is borrowed or saved or in the range where something is borrowed. A similar argument, applied to savings, accounts for the nodes in the left tail (103 with access and 109 without access).

V. Conclusion

This study used numerical methods to solve a model of financial decisions by a peasant household with and without access to formal savings and loans. The model incorporated the uncertainty of income, the possibility of informal financial contracts, the intertemporality of financial contracts, and the reality of credit limits and of differing rates of interest for lending (saving) and borrowing.

It turns out that incorporating the characteristics often missed by analytic models makes a difference. In particular, the spread between the interest rates for saving and borrowing mean the optimal decision rule for saving (as a function of assets) has a flat stretch where neither borrowing nor saving are optimal.[7] In addition, the flat stretch leads to an extra mode in the long-run distribution of consumption.

Finally, simulation results suggests that formal financial contracts, if they offer more favorable rates than informal contracts, are more useful for smoothing consumption than are informal contracts. In particular, access to formal deposits and loans increases the mean of consumption and decreases its standard deviation.

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[7] There is also a flat stretch for levels of assets where the credit limit binds.

Figure 1

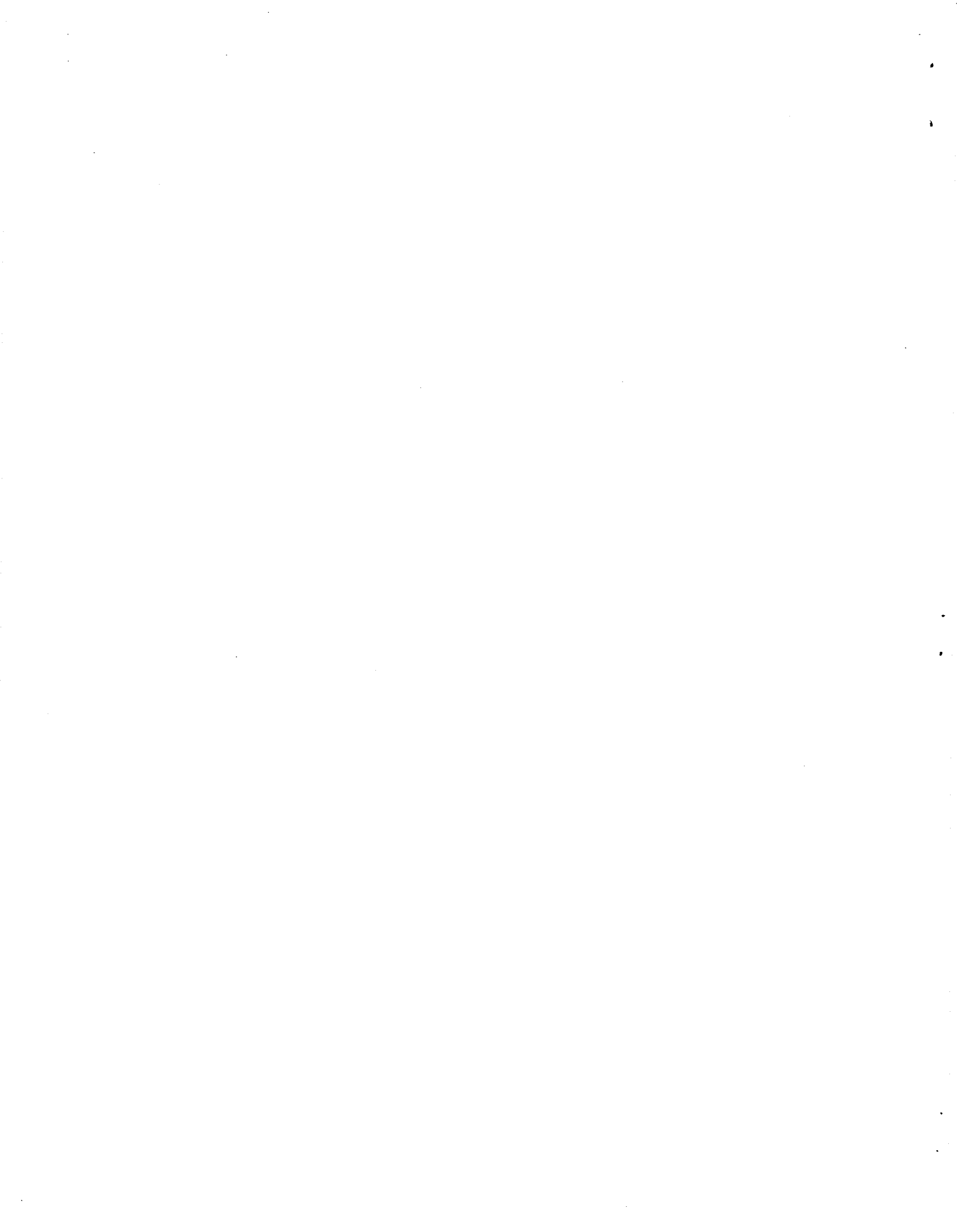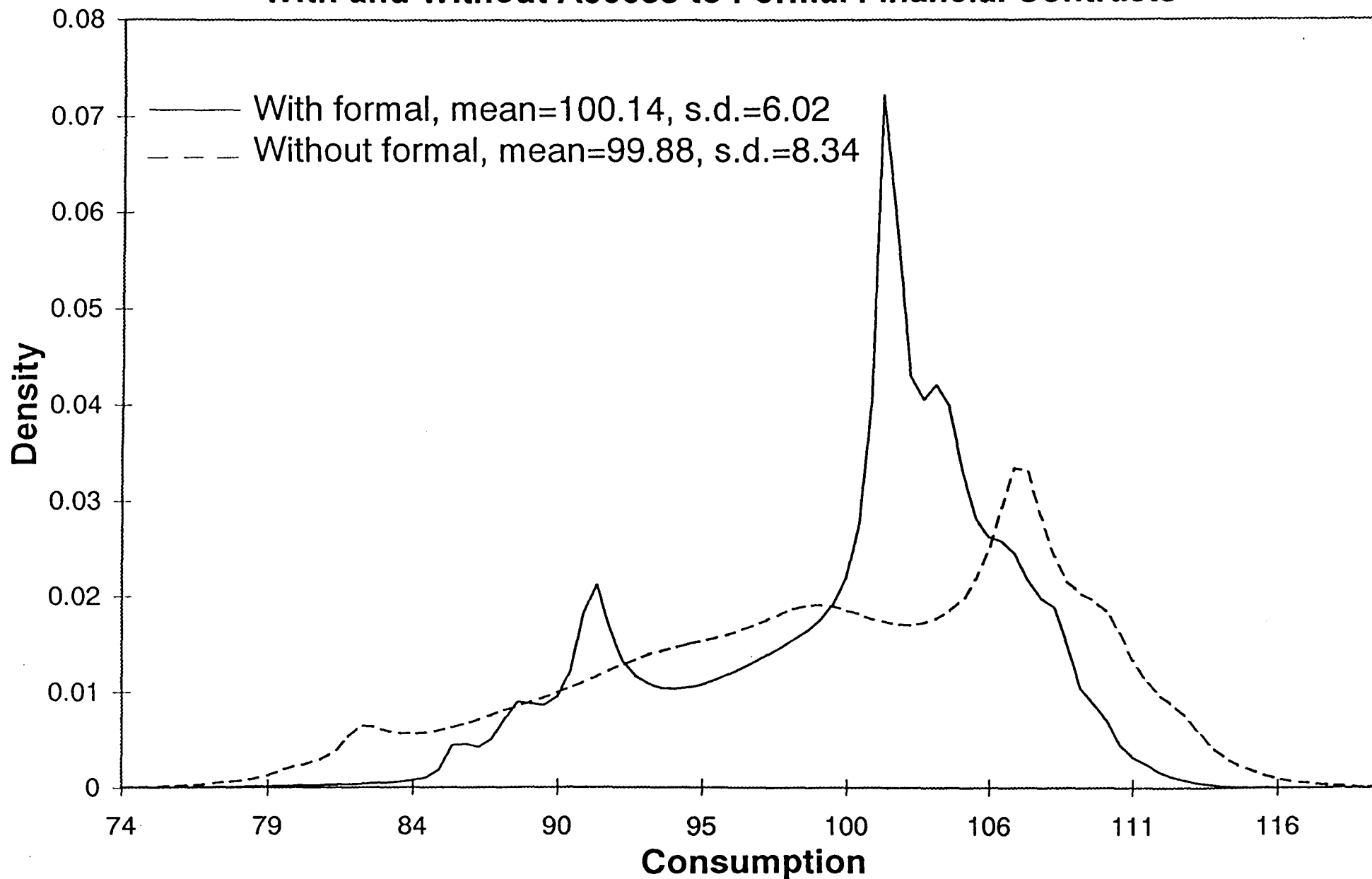## Optimal Decisions With and Without Access
To Formal Financial Contracts
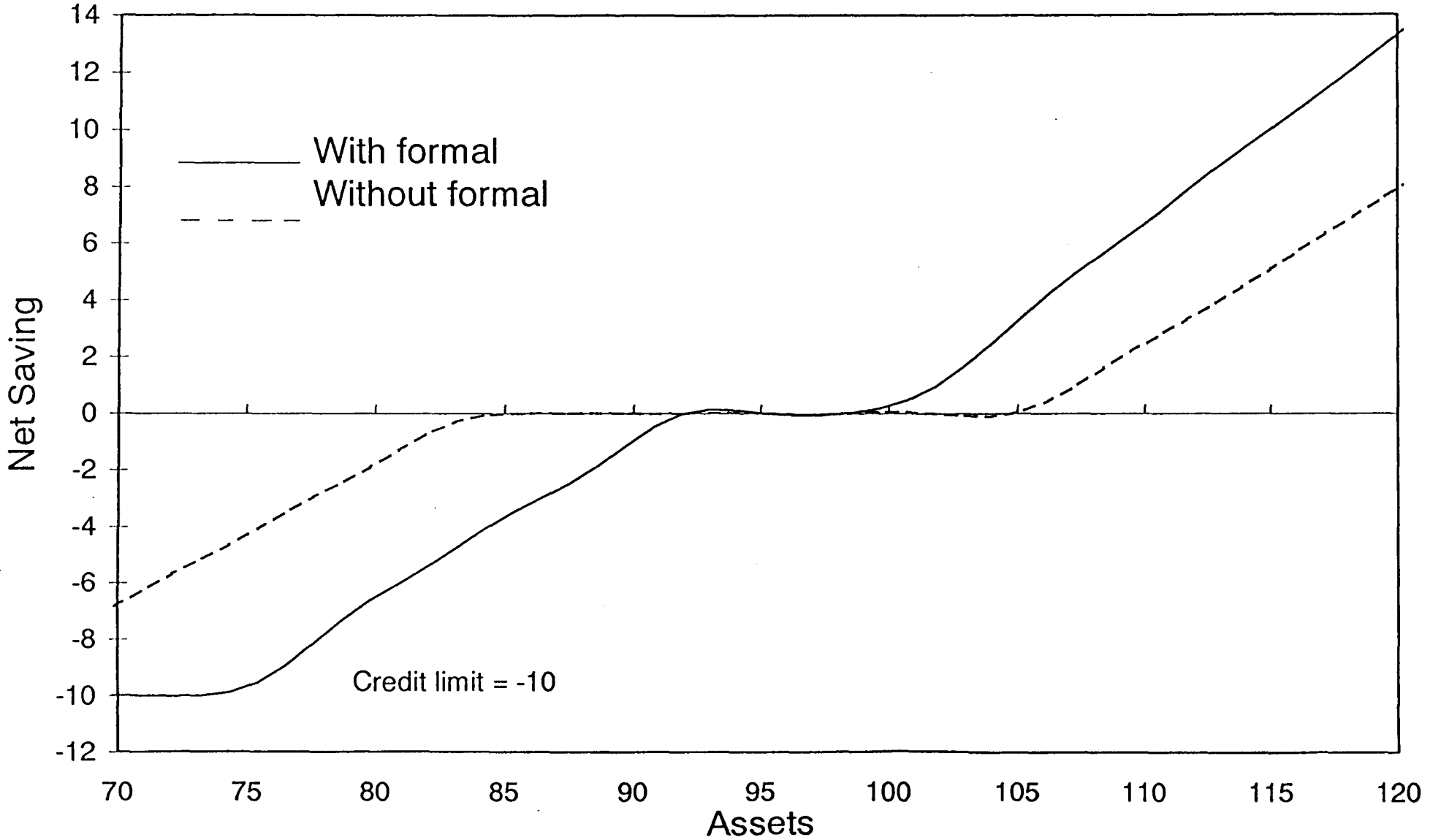
Figure 2

Long-run Distribution of Consumption
With and Without Access to Formal Financial Contracts

Legend:
— With formal, mean=100.14, s.d.=6.02
– – – Without formal, mean=99.88, s.d.=8.34

Y-axis: Density (0, 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08)

X-axis: Consumption (74, 79, 84, 90, 95, 100, 106, 111, 116)

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