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Hand-to-mouth consumers and asset prices

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1. Introduction

Many consumers seem to lead a hand-to-mouth existence: they simply consume their current income. This may be the result of unsophisticated behavior (non-optimizing, or 'rule-of-thumb' consumers), or the reflection of an inability to trade in asset markets due to infinite transactions costs. The objective of this paper is to explore, in a very simple model, the implications for equilibrium asset prices of the presence of hand-to-mouth consumers. I will establish that allowing for the existence of hand-to-mouth consumers contributes, under plausible assumptions, to the resolution of the equity premium puzzle[1] and of the riskfree rate puzzle.[2] As a consequence, the same phenomenon – hand-to-mouth consumption – which Campbell and Mankiw (1989) have shown to be crucial to the description of the time-series behavior of aggregate consumption has the potential of explaining asset market data.

I lay out in section 2 the structure of the economy, and compute, in section 3, equilibrium asset prices and returns. I then show in section 4 that, under plausible assumptions, the presence of hand-to-mouth consumers depresses the equilibrium riskless rate and raises the equity premium relative to what would be predicted by a calibrator mistakenly believing in the existence of a fictitious representative average consumer with free access to asset markets. The conclusion takes stock of the results, and offers some directions for future research.

2. The model

To keep the results as transparent as possible, I limit the analysis to the

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[1]Mehra and Prescott (1985).

[2]Weil (1989).

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case of a two-period economy peopled with two-period lived consumers.[3] In order to highlight important analogies with some recent work in consumption theory, I assume that there are two types of consumers: consumers who freely participate in asset markets, and consumers who (for an unspecified reason) are prevented from doing so.

2.1. Unconstrained consumers

The first type of consumers, which I will call type A consumers, is composed of identical optimizing consumers. In keeping with the spirit of Lucas (1978), they each are endowed at birth with one claim (equity) to a tree which produces in the second period a random number $\tilde{d}$ of fruits – the consumption good. They also receive an endowment (y_1^A, y_2^A) of the consumption good over the two periods of their life. This endowment vector can be interpreted, if labor is supplied inelastically at a fixed wage, as the lifetime labor income profile of type A individuals. The consumption good is perishable.

Type A consumers can freely participate in the market for riskless bonds, and in the stock market in which risky claims to trees are traded. Assuming that our consumers maximize a time-additive utility index,[4] a typical type A agent solves the following problem:

$$\max_{c_1^A, c_2^A, b^A, x^A} \quad u(c_1^A) + Ev(c_2^A), \tag{2.1}$$

subject to

$$c_1^A + qb^A + px^A = y_1^A + p\,.\,1, \tag{2.2}$$

$$\tilde{c}_2^A = y_2^A + b^A + \tilde{d}x^A, \tag{2.3}$$

$$c_1^A, c_1^A \geqq 0, \tag{2.4}$$

where c_1^A and $\tilde{c}_2^A$ denote, respectively, the first-period and random second-period consumptions of a type A agent, b^A and x^A his bond and stock holdings, and q and p the consumption good prices of bonds and stocks. The felicity functions $u(\cdot)$ and $v(\cdot)$ are strictly increasing and concave.

The necessary and sufficient first-order conditions for utility maximization by type A agents are simply

$$qu'(c_1^A) = Ev'(\tilde{c}_2^A), \tag{2.5}$$

[3]The infinite-horizon extension of the results is (almost) straightforward.

[4]It will become clear below that time-additivity is an innocuous assumption, as first-period consumption is fixed in equilibrium. Expected utility is not as innocent an assumption.

$$pu'(c_1^A) = E\tilde{d}v'(\tilde{c}_2^A). \tag{2.6}$$

Given p and q, these two equations, together with the budget constraints (1.2) and (1.3), determine $\{c_1^A, c_2^A, b^A, x^A\}$.

2.2. Constrained consumers

Type B agents – the second type of consumers – also hold one unit of equity at birth, but receive an endowment (y_1^B, y_2^B) of the consumption good. I assume that type B consumers do not participate at all in asset markets, so that the consumption of a typical type B agent is simply

$$c_1^B = y_1^B \quad \text{and} \quad c_2^B = y_2^B + \tilde{d}. \tag{2.7}$$

Two interpretations may be given to explain the behavior of type B agents. It might be argued that they are, as in Campbell and Mankiw (1989), 'rule-of-thumb' consumers whose unsophisticated (non-optimizing) behavior leads them to consume their current income. Alternatively, and without any hint of irrationality, type B consumers might be thought of as facing infinite transactions costs which prevent them from trading in asset markets – although they would participate if the costs were smaller. In any case – and this is what is crucial here – type B consumers live hand-to-mouth.

2.3. Summary

The economy I have just constructed is designed to replicate some well-known stylized facts: some consumers (type A) behave as the permanent income hypothesis predict they should, while others (type B) consume their current income. The former participate in asset markets while the latter don't.

3. Equilibrium asset prices and returns

I now compute equilibrium asset prices and returns in the stylized economy I have described above.

Since all type A consumers are identical, and since type B consumers don't trade in asset markets, clearing of the bond and stock markets requires that

$$b^A = 0 \quad \text{and} \quad x^A = 1, \tag{3.1}$$

as bonds are inside bonds, and the number of claims to fruit trees received by type A agents was assumed above to be equal to the number of type A consumers. Therefore, using the budget constraints (2.2) and (2.3), it must be the case in equilibrium that

$$c_1^A = y_1^A \quad \text{and} \quad \tilde{c}_2^A = y_2^A + \tilde{d}. \tag{3.2}$$

It immediately follows, using eqs. (2.5) and (2.6), that the equilibrium prices of bonds and stocks are given by

$$q = \frac{Ev'(y_2^A + \tilde{d})}{u'(y_1^A)}, \tag{3.3}$$

$$p = \frac{E\tilde{d}v'(y_2^A + \tilde{d})}{u'(y_1^A)}. \tag{3.4}$$

The equilibrium riskfree gross return on bonds and equilibrium expected gross rate of return on stocks are thus

$$R^F = 1/q = \frac{u'(y_1^A)}{Ev'(y_2^A + \tilde{d})}, \tag{3.5}$$

$$R = E\tilde{d}/p = \frac{E\tilde{d}u'(y_1^A)}{E\tilde{d}v'(y_2^A + \tilde{d})}. \tag{3.6}$$

Therefore, the equilibrium risk premium on equity – defined as the ratio of the expected return on stock to the rate of return on bonds – is simply

$$\Pi = R/R^F = \frac{E\tilde{d}Ev'(y_2^A + \tilde{d})}{E\tilde{d}v'(y_2^A + \tilde{d})}. \tag{3.7}$$

Eqs. (3.3), (3.4), (3.5), (3.6) and (3.7) emphasize a slightly trivial but crucial point: equilibrium returns are only determined, in this economy, by the consumption of those who participate in asset markets.

4. Should we be puzzled by the riskfree rate and the equity premium?

A major problem that has preoccupied the asset pricing literature in the past ten years or so is that, as Mehra and Prescott (1985) have shown, the equity premium predicted the representative agent, complete market model – about 1% or less for plausible parameterizations of preferences – is strongly at odds with the empirical evidence which suggests a premium of the order of 5 or 6%. As I have emphasized elsewhere,[5] the equity premium puzzle is accompanied by a riskfree rate puzzle: the representative agent, complete market model predicts counterfactually high riskfree rates, and thus cannot explain why the riskfree rate has historically been approximately equal to 0.5%.

I now want to examine – using an approach I have used before[6] – whether these two puzzles (riskfree rate and equity premium puzzles) might not be at least partly the reflection of a *miscalibration error*. Namely, could it be the case that the complete market, representative agent model predicts a counterfactually high riskfree rate and counterfactually low equity premium because it is *not* the model which actually generated the data?

In terms of the particulars of the model studied here, I therefore want to ask whether equilibrium prices and returns will be under- or over-predicted by an observer who would calibrate our economy – in which there *are* hand-to-mouth consumers – under the mistaken belief that there exists a representative consumer who is endowed with the economy's average endowment, consumes its per capita consumption, and has free access to asset markets.

4.1. *The fictitious representative consumer*

Suppose that a fraction λ of the population is of type A, and a fraction $1-\lambda$ of type B. Our naive calibrator believes that there is a representative consumer who receives the average endowment vector.

$$(\bar{y}_1, \bar{y}_2) = \lambda(y_1^A, y_2^A) + (1-\lambda)(y_1^B, y_2^B), \tag{4.1}$$

is endowed at birth with one claim to fruit trees, and who solves, with free unconstrained access to asset markets, the following representative problem:[7]

$$\max_{c_1, c_2, b, x} \; u(c_1) + Ev(c_2) \tag{4.2}$$

such that

$$c_1 + qb + px = \bar{y}_1 + p \,.\, 1, \tag{4.3}$$

$$\tilde{c}_2 = \bar{y}_2 + b + \tilde{d}x, \tag{4.4}$$

$$c_1, c_2 \geqq 0. \tag{4.5}$$

[5] Weil (1989).
[6] Weil (1992).
[7] In purposefully assuming away possible errors in the specification of the utility function: they are not the focus of this paper.

Our calibrator will thus believe that the Euler conditions satisfied by the data are

$$qu'(c_1)=Ev'(\tilde{c}_2), \tag{4.6}$$

$$pu'(c_1)=E\tilde{d}v'(\tilde{c}_2), \tag{4.7}$$

and observing that consumption is perishable and that market clearing requires that $c_1=\bar{y}_1$ and $c_2=\bar{y}_2+\tilde{d}$ (i.e., $b=0$ and $x=1$), he will conclude that the equilibrium riskless rate, the expected return on stocks, and equity premium are given by[8]

$$\hat{R}^F=\frac{u'(\bar{y}_1)}{Ev'(\bar{y}_2+\tilde{d})}, \tag{4.8}$$

$$\hat{R}=\frac{E\tilde{d}u'(\bar{y}_1)}{E\tilde{d}v'(\bar{y}_2+\tilde{d})}, \tag{4.9}$$

$$\hat{\Pi}=\frac{E\tilde{d}Ev'(\bar{y}_2+\tilde{d})}{E\tilde{d}v'(\bar{y}_2+\tilde{d})}. \tag{4.10}$$

4.2. Miscalibration biases

I now examine whether the true riskfree rate R^F is smaller or larger than the predicted $\hat{R}^F$, and whether the true equity premium Π falls short of or exceeds the calibrated $\hat{\Pi}$.

4.2.1. Riskfree and risky rates

Eqs. (3.1), (3.8) and (2.6) imply that the predicted riskless rate and average risk rate are a function of the fraction of the population which lives hand-to-mouth. On the basis of this observation, it is straightforward to establish the following:

Proposition 1. If $y_1^A>y_1^B$ and $y_2^A<y_2^B$, then $R^F<\hat{R}^F$ and $R<\hat{R}$.

Proof. From (4.1) and (4.8), under the condition of the proposition,

$$\frac{\partial\hat{R}^f}{\partial\lambda}=\frac{(y_1^A-y_1^B)u''(c_1)Ev'(\tilde{c}_2)-(y_2^A-y_2^B)u'(c_1)Ev''(\tilde{c}_2)}{[Ev'(\tilde{c}_2)]^2}<0,$$

since $u(\cdot)$ and $v(\cdot)$ are strictly increasing and concave. Now $R^F=\hat{R}^F$ when

[8] I skip some obvious intermediate steps which parallel those in section 3.

$\lambda = 1$. Therefore, $R^F < \hat{R}^F$ when $\lambda < 1$. A parallel argument establishes that $R < \hat{R}$.

This proposition simply tells us that if hand-to-mouth consumers would like, were it possible, to *borrow* from type A consumers (because the former's endowment profile is more tilted towards the future than the latter's), then the true equilibrium interest rates are *smaller* than the ones predicted by our bumbling calibrator.[9] The intuition for this result is straightforward: under the conditions of the proposition, the rate of growth of the endowment – and thus, in equilibrium, of consumption – of type A consumers is smaller than that of the fictitious 'average' consumer. Since it is the Euler equation of type A consumers which determines equilibrium returns, true interest rates must be smaller than predicted by our calibrator.

This result provides a theoretical rationale for the view – for which there is strong numerical evidence[10] – that the presence of consumers which face binding borrowing constraints depresses equilibrium rates of return and thus contributes to the resolution of the riskfree rate puzzle.

4.2.2. Equity premium

Since I have just established that both the expected return on stocks and the riskfree rate are depressed by the presence of hand-to-mouth consumers, there is an a priori ambiguity as to the effect of miscalibration on the equity premium. Fortunately, a simple restriction on the utility function lifts this ambiguity:

Proposition 2. If $y_2^A < y_2^B$ and $v(\cdot)$ exhibits decreasing absolute risk aversion, then $\Pi > \hat{\Pi}$.

Proof. The argument proceeds in two steps.

(i) $0 < \lambda < 1$ implies, under the conditions of the proposition, that $y_2^A < \bar{y}_2$. Therefore, using results in Pratt (1964), decreasing absolute risk aversion implies that the function $w_1(z) = u(y_2^A + z)$ is more risk averse than the function $w_2(z) = u(\bar{y}_2 + z)$.

(ii) I have shown in Weil (1992) that if, for any two increasing and concave utility functions $W_1(\cdot)$ and $W_2(\cdot)$, $W_1(\cdot)$ is more risk averse than $W_2(\cdot)$, then, for any positive random variable η, $E\eta EW_1'(\eta)/E\eta W_1'(\eta) > E\eta EW_2'(\eta)/E\eta W_2'(\eta)$.

To complete the proof, it suffices to set $W_1(\cdot) = w_1(\cdot)$, $W_2(\cdot) = w_2(\cdot)$, and $\eta = \tilde{d}$.

[9] It might be useful to note that, quite naturally, the magnitude of the miscalibration bias is larger the smaller λ.

[10] See the recent work of Marcet and Singleton (1991).

The intuition underlying this proposition is again quite simple. Under the condition of the proposition, type B consumers have a lower second period endowment than the fictitious average consumer. Since their second period utility function (which is the one relevant to assess attitudes towards risk) exhibits decreasing absolute risk aversion, type A consumers are *more* unwilling to bear dividend risk than the average consumer. But since dividend risk must be borne in equilibrium, the risk premium on equity required to entice type A consumers to hold stocks is actually larger than what our calibrator would predict.

4.3. Discussion

How plausible are the restrictions on endowments and preferences which underly Propositions 1 and 2? If we think of our economy as a two-period slice of an overlapping generation model in which consumers live for three periods, working in their middle age but very little when young or old, then the condition on endowments ($y_1^A > y_1^B$ and $y_2^A < y_2^B$) is satisfied if we interpret type A consumers – who have access to asset markets – as middle-age agents, and type B consumers – who live hand-to-mouth – as young agents. This is probably a not unrealistic depiction of the world. As for the assumption of decreasing absolute risk aversion, it is relatively uncontroversial, as it is not only intuitive but also required to rationalize some aspects of portfolio choice.

4.4. Summary

If the consumers who do not have access to credit markets would otherwise wish to be borrowers, and if the consumers who do participate in asset markets have decreasing absolute risk aversion, then the true riskfree rate is lower, and the true equity premium higher than would be predicted by a calibrator who mistakenly believes that there exists a representative average consumer who has free access to perfect credit markets.

5. Conclusion

What emerges from this slightly pointillist paper is a simple picture. Partial equilibrium work by Campbell and Mankiw (1989) on the empirical performance of the permanent income hypothesis has already established the strong desire of the consumption data to be described as resulting from the combined behavior of about 50% of unconstrained consumers and 50% of 'rule-of-thumb' consumers. What this paper shows is that the presence, more generally, of hand-to-mouth consumers who are shut off from asset markets is likely – if these consumers would tend to be borrowers were they to participate in asset markets, and if investors have decreasing absolute aversion to risk – to contribute to the resolution of both the riskfree rate and equity premium puzzles.

This is a reassuring conclusion for two reasons. On the one hand, it shows that one need not resort to different arguments to explain consumption and asset market puzzles. On the other hand, the very conjunction of the consumption and asset market evidence lends additional credence to the notion alread put forth by Mankiw and Zeldes (1989) that non-accessibility of asset markets to a large segment of the population to asset markets ought to be taken seriously.

The challenge remains of course to rationalize the existence of hand-to-mouth consumers. But it is not clear that, in this respect, one can do much better than postulate their presence if it is due more to non-sophisticated behavior than to transactions costs or borrowing constraints. As to the quantitative importance of the effects described here, one can have some degree of confidence that it is large, based on the array of evidence presented to us by the empirical findings of Campbell and Mankiw (1989) and the numerical results of Marcet and Singleton (1991).

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