Show, using UK and US data, that the variability of the consumption-output ratio is lower than that of the investment-output ratio (consumption smoothing). How do intertemporal based theories explain the phenomenon of consumption smoothing?

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Principles of Macroeconomics

Introduction

UK and US data show, that consumption is less volatile than investment. Yet, both are a function of income. This essay aims to shed light on this puzzle from the consumption side, by demonstrating that consumption is less volatile than income – a phenomenon called consumption smoothing.

There are a number of differing approaches to consumption smoothing up to this date. Broadly speaking, two non-conflicting strands of thinking have emerged: One thinking along the lines of Friedman's 1957 permanent income hypothesis (PIH/REPIH), and the other along the lines of Modigliani's 1940-50s life-cycle hypothesis (LCH) (Fernandez-Corugedo 2004). The explanations in this essay are based on the latter.

The structure is as follows. First, I will constitute that the volatility of the consumption-output ratio is indeed lower than that of the investment-output ratio. This will raise the question of why there is such an excess smoothness. Second, to explain the excess smoothness theoretically, I will present Modigliani's LCH, together with its roots in Irving Fisher's 1930s model of intertemporal choice (Deaton 2005, Modigliani 1986, Thaler 1997). Third, I will test the hypothesis against Gourinchas' and Parker's empirical evidence. Having found the extent of smoothening to be less than predicted by the LCH, I will end with two limitations of the LCH that could explain this result.

Let us first constitute, that the volatility of the consumption-output ratio C/Y is indeed lower than that of the investment-output ratio I/Y. The given data is quarterly UK and US data from 1955 to 2005 augmented by ONS and BEA GDP data. When plotting the changes in C/Y, I/Y and Y over time, the graphs illustrate that consumption is less volatile than investment (Fig. 1). The coefficients of variation express the same observation numerically (Fig. 2). One caveat is that the difference in volatility may partly be explained by the high volatility of investment relative to income, due for example to the accelerator principle (Sloman *et al.* 2012). However, the difference cannot be accounted for by volatile investment alone. As I will explore in this essay, consumption is also less volatile than income – there is excess smoothness (Fernandez-Corugedo 2004).

Fig. 1a:

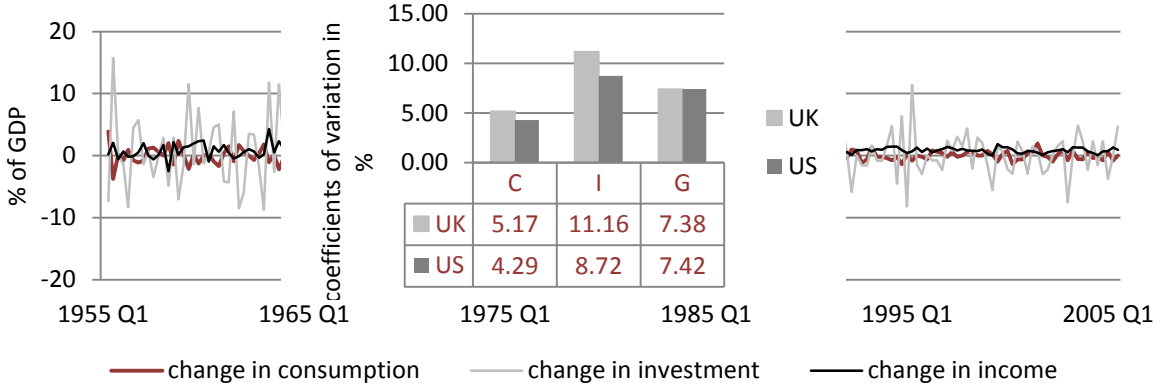
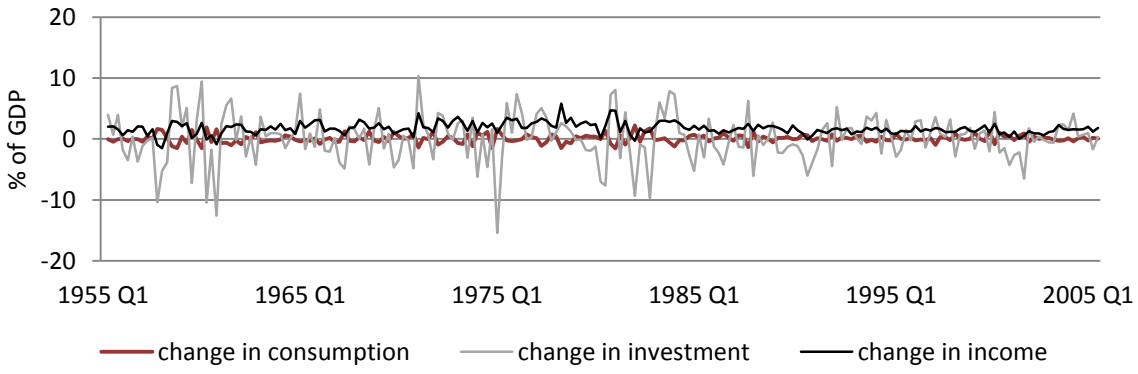


Fig. 2: volatility

:ome (UK)

Fig. 1b: change in consumption, investment and income (US)



How do intertemporal choice theories explain the excess smoothness? To begin with, intertemporal choice is the choice between giving up some consumption now for more consumption later and vice versa. To show how this ties in with consumption smoothing, I will first outline Fisher's model, and then expand to Modigliani's LCH.

In Fisher's model, we start with agents who are endowed with a current income Y_1, and an expected future income Y_2. In each of the two periods 1 and 2 they consume $C_1$and C_2 respectively. What is at the heart of this model, is that current and future consumption can theoretically be "exchanged" for each other. In practice, this exchange is plain borrowing and saving.

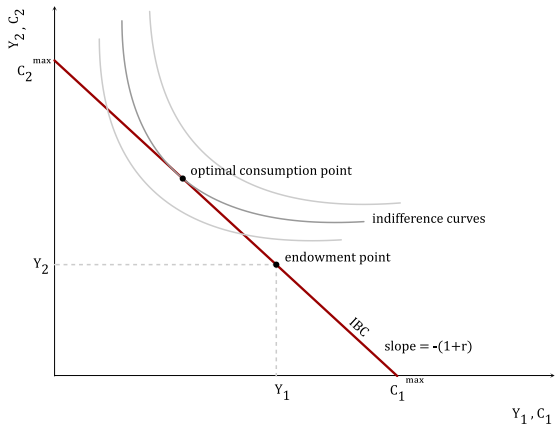
Suppose now, all future income is borrowed into the present. The agent will be able to consume at the maximum possible present consumption C_1^{max}. Note, however, that, because of the interest to be paid, any borrowing is discounted by the real interest rate r. Similarly, when saving everything now, agents can consume at the maximum later C_2^{max}. Interest payments are then added, not discounted:

$$C_1^{max} = Y_1 + \frac{1}{(1+r)} Y_2$$

$C_2^{max} = Y_2 + (1+r)Y_1$.

If we now, in the latter equation, allow for a proportion to be consumed in period 1, all feasible

Fig. 3: Fisher's intertemporal choice of consumption



combinations of $C_1$and C_2 are defined. We call this the intertemporal budget constraint (IBC):

$C_2 = Y_2 + (1 + r)Y_1 - (1 + r)C_1$. Which feasible combination the agent chooses to maximise utility depends on their individual preferences, reflected in their indifference map (Fig. 3) (Mankiw 2013).

What is important about Fisher's model for our purposes, is that agent's consider both their current income and their expected future income for consumption decisions. This displaces Keynes earlier hypothesis, that only current income matters (Mankiw 2013). On the basis of this insight, Modigliani develops his LCH to explain consumption smoothing.

We assume a life-cycle to have two periods, the working phase and the retirement phase. Other assumptions are that agents generally prefer less variation in consumption (Modigliani 1986) and that they do not face borrowing constraints.

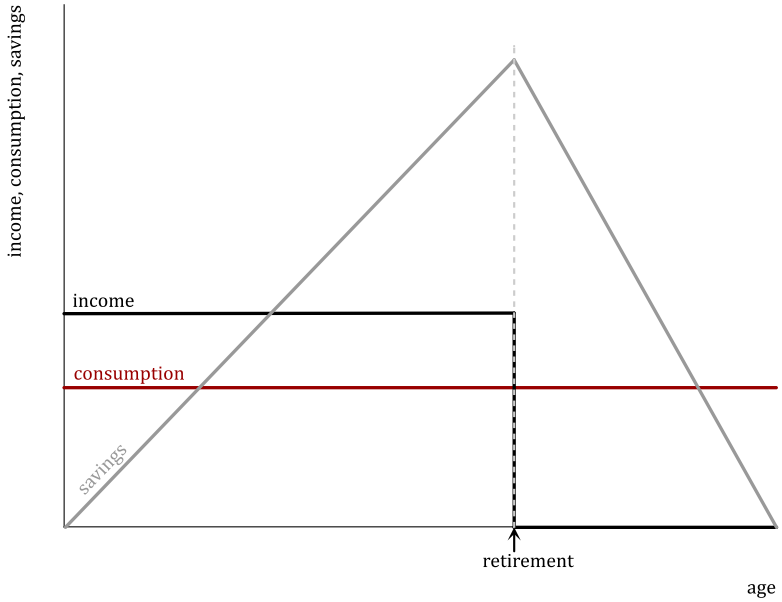
In the working phase, there is labour income to finance consumption. But in the retirement phase, there will not. So, at retirement, a drop to zero consumption along with labour income has to be avoided somehow. Agents do that by saving some of their working phase income to dissave it (consuming out of savings rather than income) during their retirement phase (Fig. 4) (Mankiw 2013, Modigliani 1986).

In Fisher's terms some of $C_1$is exchanged for C_2. Thus, the indifference map would be such that optimal consumption lies above the endowment point. Mind though, that in this case the endowment would lie at C_1^{max}, because we defined income in the retirement phase to be zero.

Therefore, this simple hypothesis, of common life-cycle events, motivating every consumer to save and smooth their consumption, provides a plausible explanation for the overall low volatility of consumption.

On relaxing the assumption of only two phases, more irregularities in income would emerge, e.g. lower income in the pre-working phase, a parenting phase etc. It would not change our result, however, because all life-cycle irregularities could theoretically be smoothed with borrowing and saving. As will become clear in the last part, the other two assumptions are necessary.

Fig. 4: Life-Cycle Hypothesis



Let us now do some empirical testing of this hypothesis. Gourinchas and Parker have analysed the consumption data of around 40,000 US households from 1980 to 1993 (Fig. 5). As it only ranges up to retirement age, we can only test consumption behaviour during the working phase. Moreover, it is safe to ignore the peculiarities of the early years here (Gourinchas & Parker 2002).

Taking the LCH literally, we would expect consumption data to form a flat line lying below current income (Fig. 4). Taking Keynes literally, we would expect consumption to run almost parallel to current income (Mankiw 2013). What we see in Fig. 5, however, is the middle ground. Consumption resembles the income curve in its hump shape, which indicates that current income indeed has more weight than expected. Yet, consumption is flatter. Therefore, we do observe some moderate smoothing. But is this smoothening due to life-cycle considerations?

Notice that consumption is peaking *before* income, with income still rising. A conscious decision to cut consumption, related to saving for retirement, and not to the missing cut in income, could be an explanation. And that is consistent with further empirical evidence. In Fig. 6 Gourinchas and Parker isolate retirement-motivated savings from total savings. The data show a rather constant and low level until the agent's mid-30s. These savings are assumed to be precautions against shocks. Past that age, however, savings abruptly shoot up. It has intuitive appeal to interpret an increase at this moment in the life-cycle as saving for retirement. Therefore, we can conclude that, despite the more pronounced than expected role of current income, life-cycle events do nonetheless have a

smoothening effect on consumption.

It is still left to explain, however, why consumption turns out more dependant on income than predicted. I am suggesting here two reasons: Impatience and borrowing constraints.

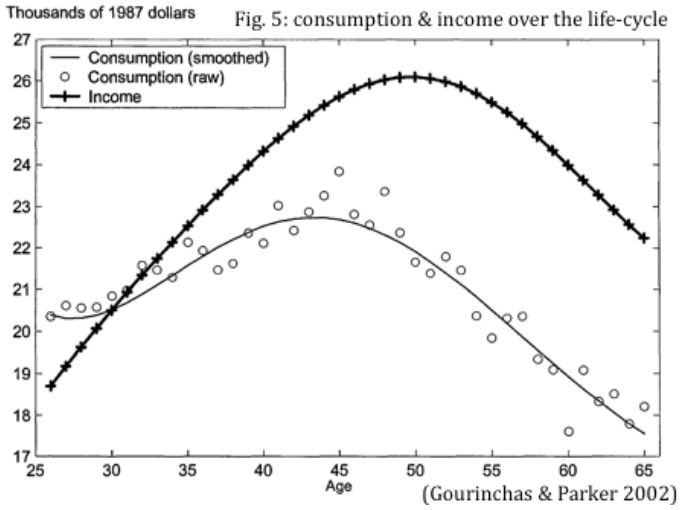
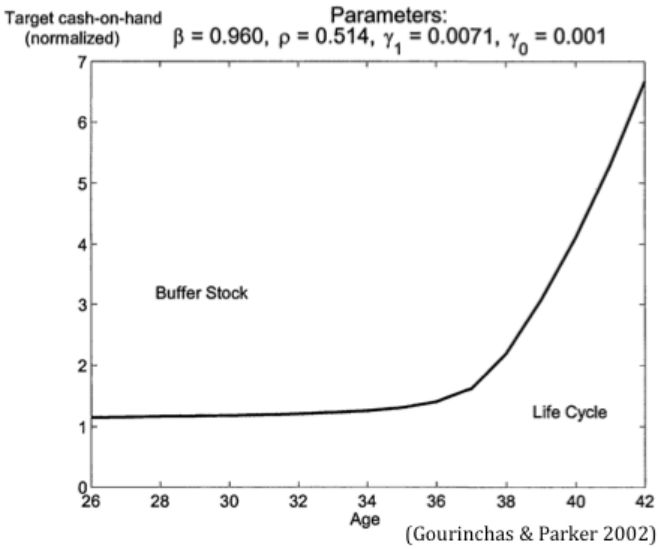


Fig. 5: consumption & income over the life-cycle

(Gourinchas & Parker 2002)

Fig. 6: retirement-motivated saving



(Gourinchas & Parker 2002)

Impatience. Laibson's behavioural research suggests that consumers prefer instant gratification. Consequently, future income and consumption are discounted irrationally heavily (Laibson 2005). Using 1948-78 US data, Hayashi estimates the discount rate to lie 25% above the real interest rate (Hayashi 1982). This feeds into our analysis in two ways. On the one hand, a higher discount rate is an explanation for a more prominent role of current income in consumption decisions (Muellbauer 1994).

$$\Delta C_1 = \Delta Y_1 + \frac{1}{(1+r_d)}\Delta Y_2 - \frac{1}{(1+r_d)}\Delta C_2$$

As the discount rate r_d rises, the change in consumption becomes increasingly dependent on changes in current income. Hence, the generally more hump shaped than flat curve.

On the other hand, however, we probably have to drop our assumption of the interest and discount rate to be the same for saving and borrowing. If the assumption held, we would expect undersaving, which conflicts with the data (Fig. 5).

Borrowing constraints. Some consumers may face borrowing constraints, because banks are unwilling or unable to lend. There is a tendency for borrowing-constrained consumers also to have low incomes (Muellbauer 1994). For example consider different life-cycle phases again: Consumers in their young pre-working phase will likely face borrowing constraints and low income. If that is the case, then there is less scope for saving, which makes them more vulnerable to income or expenditure shocks. Without the ability to compensate for shocks with either savings or borrowing, there is no alternative but to vary consumption along with income (Deaton 1991).

Conclusion

Summing up then, we have discovered excess smoothness in UK and US consumption data relative to investment, but also noted that it is crucial to examine consumption relative to income. Subsequently, with Fisher's and Modigliani's theories, we have revealed mechanisms behind the smoothening. From a theoretic perspective, the LCH provides an explanation with much intuitive appeal, as life-cycle events are realities which everybody can relate to, and which require conscious consumption or saving decisions. Empirically, however, it turned out that while there is evidence for the predicted mechanisms to work, they do not smooth consumption to the extent predicted. Irrational impatience as well as borrowing constraints are two limitations of the LCH that may account for the higher than expected weighting of current income in consumption decisions.

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