FROM SMITH TO THE EQUILIBRIUM RATE OF PROFIT

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The fundamental structure of a scientific theory may be quite old, to take an example this year is the 150th anniversary of Darwin's greatest work. But though it is 150 years old, Darwin's theory of evolution remains very *fertile*. Basing themselves on its premises, biologists are able to come up with new non-obvious but testable propositions about the biological world. I would contend that Smith's work on economics, even older than that of Darwin remains in this sense *fertile*.

We can use it to make new predictions about the economy that are both testable and non-obvious. In particular I will show that starting from certain premises of Smith we can derive a formula for the rate of profit that is not at all obvious, but which when tested gives excellent results.

1. Smithian Premises

(1) That labour is the source of value.
(2) That capital or 'stock' is the accumulated result of past labour.
(3) That unproductive expenditure impedes the accumulation of capital.
(4) That the development of the productivity of labour drives down the values of commodities.

2. Development of the premises

2.1. **That labour is the source of value.** If labour is the source of value, and the real measure of the value of a commodity is the labour that it will command then it follows that the value created in an economy will be proportional both to the number of workers and to how long they work. If we take a certain number of working hours per annum to be the norm, we can express the labouring capacity, and hence the value creating capacity of an economy in terms of the number of full time equivalent workers it has. Note that when we do this we are abstracting from the problem of the differential valuation of the various nation's labours on the world market. We can do this as we are looking at the internal rate of profit of the economy.

From these assumptions we obtain our first equation

$$P = N(1 - w) \tag{2.1}$$

Where P is the total profit in the economy, N the number of full time equivalent workers and w is the wage expressed as the fraction of a full time equivalent working year required to produce the wants and necessities consumed by the average labourer. Note that the dimension of P is millions full time of person years per annum, which reduces to millions of full time equivalent persons. We can view this as the population which produces those goods purchased out of profits.

This paper presents results that extend the work of [Zachariah(2008)]. I am also greatful to Allin Cottrell for his help in the theoretical work that went into it and to Tamerlan Tajadinov for his website applying the theory.

2.2. **That Stock is accumulated labour.** If we follow Smith and view stock as the accumulation of past labour, then it can be valued in terms of working years, and the total stock of the nation will be expressible as so many millions of working years, accumulated over previous years. The rate of profit per annum r is then given by

$$r = \frac{P}{K} \tag{2.2}$$

where K is the stock measured in millions of person years. Dimensionally this is thus Persons/ person years which gives dimension t^{-1} which is what we expect for profit.

It is clear that r will fall if the rate of growth of K is greater than the rate of growth of P and r will rise if the converse holds.

But it is clear from equation 2.1 that the main determinant of the rate of growth of P will be the growth of the working population. A secondary influence will be any tendancy for w , the wage share, to fall. Why is this secondary?

Suppose the working population grows by 5% a year, then if the wage share remains constant then equation 2.1 total profit will grow by 5% too. But suppose that the wage share is initially 40%, then a 5% reduction in the labour content of the real wage will result in only a 2% increase in profit. The further that w is depressed, the less significant will the growth in profit be for each 1% reduction in the labour time going as the real wage. Besides Smith repeatedly points out that in countries with more productive labour, the real wage rises. Thus the Smithian assumption would be to assume that w is relatively stable. We will thus assume that the rate of change of profit $\dot{P}$ is given by the rate of growth of the population g_π ,

$$\dot{P} = g_\pi \tag{2.3}$$

Population on the other hand is not stable. In the early stages of capitalist development it grows very rapidly. Later, with the elevation of the social status of women, and with education being more important, family sizes shrink. In highly developed capitalist countries the population stabilises or even starts to decline.

What is the implication of this?

If population stabilises, then by equation 2.2 any rate of increase in the stock of capital must tend to depress the rate of profit.

What then influences the stock of capital?

2.3. **Unproductive versus productive expenditure.** One of Smith's great concerns was the promotion of productive industry. His chapter III is titled "Of the Accumulation of Capital, or of Productive and Unproductive Labour". Here he distinguishes between the labour of the manufacturer which

> fixes and realizes itself in some particular subject or vendible commodity, which lasts for some time at least after that labour is past. It is, as it were, a certain quantity of labour stocked and stored up to be employed, if necessary, upon some other occasion

and the labour of the menial servant which

> on the contrary, does not fix or realize itself in any particular subject or vendible commodity. His services generally perish in the very instant of their performance, and seldom leave any trace or value

This distinction is relevant to accumulation because

> That part of the annual produce of the land and labour of any country which replaces a capital never is immediately employed to maintain any but productive hands. It pays the wages of productive labour only. That which is immediately destined for constituting a revenue, either as profit or as rent, may maintain indifferently either productive or unproductive hands.

Now consider the situation in which the entire profit is directed to the employment of productive labour and thus fixes iteself in a material product that lasts beyond the execution of the labour. If the profit were 5% per annum, then the annual growth of stock would likewise be 5%. If in constrast 40% of the profit were spent unproductively then the growth of stock would be only 3% per annum. This principle of Smith's thus provides us with $\dot{K}_1$, a first estimate of the growth of stock:

$$\dot{K}_1 = (1-u)r \tag{2.4}$$

In equation 2.4 the variable u represents the portion of profit that is spent unproductively. But this is not the only thing that affects the capital stock. We have to take into account the part of the produce that is "destined for replacing a capital, or for renewing the provisions, materials, and finished work, which had been withdrawn from a capital", or what we would now call depreciation of fixed capital. In addition there is the technical devalution of stock, although Smith does not emphasises this, it can be deduced from other parts of his theory.

2.4. **That the development of the productivity of labour drives down the values of commodities.**

> Labour, therefore, it appears evidently, is the only universal, as well as the only accurate measure of value, or the only standard by which we can compare the values of different commodities at all times, and at all places.

It follows that as time passes and as the productivity of labour improves, the real price of commodities falls. This will in turn affect the existing stock of capital in a country. If the productivity of labour grows rapidly then that nation's stock will be subject to an equatlly rapid devalution. This gives us a second estimate of the change in stock

$$\dot{K}_2 = (1-u)r - g_\tau \tag{2.5}$$

in equation 2.5 the variable g_τ is the growth in the technical productivity of labour.

3. Equilibrium rate of profit

If profit in a nation grows at the same proportionate rate as its stock ($\dot{K} = \dot{P}$), then the rate of profit will be stable or in equilibrium. Is there some particular rate of profit that will bring about this equilibrium?

Yes, since for equilibrium we have

$$\dot{K} = \dot{P} = (1-u)r - g_\tau = g_\pi \tag{3.1}$$

from equations 2.5 and 2.3. From this we can readily derive an equilibrium rate of profit

$$\bar{r} = \frac{g_\tau + g_\pi}{1 - u} \tag{3.2}$$

What does an equilibrium rate of profit $\bar{r}$ mean in this context?

- It is the rate of profit which is compatible with the current growth of technology and labour force and the current split in the usage of profit between productive and unproductive uses.
- The equilibrium rate itself will change if the growth of the labour force growth of technology or the share of unproductive expenditure changes. The important points are
  - If population growth slows, then the equilibium rate of profit will tend to fall
  - If more of profit is productively reinvested the equilibrium rate will fall and vice versa
  - If technology growth speeds up, the rate of profit will rise.
- It is the rate towards which the actual rate of profit will tend, such that if the actual rate is different than the equilibrium rate then the actual rate will tend towards the equilibrium
  - If $\bar{r}_t < r_t$ then we would expect that at time $t+1$ we would see $r_{t+1} < r_t$ whereas
  - If $\bar{r}_t > r_t$ then we would expect that at time $t+1$ we would see $r_{t+1} > r_t$

This formula for the equilibrium rate is non-obvious, and it allows us to make empirical predictions, two criteria for a fertile theory. But are the predictions confirmed?

4. Testing the Theory

The theory is both testable in principle, and, when tested gives very accurate results. Such tests have become much easier since the advent of the internet. The Extended Penn World Tables [Marquetti(2009)] provide access to the key information required to test the theory. A student in our department has built a website to test the theory against the data [Tajaddinov(2009)] and the results I present below are drawn from this website[1].

4.1. **First Pattern.** The graphs have several characteristic forms. The first is shown in Figure 4.1, which gives the trends for Japan and Switzerland[2]. The solid line in the figures is the equilibrium rate of profit the doted line the actual rate. Note how the actual rate lags the equilibrium rate by a few years.

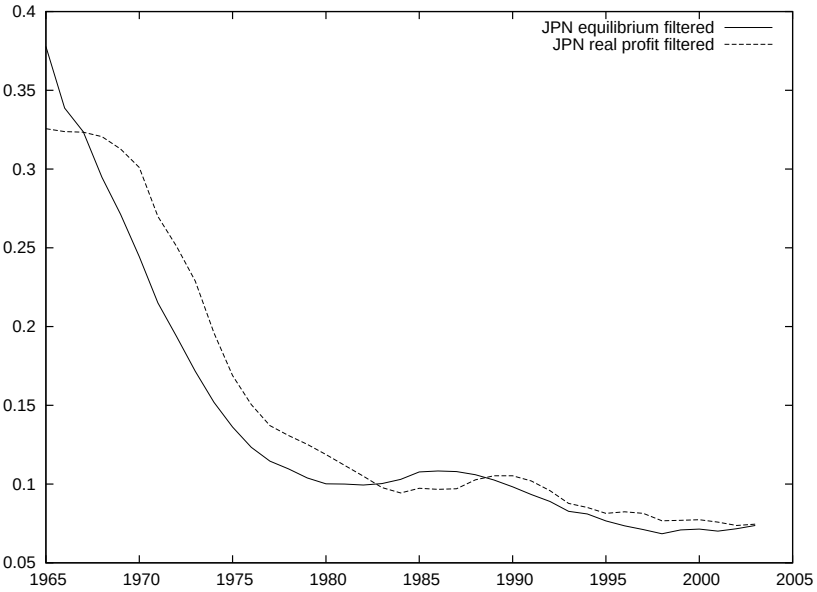
So our first result is that the equilibrium rate does act as an attractor for the real rate. This is validation of the basic theory set out above. Since the theory of the equilibrium rate consists of simple mathematical deductions from Smithian premises, it confirms the basic premises of Smith.

This is striking since Equation 3.2 is very far from obvious. It contains none of the variables one might initially expect to determine the rate of profit, yet is predicts it with great accuracy.

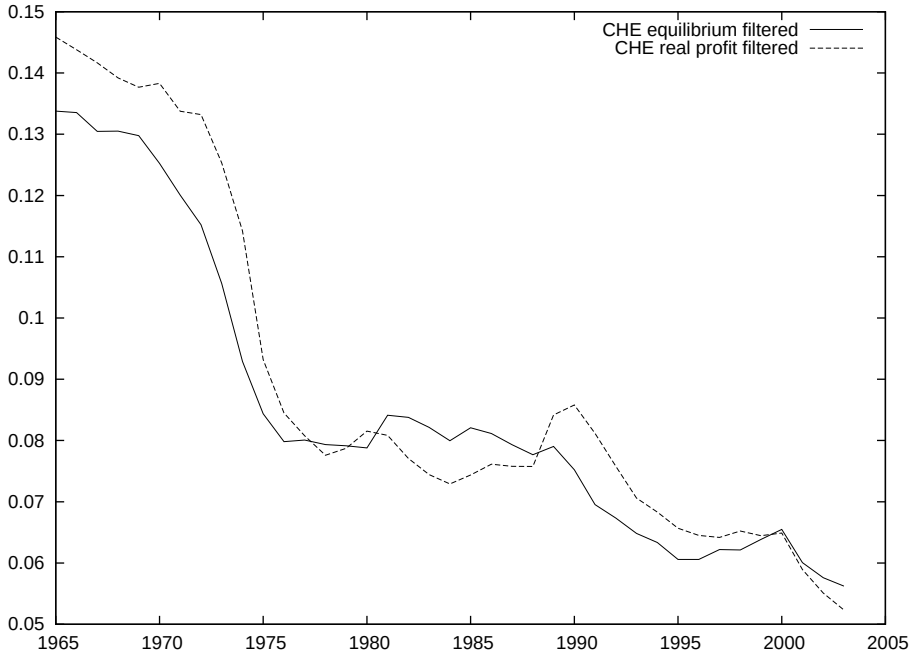
The next striking point about the graphs for Japan and Switzerland is the way they seem to confirm the Marxian theory of the tendancy of the rate of profit to fall. In a sense they do, but we will present graphs for other countries where the rate

[1]There are one or two complexities relating to accounting for depreciation when using the EPWT, these are explained in the documentation that accompanies the website.

[2]China is not included in the Penn World tables, but when the corresponding graphs are computed from the China National Statistical Yearbook, the trend is remarkably like that shown by Japan 30 years earlier. Korea again shows a very similar trend.



Japan



Switzerland

FIGURE 4.1. The first characteristic pattern, Japan and Switzerland. The solid line is the equilibrium rate of profit the doted line the actual rate. Note how the actual rate lags the equilibrium rate by several years just as theory would predict.

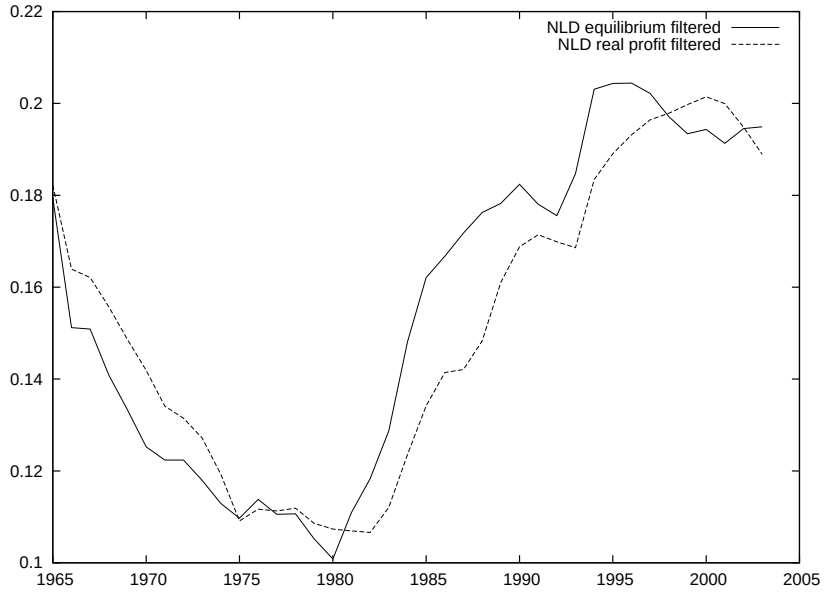


FIGURE 4.2. Netherlands which shows the typical pattern for European Union countries.

of profit rises, so the question remains why the equilibrium rate was on a declining trend for Japan and Switzerland?

Look at figures for female fertility in these countries and you have the answer. In Switzerland the fertility rate fell from 2.5 children per woman in 1965 to 1.5 babies per woman in 1995. A similar if less pronounced decline can be seen in Japan from 2 babies per woman to 1.5 in 1995. This decreases the rate of growth of the population and by Equation 3.2, brings down the equilibrium rate of profit.

4.2. **Typical European Union Pattern.** The next typical pattern we see is illustrated here by the Netherlands. In the first period the shape of the curve is like that of Japan or Switzerland, a steady decline in the equilibrium rate driven down by falling population growth. From the start of the 1980s these countries see a recovery of profit rates. These have two underlying causes: increased imigration substitutes for a low birthrate, and a rising consumption of the surplus by unproductive services (finance, advertising etc), slows the growth of capital stock. As Equation 3.2 shows, a rise in unproductive expenditure has the paradoxical effect of raising the equilibrium rate of profit.

As Figure 4.2 shows, the equilibrium rate rises first, and then pulls up the real rate with a 2 to 3 year lag.

4.3. **African Pattern.** Africa shows a quite different pattern, illustrated by Egypt in Figure 4.3. Once more we see that the equilibrium rate predicts what the actual rate of profit will be in subsequent years (a lag of about 5 years in this case). But unlike the other two patterns, the equilibrium rate is rising. We would explain this as being the result of a very rapidly rising workforce (it grows from 29 million to 63 million between 1965 and 2000. Alongside this rapid rate of growth of the

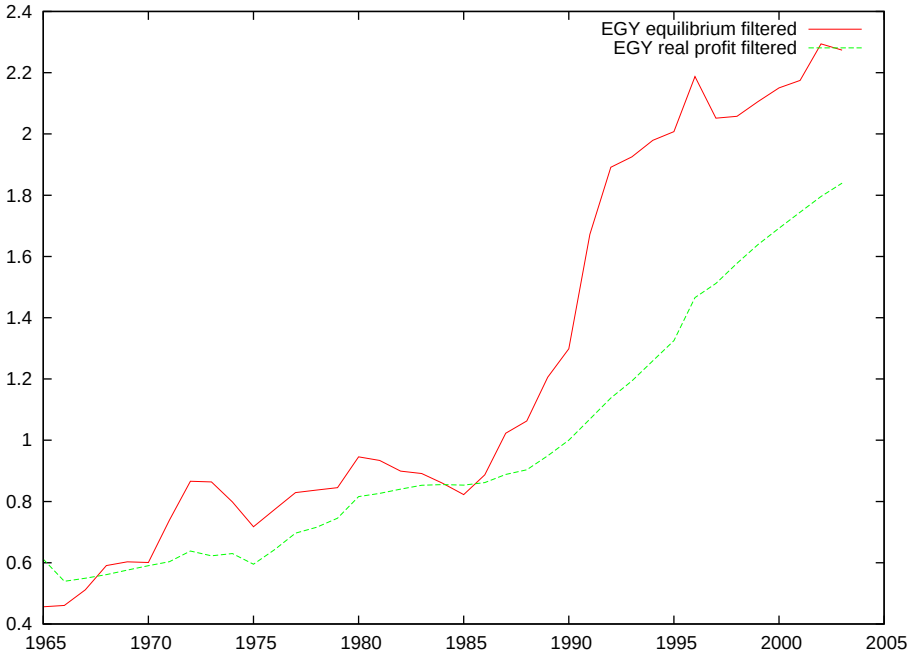


FIGURE 4.3. Egypt which shows a quite different pattern.

population goes a falling capital output ratio since the share of the surplus being reinvested is relatively low (u is near to 1). The consequence is a rising tendancy of the rate of profit.

5. CONCLUSION

I have shown that, starting from Smithian premises about the economy, one can construct a set of equations that make non-obvious predictions about the trends of profitability accross the world economy. I have presented a small sample of our results here, but the predictive power is there quite generally.

But what does equation 3.2 tell us about the long term future of the world economy?

I think it shows that the epoch of capitalist profit is transitory. It shows that as population growth slows, and eventually declines, profitability will fall. Indeed with a declining population the equilibrium profit rate could be negative.

The steady state condition is one in which profit is merely sufficient to maintain the value of capital stock against the devalutations it continually experiences due to technical advances.

In Japan and Korea today we see this state being approached. Europe postponed it by being much more open to immigration than the far eastern countries. Japan, lacking sufficient domestic labour, has long been a big capital exporter. China, with its 1 child families will soon be in the same position as Japan in the 1980s. Already it is becoming a major capital exporter. But, as compared to European capital export a century ago, there is great disproportion in scale. In 1909 Europe

was much smaller in population than Asia and Africa, so it was unable to eport sufficient capital to saturate the supplies of labour on these continents. Today's industrialised capitalist Asia, has only Africa available to it as a relatively pristine source of new labour. In the face of the huge flow of capital out of China, even the abundent labour reserves of that Southern Continent will rapidly be exhaused.

Then civilisation will enter a new phase, as across the world labour becomes scarce relative to capital. The economic an moral order of commercial civilisation, the order of the *Wealth of Nations*, will come to an end. Perhaps then the principles of the *Theory of Moral Sentiments*, can come to the fore.

References

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