Part I
Modelling Money in General Equilibrium: a Primer
Lecture 1
Motivation and Selected Stylized Facts

Leopold von Thadden
University of Mainz and ECB (on leave)

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General remarks

→ What is the role of money in market-based economies?
→ How does the economy react to changes in monetary policy?
→ How should monetary policy be conducted?

To address questions of this type, there exists a well-established tradition in monetary economics to distinguish between 'long-run' and 'short-run' features

Long-run:

- Quantity theory tradition predicts that money is neutral ('money does not matter'), ie this view starts out from a fundamental 'dichotomy' between real and nominal variables

- Neutrality properties of money are associated with the long-run position of the economy under flexible prices

General remarks

Short-run:

- At 'given' prices and for given private sector beliefs about future policies, money is not neutral
- Keynesian and Monetarist traditions disagree about the implications of this non-neutrality
- **Keynesian tradition:**
  $\rightarrow$ typically stresses slow and often fragile self-stabilizing forces of the economy
  $\rightarrow$ typically assigns to monetary (and fiscal) policies an active role to stabilize the economy
- **Monetarist tradition:**
  $\rightarrow$ is more optimistic about self-stabilizing forces
  $\rightarrow$ expresses scepticism about the ability of policymakers to fine-tune the economy
  $\rightarrow$ prefers a rules-based approach over ad hoc interventions

General remarks

Part I of the Lecture:

$\rightarrow$ deals only with **long-run** features
$\rightarrow$ discusses in detail a particular **monetary version of the neoclassical growth model** with flexible prices, the **'money-in-the-utility-function' model**, due to *Patinkin (1965)* and *Sidrauski (1967)*

But let us first do 3 things:

- Confirm that the motivation for such modelling approach is anchored in a time-honoured tradition
- Establish some selected **stylized long-run monetary facts** from the empirical literature
- Mention possible **modelling alternatives**

David Hume:

"...Augmentation in the quantity of money has no other effect than to heighten the price of labour and commodities...In the progress toward these changes, the augmentation may have some influence, by exciting industry, but after the prices are settled...it has no manner of influence. Though the high price of commodities be a necessary consequence of the increase of gold and silver, yet it follows not immediately upon that increase; but some time is required before the money circulates through the whole state...It is only in this interval of intermediate situation, between the acquisition of money and rise of prices, that the increasing quantity of gold and silver is favourable to industry...We may conclude that it is of no manner of consequence, with regard to the domestic happiness of a state, whether money be in greater or less quantity."

Essays and Treatises, 1752

Some quotes from the history of monetary economics

Comment on **David Hume:** Doesn't this sound familiar...?

$\rightarrow$ Effects of a non-anticipated monetary expansion in a DSGE model:

- Permanent increase in the level of M by 3% in the Taylor-model, estimated on German data
- Production effect peaks after 3 quarters and entirely disappears after about 5 years
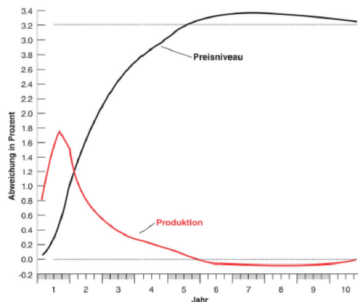- Long-run effect on P: increase by about 3%

Abbildung 1: Effekte einer monetären Expansion im Taylor-Modell

Quelle: Taylor, John, Macroeconomic Policy in a World Economy (New York: W.W. Norton, 1993), Figure 5-4A, S. 150.

John Stuart Mill:

"There cannot ... be intrinsically a more insignificant thing, in the economy of society, than money; except in the character of a contrivance for sparing time and labour. It is a machine for doing quickly and commodiously, what would be done, though less quickly and commodiously, without it: and like many other kinds of machinery, it only exerts a distinct and independent influence of its own when it gets out of order."

Principles of Political Economy, 1848

Milton Friedman:

"The monetary authority controls nominal quantities - directly, the quantity of its own liabilities. In principle, it can use this control to peg a *nominal quantity* - an exchange rate, the price level, the nominal level of national income, the quantity of money by one or another definition - or to peg the *rate of change in a nominal quantity* - the rate of inflation or deflation, the rate of growth or decline in nominal national income, the rate of growth of the quantity of money.
It cannot use its control over nominal quantities to peg a *real quantity* - the real rate of interest, the rate of unemployment, the level of real national income, the real quantity of money, the rate of growth of real national income, or the rate of growth of the real quantity of money."

The Role of Monetary Policy, 1968

Selected stylized monetary facts

The study by *McCandless and Weber (1995)*:

- establishes 3 stylized facts which offer widely quoted (but not in all dimensions entirely undisputed) empirical benchmark findings
- is based on time series data for 110 countries for the time period from 1960-1990
- calculates for each country long-run averages of the growth rates of **real GDP**, **consumer price inflation** and **3 definitions of money (M0, M1, M2)**, using comparable IMF-data, where
  M0: currency plus bank reserves
  M1: money easily used in transactions
  M2: money easily used or converted into use for transactions
- allows for two homogenous subsamples of countries: i) 21 OECD countries and ii) 14 Latin American countries
- investigates such broad cross section (rather than just a single country) to make sure that the results do not depend on country-specific policy rules

Selected stylized monetary facts

Finding 1 on money growth and inflation:
*(see Tables 1 and 2 and Chart 1 from McCandless and Weber, 1995)*

$\rightarrow$ *"In the long run, there is a high (almost unity) correlation between the rate of growth of the money supply and the rate of inflation. This holds across three definitions of money and across the full sample of countries and two subsamples."*

Selected stylized monetary facts

Chart 1

Money Growth and Inflation:
A High, Positive Correlation

Average Annual Rates of Growth in M2 and in Consumer Prices
During 1960–90 in 110 Countries
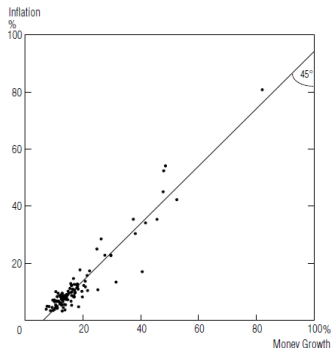
Source: McCandless, G. and Weber, W., Some Monetary Facts, Federal
Reserve Bank of Minneapolis Quarterly Review, 19/3, 2-11.

Selected stylized monetary facts

Finding 1 on money growth and inflation: some comments

- Correlations for the broader definitions of money (M1, M2) with inflation are both approximately 0.95 and slightly larger than that for the narrow definition of money (M0) which stands at 0.925

- The **nearly linear relationship has a slope close to unity** (see Chart 1), in line with predictions from the **quantity equation**

$$M \cdot V = P \cdot Y$$

which becomes, when written in terms of growth rates,

$$g_M + g_V = g_P + g_Y$$

- The 45-degree line in Chart 1 does *not* go through the origin, implying that long-run inflation is not only determined by the growth rate of money, but as well by the growth rates of real output and velocity

- For **very low inflation environments**, the linear relationship becomes fragile (see *Teles and Uhlig, 2010*)

Finding 2 on money growth and real output growth:
*(see Tables 3 and 4 and Charts 2 and 3 from McCandless and Weber, 1995)*

$\rightarrow$ *"In the long run, there is no correlation between the growth rates of money and real output. This holds across all definitions of money, but not for a subsample of OECD countries, where the correlation seems to be positive."*

Selected stylized monetary facts

Chart 2

Money and Real Output Growth:
No Correlation in the Full Sample . . .

Average Annual Rates of Growth in M2
and in Nominal Gross Domestic Product, Deflated by Consumer Prices
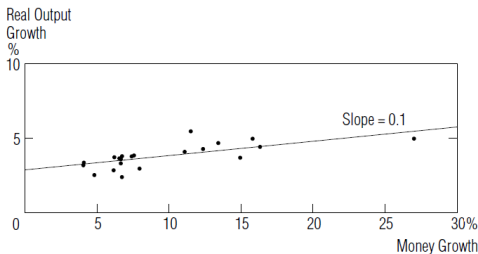During 1960–90 in 110 Countries
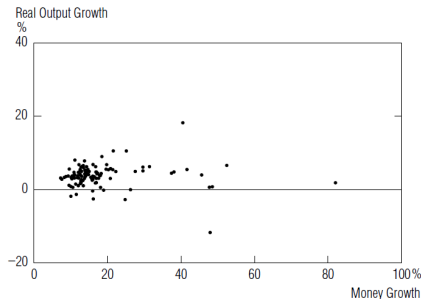
Source: McCandless, G. and Weber, W., Some Monetary Facts, Federal
Reserve Bank of Minneapolis Quarterly Review, 19/3, 2-11.

Selected stylized monetary facts

Chart 3

. . . But a Positive Correlation in the OECD Subsample

Average Annual Rates of Growth in M0
and in Nominal Gross Domestic Product, Deflated by Consumer Prices
During 1960–90 in 21 Countries

Source: McCandless, G. and Weber, W., Some Monetary Facts, Federal
Reserve Bank of Minneapolis Quarterly Review, 19/3, 2-11.

Selected stylized monetary facts

Finding 2 on money growth and real output growth: some comments

- For the **full sample**, correlation coefficients are lower than -0.05 and statistically not significantly different from 0
- Sub-sample of **OECD countries** is a certain exception:
  $\rightarrow$ Correlation coefficients are higher than 0.5 (and highest for M0 growth)
  $\rightarrow$ But the magnitude of the relationship is small (ie the slope coefficient in Chart 3 is 0.1) and it is unlikely that it reflects a causal (and exploitable) relationship from money growth to real output growth
  $\rightarrow$ Instead it seems to be driven by a similarity of feedback rules running from real output growth to money growth
  $\rightarrow$ The finding for the sub-sample of OECD countries is contested by other studies (going back to *Geweke, 1986)* which favour superneutrality (ie a zero correlation)

Finding 3 on inflation and real output growth:
*(see Tables 5 and 6 and Chart 4 from McCandless and Weber, 1995)*

$\rightarrow$ *"In the long run, there is no correlation between inflation and real output growth. This finding holds across the full sample and both subsamples."*

Selected stylized monetary facts

Chart 4

Inflation and Real Output Growth: No Correlation

Average Annual Rates of Growth in Consumer Prices
and in Nominal Gross Domestic Product, Deflated by Consumer Prices
During 1960–90 in 110 Countries
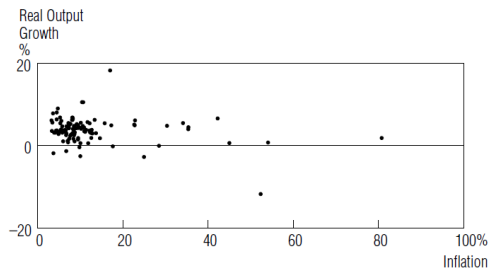
Source: McCandless, G. and Weber, W., Some Monetary Facts, Federal
Reserve Bank of Minneapolis Quarterly Review, 19/3, 2-11.

Finding 3 on inflation and real output growth: some comments

- Finding 3 obtains after correcting for a single and 'unusual' country observation, ie w/o Nicaragua the correlation coefficient for the remaining 109 countries is −0.101 (and not significantly different from 0)
- For the OECD the coefficient is positive, but, again, not significantly different from 0
- Other studies (like *Barro, 1995*) find significantly negative correlations when allowing for non-linearities, implying that in high inflation environments the correlations are strongly negative, while in low inflation environments the effects become fragile

Alternative modelling approaches

→ **How to incorporate money into modern general equilibrium approaches?**

1) MIU model inserts real balances into the utility function of agents

Alternatives:
2) Various ways to impose that certain transactions (like purchases of goods or trades in assets) are costly w/o money, creating thereby a positive demand for real balances
→ example: Cash-in-advance models (see Part II of the Lecture)
3) Treat money like other assets to transfer resources intertemporally (*Samuelson 1958*)
→ moreover, when being dominated in return by other assets, money may receive support through additional assumptions like legal restrictions

Caveat: All these approaches involve one way or the other non-trivial shortcuts