 To Main Proceedings Document

Prediction of exchange rates

A system dynamic framework for macroeconomic forecasting in a multilateral context

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1. Introduction

The accuracy of econometric models has been discussed in recent times by dissatisfied customers from economy and administration alike. This state of affairs has its roots in the fact, that the period of quasi inflationfree growth in the US (with low interest rates driving an international boom in shares) has not been forecast by the profession as to its extent and timing. Instead we have witnessed a routine show of repeated post factum adjustements of current forecasts.

If one asks for explanations for this state of affairs, it is unavoidable to look at the kind of econometrics in use.
Econometrics per se does not make a difference between causal relations and correlation: models replay historical correlations without explaining causal relations. A good example in question is the Phillips Curve, which is currently a topic again.

This functional relationship has never modeled the real causes of inflation or /and wage increases, it is solely a very much aggregated summary of statistical system behaviour of the observed past, which is arrived at essentially by curve fitting methods. The cited relationship of high inflation and corresponding low unemployment (and vice versa) had to be off course when in the 70's inflation run away: system behaviour had changed, but certainly the causal relationships at the base not! With increasing inflation cause-effect relations (e.g. indexing mechanisms, etc.) were important again. But by these indexing mechanisms the relation of inflation and wage was changed in a way not to be forecast by the Phillips Curve. If inplace of the Phillipscurve we would have used a model representing the working cause-effect relations, such a model would have given insight about the consequences of a changed system behaviour, it would have been possible even to forecast such a change quantity- and timewise.

With this practical exemple we wanted to illustrate, that econometrics deliver in general dependable results when no change of system behaviour occurs. For cases including change of system behaviour we advice application of system dynamic models centered on simulation of cause-effect over the time horizon considered.
A topical case in question was and still is the introduction of the EURO, because it is changing profoundly the whole fabric of exchange rates in Europe and elsewhere.

A very practical question of forecast would be:

What are the repercussions of the Euro for the interest-rates in Switzerland ?

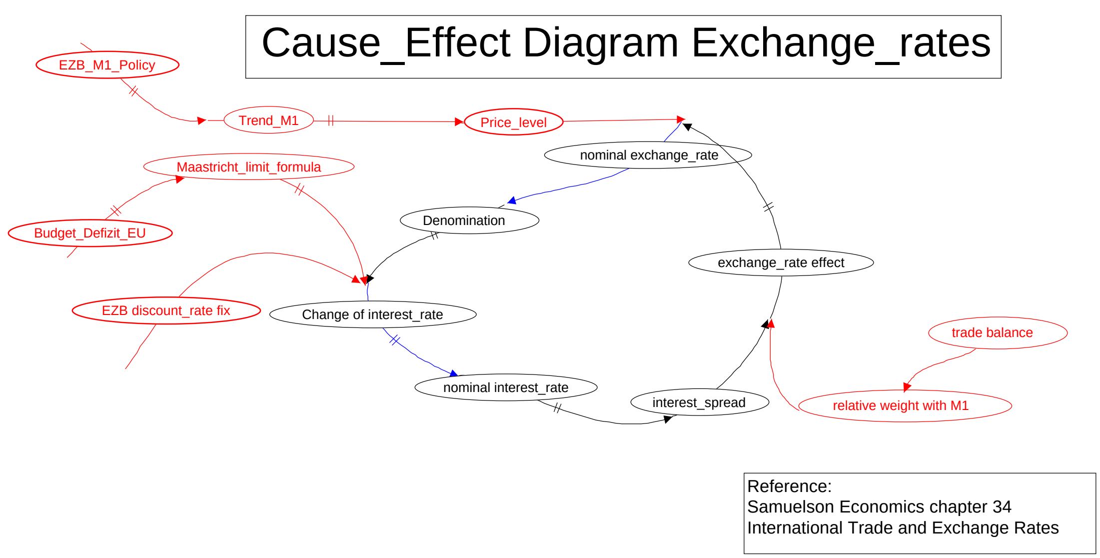
For answering this question we have in cooperation with a bigger Swiss financial institution worked out an elementary system dynamics model. Its purpose was to

make a first practical sysnthesis of the main cause-effect relationships which are at the
base of the econometrics models used actually as an experimental platform for a first round of validation. This translation to a system dynamics model comprises the most important cause-effect relationsships such as relative level of prices, the interest spread and the resulting exchange rate also including the influence of the monetary policy of the national central banks involved.

In a rather short time and with reasonable cost it was possible to get to a model, which during validation did sufficiently well replay the exchange rates DEM vs CHF in the time span from 1985 to 1995. This period had its share of events changing system behavier quite drastically, We remember the breakthrough of electronic currencies in the late 80‘s, the fall of the Berlin wall in 1989, and the difficult adjustements of germany‘s economy afterwards.

With this very positive validation experience the way is opened for further work allowing to treat more complex questions of the ongoing changes anywhere in the monetary world and its effect on exchange rates. The simulation of appropriate models is resulting in quantitative scenario forecast with proper timing information.
The possibility to do quantitative scenario simulation is outperforming the traditional econometrics by a wide margin, especially so in an ever faster and more unpredictable environment.

The working assumption of this new and complementary approach is that the underlying cause-effect relationships change if ever very gradually, which allows to have very robust scenario simulation with a high degree of credibilty even with drastic changes of the economic environment included.



The reported model structure is explained in detail below.
Its functionality can be summarized as follows:

2. The elementary System Dynamics model to simulate the problem of exchange rate

The model presented has the purpose of a template, exposing the translation of econometric formula into the cause-effect language with levels and delays of a true system dynamics model.

In the following we give a detailed description of the model parts, which were constructed directly from the relevant econometric formula and describe the connection of differences of interest rates in two currencies and the respective exchange rate.

The total model has six parts:

- M1-Scenario-Input
- nom-exchange rate/trend exchange rate
- interest spread with Interface
- changes of interest rates (discountrate, etc.)
- buget-deficit-influence on interest rate
- trade and current account balance

2.1. M1-Scenario-Input

In this submodel the internal level of prices dependent on the volume of M1 (generalized and covering M1 to M3 aggregates) is calculated.
The input is the M1-Scenario over the time considered. Effective volume M1 means, that we include the total sum of liquidity of a national economy (including electronic payment).
Any change of M1 has two separate effects on the price level:

- Instant reaction because of price-elasticity of goods and services exchange for money:
  From general econometrics this elasticity in standard cases is:

  - 0.8 * trend of M1

- delayed effect of volume M1 price_level
  Inflation follows any chaqnge of M1 directly proportional, but with a delay of about 36 months. This is the time the change of M1 takes to work through the national economy considered.

  Inflation = Delayed (Trend von M1)

Inflation is the result of different individual changes of M1 according to the actual policies of money-supply of the central banks involved, superimposed one upon the other.

2.2. nom-exchange rate/trend exchange rate

The nominal exchange rate is a function of the following inputs:

- Price-levels of the currency regions (compared for their exchange rate)
  These are derived from a starting value and the correction for the price-level calculated in the submodel M1-Scenario-Input
- Basis-Exchange rate is calculated from the effect an interest-spread has on the exchange rate plus effects from the trade balance between the considered currency regions, initiated a starting value. The needed values for the Interest spread are taken from the submodel Interest-Spread.
- Input for Interestchange is the (anticipated) exchange rate change following the Trend-Extrapolation of the timewise development of Exchange rates. This is the devaluation of the currency concerned.

2.3. interest spread

The submodel contains the calculation of Interestspread as direct differential of the two currencies: e.g.

- interestchange_CH - interestchange_D

taken from the submodel Interestchange

2.4. changes of interest (discountrate, etc.)

The submodel contains the two model elements for calculating of Interestchange from the inputs of a currency:

- Devaluation (anticipation of the market) from the submodel nom-Exchange rate
- Discount-rate of the central bank involved
- And finally the influence of the fiscal-budget deficit of the currency region considered from the submodel budget-deficit-effect Interest.
  This value is calculated here e.g from the generalized so called “Maastricht formula”

2.5. buget-deficit-influence on Interest

This submodel serves to calculate the effect of the budget deficit as one of the parameters to measure dept capacity of the national economy on the (anticipated) market weigthed interestrate.
The applied ”Maastricht-formula” does has the following content:

- Allowed new debt < growth of national economy times limit governement debt in % BIP

exemple ”Maastricht-formula”:
Assuming growth of a national economy 5% and limit governement debt in % BIP of 60% would result in the famous cited 3.0% of allowed new debt p.a.

(which means that the politically fixed rate of 3% in the European Community and its followers is only correctly calculated for a growth of national economy 5% p.a., since quite a few years the allowed new debt in European Community is more than double the economically safe value and therefore the current devaluation of the EURO towards the US Dollar is a correction which should have surprised no one.)

The submodel explained reflects, that there will be definitely an influence on the anticipated interest rate caused by the accumulated budgetary deficit and the current total tax rate. This is modeled as the product of these parameters.
The correction is applied on the discountrate controlled by the central banks involved.. (e.g. the bigger the budgetary deficit and the bigger and the current total tax rate, the higher will be the cost of capital for international transfers, as shown by recent developments around IMF in Asia)

2.6 trade and current account balance

Trade and current account balance are the last but not least important impact to be considered on exchange rate, cf [1].

- The submodel builds the sum of current account, capital account and the balance official settlements, normalised by the respective M1 values for expressing influence on exchange rate. A first approximation for the time delay of effect is taken as one reporting period (the respective figures are available to market participants only periodically), we assume that the delay of reaction is the sampling rate of the account figures and not the real reaction of the currency market, which is only limited by transaction delays.

3. Overview on the six submodels:

value	Submodel
M1-Scenario of snb and buba	**M1-Scenario-Input**
trade_balance effect	**nom-Exchange rate/Trend WK**
Discountrates of snb and buba	**Interestchange (discountrate etc.)**
BIP growth CH an D, Taxation quota CH an D, Budget deficit p.a. CH an D	**buget-deficit-effect Interest**
Init_values for prices and exchange rates	**Trend nominal exchange rate**
Central bank discount rates	**Interest changes**
Diff_current_acc, Diff_capital_acc, official_settlement	**Trade-balance**

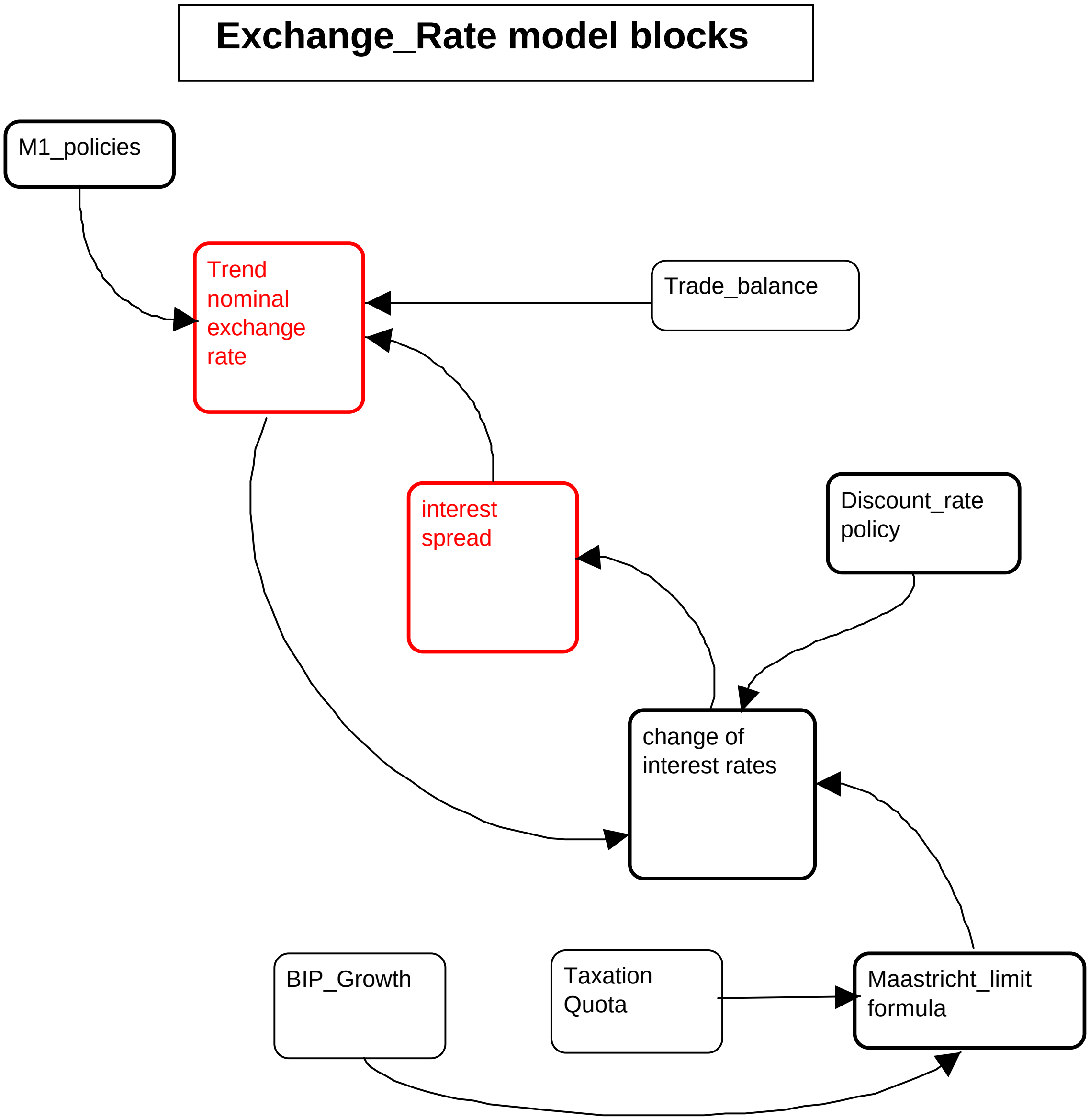
A template version of the model described will be available from Fast Focus Consulting Group, contact see www.rhone.ch/fastfocus/

The POWERSIM-model with the six submodels is illustrated below:

As is shown for validation purpose the implemented causal connections are reduced to the necessary minimum. For specified forecast or historical analysis work one would of course add and elaborate quite a few other causal connections, such as:

- Trade balance – exchange rate – interest spread: **economy & trade**

- M1-policy – Maastricht formula – dicount policy: **government policy**
  Taxation – Bip-growth:



Reference:

[1] Paul A. Samuelson and William D. Nordhaus. *Economics,* McCraw-Hill
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