

# Inflation and Real Growth in a Small Open Economy – The Swiss Case\*

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A small model of the output market, based on Philips curve analysis, is developed, showing the responses of demanders and suppliers to three categories of exogenous shocks – monetary, fiscal and foreign. The relative importance of the various forces with respect to the deviation of real growth from its trend and the rate of inflation is investigated by econometric methods using annual data for the period 1956 - 1975.

## 1. Introduction

The purpose of this article is to give an explanation of the observed changes in real growth and inflation in Switzerland over the post-war period. Switzerland is perhaps the prototype of a small, highly developed country with strong economic relationships to the rest of the world. It must therefore be expected that developments in the major trading partners have some influence on the Swiss economy. Their impact relative to the effects of changes in domestic forces will be investigated in some detail.

Two contentions are basic to the explanation of macroeconomic phenomena presented in the following sections. First, the interest lies in the longer-run movements of changes in real growth and inflation. This together with the availability of data led to the use of annual observations in the empirical work. Second, aggregate fluctuations in prices and output are hypothesized to be dominated by systematic forces. Monetary, fiscal and foreign impulses are distinguished and their relative influence on the output market are empirically investigated. Real shocks, such as harvest failures, are considered to have only transitory effects on real income and prices and are furthermore assumed to occur in a more or less random way. Note however that

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major such developments in the rest of the world, e.g. the recent oil price increase, are incorporated in the foreign impulses.

The actual behavior of both real growth and inflation was quite satisfactory over a large part of the period under investigation. The main problems occurred in the seventies with a rate of inflation approaching 10 % and the worst recession of the post-war period.<sup>1</sup>

The paper is organized as follows: In the next section a model of the output market is constructed which specifies the behavior of suppliers and demanders of newly produced goods and services determining the movements of the real growth rate and the relative change in the price level. In section 3 the measurement procedures for the various impulses are discussed. The empirical results concerning real growth and inflation for the period 1956 - 1975 are presented in section 4 together with a summary of the major findings.

## 2. The Model

The model developed in this section is designed to show the exogenous impulse forces often considered to be important for the output market and the way they influence real growth and the rate of price increase. It incorporates a price-setting function of suppliers and a demand curve and shows their interaction.<sup>2</sup> The time-lags assumed are based on best estimates — by statistical standards — in the empirical part of the paper. The lag structure which evolved from the empirical work confirms the well known microeconomic foundations of the expectations augmented Phillips-curve in the sense that real magnitudes react earlier than prices as a consequence of exogenous shocks.

The behavior of suppliers of output is summarized by the familiar price setting function

$$(1) \quad \hat{P}_t = \hat{P}_t^* + \alpha (\hat{y} - \hat{y}^*)_{t-1} + \mu_{st}$$

where  $\hat{P}$  = rate of inflation,  $\hat{P}^*$  = expected rate of inflation,  $\hat{y}$  = rate of real growth,  $\hat{y}^*$  = long-run normal rate of real growth,  $\mu_s$  = white noise error term,  $t$  = time index (years) and  $\alpha$  is a positive coefficient.

<sup>1</sup> Table A.1 in the appendix contains the data series for real growth ( $\hat{y}$ ) and inflation ( $\hat{P}$ ).

<sup>2</sup> The basic structure is discussed by *Laidler/Parkin* (1975, 774 - 779) and has been used in empirical studies for other countries, e.g. *Brunner/Meltzer* (1978), *Staff Report* (1976).

Equation (1) says that suppliers increase their prices by an expected component and by some proportion of excess demand lagged one year. Excess demand is expressed as the deviation of actual from long-run normal growth. The latter is determined by factors such as the growth in the labor force, technical progress and the existing institutional setting. The measurement procedures used to construct a time series for  $\hat{y}^*$  will be discussed below. The same applies for the expected rate of inflation  $\hat{P}^*$ .

The growth in demand for newly produced goods and services is hypothesized to consist of the long-run component  $\hat{y}^*$  and contemporaneous impulses. It is reduced in proportion to the rate of inflation. Mathematically,

$$(2) \quad \hat{y}_t = \hat{y}_t^* - \beta_0 + \beta_1 \hat{M}_t + \beta_2 F_t + \beta_3 \hat{x}_t + \beta_4 \hat{PI}_t - \beta_5 \hat{P}_t + \mu_{dt}$$

where  $\hat{M}$  = growth rate of the money stock,  $F$  = fiscal impulse,  $\hat{x}$  = growth rate of real exports,  $\hat{PI}$  = growth rate of import prices,  $\mu_d$  = white noise error term and  $\beta_{0-5}$  are positive coefficients.

The justification of the various forces influencing the demand for goods and services is straightforward.<sup>3</sup> A rise in the growth rate of money increases the real money stock above the level which people want to hold. With a stable demand for money function they try to get rid of the undesired balances by finally demanding more newly produced goods. The resulting increases, first in real growth and then in the rate of inflation, bring real money balances back to their desired level.

An increase in the demand for output from the side of the government "directly" influences  $\hat{y}$ .<sup>4</sup> Changes in taxes, which are also incorporated in the empirical measure of the fiscal impulse, work their way through changes in disposable income on the demand for consumption and investment goods.

In a study of an extremely open economy, as it is the case for Switzerland, foreign influences have to be taken into account. Three such impulse forces are identified in the model above. The first is only relevant in a system of fixed exchange rates which was in effect in Switzerland until January 1973. Under those circumstances foreign

<sup>3</sup> The nature of the impulse forces relevant for a small open economy is discussed in *Brunner (1974)*.

<sup>4</sup> The term "directly" in the sense used here means that the government is actively engaged in the output market itself. It does not follow from this fact that fiscal policy therefore works faster or has a stronger impact compared to other impulses.



reserve holdings are adjusted in order to stabilize the exchange rate leading to changes in  $\hat{M}$  over the money supply process.

The second impulse from abroad is related to the demand for output of foreigners which has its effect on total demand much in the same way as changing real government expenditures. Thirdly, a rise in the growth rate of import prices — of course adjusted for exchange rate movements — has a positive influence on the demand for domestically produced output because it creates an incentive to substitute away from foreign goods and services.<sup>5</sup>

Changes in the various impulses have only temporary effects on output. After expectations of inflation have been fully adjusted to prevailing market conditions real effects vanish, e. g.  $\hat{y}$  equals  $\hat{y}^*$  in the long-run. The focus of the model is exclusively on these adjustment processes in the market for newly produced goods. Especially the role of the asset markets is not specified. They can be thought of as lying “behind the demand curve”.

The demand equation shows the comparative effects of the various impulses in determining the rate of inflation in the long-run as shown by equation (3).

$$(3) \quad \hat{P} = -\frac{\beta_0}{\beta_5} + \frac{\beta_1}{\beta_5} \hat{M} + \frac{\beta_2}{\beta_5} F + \frac{\beta_3}{\beta_5} \hat{x} + \frac{\beta_4}{\beta_5} \hat{P}I + \frac{1}{\beta_5} \mu_d$$

In this long-run context it is appropriate to explain the negative constant  $\beta_0$  in the demand equation. An economy growing at its normal rate either requires that one or more of the various impulses are constant but positive or that the price level decreases at a given rate. Consider a situation where the growth rate in the quantity of money is the only significant impulse. In long-run equilibrium at constant prices characterized by  $\hat{y} = \hat{y}^*$  and  $\hat{P} = 0$ ,  $\hat{M}$  would have to be some positive number to ensure that the real quantity of money is kept in line with the growth in output. It follows from (3) that the required rate of monetary growth in this case would be  $\beta_0/\beta_1$ . Similar arguments apply to the other impulse forces.

The model need be closed by hypotheses concerning expected magnitudes which are not directly observable.

Long-run real growth is measured by the time trend of actual real growth determined by ordinary least squares over the period 1951 to

<sup>5</sup> To keep the model manageable, the simplifying assumption is made that imported goods are not good substitutes for goods exported by Switzerland. Otherwise, import prices and real exports are not independent leading to simultaneity problems in estimation.

1975. The error terms of the regression are then used as a proxy for excess demand.<sup>6</sup> This measurement procedure is certainly open to criticism. The ideal would be a time-series for the potential growth in output which incorporates changes in its determinants but excludes influences from the impulse forces specified in the model. Data of that kind are however not available for the Swiss economy and an attempt to get the necessary information would have gone beyond the scope of this study.

Two alternatives to measure the expected rate of inflation are used in the empirical work. The first procedure assumes a simple proportionality to the actual rate of price increase one year ago, e.g.  $\hat{P}_t^* = d \hat{P}_{t-1}$ . The price-setting function then becomes

$$(4) \quad \hat{P}_t = d \hat{P}_{t-1} + \alpha (\hat{y} - \hat{y}^*)_{t-1} + \mu_{st}$$

The second approach is the familiar adaptive mechanism shown by equation (5).

$$(5) \quad \hat{P}_t^* - \hat{P}_{t-1}^* = k (\hat{P}_{t-1} - \hat{P}_{t-1}^*)$$

Applying a *Koyck* transformation one gets for the price-setting equation

$$(6) \quad \hat{P}_t = \hat{P}_{t-1} + \alpha (\hat{y} - \hat{y}^*)_{t-1} - \alpha (1 - k) (\hat{y} - \hat{y}^*)_{t-2} + \mu_{st} - (1 - k) \mu_{st-1}$$

### 3. Measurement of Impulses

The measurement of the monetary impulse is considered first followed by the fiscal and foreign impulses. For information on data sources and actual magnitudes of exogenous as well as endogenous variables the reader is referred to the appendix.

The *monetary impulse* is represented by the growth of the narrowly defined money stock  $M_1$ . The proposed measure contains some components which are in principle endogenous relative to real growth and inflation. The result would be inconsistent estimates of the monetary influence on the output market, a problem especially relevant with

<sup>6</sup> The resulting regression equation is

$$\hat{y}_t = 5.97^* - 0.17^* t \quad \bar{R}^2 = 0.10, SE = 3.06, DW = 1.36 \\ (4.74) (-1.95)$$

For explanation of the symbols the reader is referred to table 1. The empirical work reported later has also been done using the deviation of the natural logarithm of  $y_t$  from its trend value. The results concerning the dominance of impulses are not affected.

respect to real growth which is dependent on contemporaneous impulses. The lagged impulse forces determining the rate of inflation can be considered as pre-determined.

The endogeneity problem is however not as serious as it may first seem. Over the period examined here movements in  $M_1$  have been clearly dominated by changes in the monetary base. During the period of fixed exchange rates, that is up to 1973, the latter was almost exclusively determined by foreign reserve holdings of the Swiss National Bank. For the case of a small open economy it seems plausible to argue that domestic real growth has a negligible influence on official foreign reserve positions.

Since the flexible rate period started on January 23, 1973 the base is a policy determined variable. Other sources of endogeneity, such as the financing of budget deficits, have been of no practical importance in Switzerland.

The *fiscal impulse* includes two components.<sup>7</sup> Government expenditures have a positive effect on the demand for goods and services whereas taxes exert an influence in the opposite direction by reducing disposable income. Both parts of the impulse are arbitrarily given equal weights of one in absolute value.<sup>8</sup> The formula is:

$$(7) \quad F_t = \frac{\Delta(G_t^a - T_t^a)}{y_{t-1}} 100$$

where  $F$  = fiscal impulse,  $G^a$  = autonomous real government expenditures,  $T^a$  = autonomous real tax revenue,  $y$  is real income and  $\Delta$  denotes absolute changes in the respective variables.  $G^a$  and  $T^a$  are defined below.

The fiscal impulse measure contains only the federal level of government. The social security system (AHV) and government owned firms such as the post office and the railways are excluded. To make the measure comparable over time it is normalized by lagged real income.<sup>9</sup>

<sup>7</sup> The following discussion is based on *Blinder/Solow* (1974).

<sup>8</sup> A large variety of different fiscal measures has been examined also. The effects of fiscal policy don't depend on the exact specification. The results are reported in *Wasserfallen* (1979).

<sup>9</sup> It can be seen from table A.1 in the appendix that  $F$  doesn't vary much over time which could be responsible for the insignificant coefficients for the fiscal impulse presented in section 4. Using lagged real government expenditures as a normalizing factor increases the variability considerably without changing the econometric results.



To get autonomous figures for government expenditures and tax revenue some adjustments are made for components which are dependent on the endogenous variables in the model. When a real impulse is used, as is done here, the part of expenditures set in nominal terms by fiscal policy decisions needs to be corrected for changes in the price level.

All expenditures except for wages, amounting to 12.3 % of the total in 1975, are treated that way. Payments to state employees are assumed to be determined in real terms so that the federal government is able to hold its share of the labor force. A second correction has been made with respect to expenditures going to foreign countries which do not affect the domestic production of goods and services. In the published budget statements only some small items are separated out, amounting to 1.8 % of total expenditures in 1975. Unfortunately, no information is given on state imports. In the case of wages the consumer price index is used as a deflator whereas the other expenditure categories are deflated by the price index of government expenditures from the national income accounts.

Tax laws are usually set up in a way which makes tax revenue dependent on income. The regulations concerning tax liabilities over time of firms and households imply the procedure to be applied for the determination of the endogenous part of taxes. In the case of Switzerland one needs to distinguish direct taxes on income and wealth from indirect taxes such as sales taxes. Indirect taxes are based on actual variables, whereas direct taxes depend in a complicated way on past levels of income. The rather technical adjustment procedures used in the construction of the fiscal impulse take those institutional features into account. A detailed explanation is provided in *Wasserfallen* (1979).

Two classes of *foreign influences* other than the already discussed exchange rates are considered. The first is the growth rate of real exports acting as a proxy for the demand of goods and services by foreigners<sup>10</sup>. The second foreign impulse is the rate of change in import prices hypothesized to have a positive impact on domestic demand via the substitution effect described in section 2.

In the next section the empirical findings regarding the relative importance of the various exogenous forces are presented.

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<sup>10</sup> Exports are statistically a part of gross national product. This might result in some spurious correlation in the empirical estimates. The introduction of a one year lag between the growth rates of exports and GNP does however not change the results reported in section 4.

#### 4. Empirical Results

The empirical results are summarized in table 1. In column 1 the independent variables and test statistics are listed. Columns 2 to 4 contain the ordinary least squares estimates of equations (2), (4) and (6) using annual data over the period 1956 - 1975<sup>11</sup>. Columns 5 and 6 show the estimated reduced forms for the rate of price increase related to the two hypotheses concerning expected inflation.

In general the estimation results are in close agreement with the underlying model. With minor exceptions, the coefficients appear with the correct sign. The explanatory power is good as shown by a coefficient of determination above 0.8 in all cases. First order serial correlation seems to be no problem<sup>12</sup>. The stability conditions of the model, not explicitly derived here, are empirically fulfilled which implies that changes in the various impulse forces result in only temporary deviations from long-run real growth.

Three out of four impact multipliers are significantly positive in the case of real growth. The strongest forces are of a foreign nature. An increase in the growth of real exports or import prices by one percentage point result in a short-run deviation of actual from trend output growth by about 0.4 percentage points. The influence of changes in the monetary impulse is smaller but still highly significant. The fiscal impulse on the other hand has an impact which cannot be distinguished from zero on statistical grounds. It seems to be the case that full crowding-out occurs in less than one year. It has been argued that a fiscal policy trying to prevent deviations from long-run equilibrium real growth must result in a coefficient estimate which is biased downward<sup>13</sup>. There is no indication that fiscal policy has actually been conducted that way over the sample period.

The significant negative constant which appears in the excess demand equation leads to a quantitative estimate of the long-run influence of the exogenous variables. Consider for example a situation of long-run equilibrium with stable prices. This means that  $(\hat{y} - \hat{y}^*)$ ,  $\hat{P}$  and  $\hat{PI}$  are all zero. Neglecting the non-significant fiscal impulse the resulting equation is

<sup>11</sup> Equations (1) and (2) in the text imply a recursive structure. Ordinary least squares give consistent parameter estimates under the assumption that the error terms are uncorrelated across equations.

<sup>12</sup> The DW-statistic is biased towards two in the equations for  $\hat{P}_t$  because lagged dependent variables are included among the regressors. Checks using a grid search procedure give no indication that first order serial correlation is present.

<sup>13</sup> *Blinder/Solow* (1974, 69).



Table 1

## Impulses, Real Growth and Inflation

(1)	$(\hat{y} - \hat{y}^*)_t$ (2)	$\hat{P}_t$ (3)	$\hat{P}_t$ (4)	$\hat{P}_t$ (5)	$\hat{P}_t$ (6)
Constant	- 4.24* (- 4.86)	0.54 (1.31)	0.55 (1.26)	- 2.33* (- 2.78)	- 2.29* (- 2.62)
$(\hat{y} - \hat{y}^*)_{t-1}$		0.52* (4.62)	0.52* (4.35)		
$(\hat{y} - \hat{y}^*)_{t-2}$			0.01 (0.06)		0.04 (0.27)
$\hat{P}_t$	- 0.24 (- 1.46)				
$\hat{P}_{t-1}$		0.84* (9.13)	0.84* (7.87)	0.91* (5.53)	0.91* (5.29)
$\hat{M}_t$	0.24* (3.72)				
$F_t$	0.52 (1.00)				
$\hat{x}_t$	0.44* (5.86)				
$\hat{P}I_t$	0.34* (3.60)				
$\hat{M}_{t-1}$				0.11* (1.85)	0.11 (1.72)
$F_{t-1}$				0.59 (1.25)	0.54 (1.04)
$\hat{x}_{t-1}$				0.27* (3.48)	0.27* (3.37)
$\hat{P}I_{t-1}$				0.02 (0.19)	0.01 (0.14)
$\bar{R}^2$	0.86	0.84	0.83	0.84	0.82
SE	1.16	1.05	1.08	1.08	1.11
DW	1.81	1.83	1.84	2.20	2.20

t-values: In parentheses below estimated coefficients.

\*: Coefficient significantly different from zero on the 5 %-level.

 $\bar{R}^2$ : Coefficient of determination corrected for degrees of freedom.

SE: Standard error of the estimate.

DW: Durbin Watson statistic.

$$(8) \quad \beta_0 = \beta_1 \hat{M}_t + \beta_3 \hat{x}_t$$

Assuming that the average growth rate in real exports over the sample period, 6.0 % from 1956 - 1975, is equal to its long-run value implies a long-run non-inflationary monetary growth of 6.7 % per annum.

Column 3 in table 1 shows that excess demand lagged one year is significant in explaining the rate of growth in consumer prices. Introducing  $(\hat{y} - \hat{y}^*)_{t-2}$  as implied by the adaptive expectation scheme for expected inflation leaves the results unaltered.

The reduced forms in columns 5 and 6 inform about the impact of the exogenous impulse forces on inflation. Both the growth rates of the money supply as well as of real exports get significant parameters which come close to what is implied by the estimated structural coefficients<sup>14</sup>. The monetary impulse is relatively weak implying an implausibly long adjustment period for the rate of inflation<sup>15</sup>.

Relative changes in import prices have no influence on inflation. This is in contrast to the results obtained with respect to real growth. It seems to be the case that the necessary adjustments in the Swiss economy take place through changes in the composition of output. The model presented in section 2 is however not able to capture those effects<sup>16</sup>.

The statistical unimportance of the fiscal impulse is in agreement with the estimates for excess demand as the dependent variable.

The empirical findings are easily summarized. Monetary and foreign influences play an important role in determining the state of the output market expressed here by real growth in excess of its trend value and by the rate of inflation in consumer prices. Especially real growth depends to a considerable extent on economic developments in the major trading partners, e.g., countries in western Europe and the USA. The estimated impact of the fiscal variable on the other hand does not significantly differ from zero.

Swiss policy makers have no influence on the performance of foreign economies. The empirical results presented above imply that the population of a small open country like Switzerland benefits considerably from

<sup>14</sup> The reduced form coefficients in both columns are  $\alpha\beta_1$  for  $\hat{M}_{t-1}$  and  $\alpha\beta_3$  for  $\hat{x}_{t-1}$ . Their values in terms of the structural estimates are 0.12 and 0.22.

<sup>15</sup> Empirical estimates for other small open economies are however similar in magnitude. See *Brunner/Meltzer (1977)*.

<sup>16</sup> The influence of import prices might also be picked up by the lagged inflation rate because the basket of goods used in the calculation of the consumption price index contains imported goods.

a successful stabilization policy abroad. This conclusion is especially relevant with respect to the big nations which produce a relatively large share of the world's total output.

### Appendix: Data and their Sources

- G*: Government expenditures. Annual data. Eidgenössische Staatsrechnung.  
*M*: Money stock including demand deposits. Annual averages of end of month data. Monatsbericht der Schweizerischen Nationalbank.  
*P*: Index of consumer prices. Annual averages of monthly data. Monatsbericht der Schweizerischen Nationalbank.  
*PI*: Index of import prices for goods and services, corrected for changes in exchange rates. Annual data from national income statistics. Volkswirtschaft.  
*T*: Government revenue from all sources. Annual data. Eidgenössische Staatsrechnung.  
*x*: Real exports of goods and services (1958 = 100). Annual data from national income statistics. Volkswirtschaft.  
*y*: Real income. Gross national product at 1958 prices. Annual data. Volkswirtschaft.

Table A.1

#### Data

Year	$\hat{y}$ (%)	$\hat{P}$ (%)	$\hat{M}$ (%)	$F$ (%)	$\hat{x}$ (%)	$\hat{PI}$ (%)
1956	6.0	1.5	4.3	0.2	10.1	3.0
1957	2.9	1.9	3.7	1.0	4.9	2.9
1958	-1.8	1.8	3.4	0.7	-1.2	-3.8
1959	7.2	-0.6	9.9	-0.4	11.8	-3.9
1960	5.8	1.4	7.3	-0.2	6.5	0.0
1961	7.3	1.9	14.3	2.0	7.6	0.0
1962	5.1	4.3	10.5	0.6	5.9	1.1
1963	4.6	3.4	7.6	0.5	5.4	3.0
1964	5.1	3.1	5.9	1.0	6.9	1.9
1965	4.3	3.4	4.5	0.9	11.6	0.9
1966	2.9	4.8	2.6	1.0	5.2	2.8
1967	1.8	4.0	3.0	0.1	3.6	0.5
1968	4.2	2.4	9.5	0.4	9.7	0.6
1969	5.5	2.5	5.4	0.4	13.5	1.9
1970	6.0	3.6	5.0	0.8	6.7	6.2
1971	3.9	6.6	16.5	0.9	3.9	1.4
1972	3.2	6.6	17.5	0.7	6.4	2.0
1973	3.2	8.7	2.3	1.1	7.9	6.3
1974	1.7	9.8	0.1	0.7	1.0	17.9
1975	-7.6	6.7	4.3	-0.3	-6.6	-2.8



### Summary

A small model of the output market, based on Phillips-curve analysis, is developed, showing the responses of demanders and suppliers to three categories of exogenous shocks — monetary, fiscal and foreign. The relative importance of the various forces is investigated by econometric methods using annual data for the period 1956 - 1975. The deviation of real growth from its trend is mainly influenced by relative changes in the stock of money, real exports and import prices. The first two impulses are also significantly related to inflation. No effects of fiscal policy could be discovered.

### Zusammenfassung

Auf der Grundlage der modernen Phillips-Kurven Analyse wird ein kleines Modell des Gütermarktes entwickelt, das die Reaktionen der Anbieter und Nachfrager auf drei Arten exogener Faktoren beschreibt. Die relative Bedeutung monetärer, fiskalpolitischer und außenwirtschaftlicher Impulse wird mittels Jahresdaten der Periode 1956 - 1975 empirisch untersucht. Es zeigt sich, daß die Abweichung der Wachstumsrate des realen Bruttosozialprodukts von seinem Trend hauptsächlich durch Änderungen in den Wachstumsraten der Geldmenge, der realen Exporte und Importpreise bestimmt wird. Die beiden ersten Impulse sind auch wesentliche Ursachen der Inflationsrate. Ein statistisch signifikanter Einfluß fiskalpolitischer Variablen kann dagegen nicht nachgewiesen werden.

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