Inflation, Inflation Variability and Relative Price Variability in Switzerland

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INTRODUCTION

In the discussion on the costs of inflation, two aspects usually emerge as having a particular influence on real variables: inflation variability and relative price variability (see FRIEDMAN 1977, GOLOB 1993). Inflation variability increases the uncertainty associated with long-term contracts fixing any kind of prices, such as prices in the narrow sense of the word, wages, and interest rates. Inflation variability can lead to shorter maturities or to an indexation of contracts. Frequent renegotiation and indexation cause high costs without being able to protect individuals entirely against unanticipated inflation fluctuations. Inflation variability may lead investors to ask for risk premiums that would not be necessary under a stable inflation rate. Finally, unanticipated inflation movements give rise to an arbitrary redistribution of income and wealth. Relative price variability, on the other hand, means shifts in the relative prices between different products or groups of products. A high relative price variability decreases the efficiency of the markets, leads to distortions in the price system and to a misallocation of scarce resources.

On the other hand, the absolute size of the inflation rate, if it is stable, perfectly anticipated and does not cause shifts in the relative prices, should only have minor effects on real variables, mainly by leading to inefficiently small real money balances and thereby causing transaction and coordination costs. However, there are strong doubts in literature that inflation, its volatility and relative price variability are independent of each other. There rather seems to be a positive empirical relation between inflation and its volatility and relative price variability. These empirical regularities can be explained by various theoretical approaches.

This contribution examines the relation between inflation, its variability and relative price variability in Switzerland. The Swiss case is of particular interest as Switzerland is a traditional low inflation country. While most of the empirical evidence for the above mentioned positive relation comes from US-data, the question at issue here is wether this positive relation also holds in a low inflation country. The paper is organized as follows. Part 1 gives a short summary of the various theoretical explanations for the above mentioned relations, and part 2 surveys the existing empirical work. Part 3 presents empirical results for Switzerland, and part 4 concludes.

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1. THEORETICAL EXPLANATIONS

In the theoretical literature various explanations can be found for the positive relation between inflation and inflation variability (see HOLLAND 1995). The most common approach can be traced back to OKUN (1971) and was formalized by BALL (1992). The approach is based on the specific behaviour of the monetary authorities in phases of high or low inflation. If the inflation rate is low, there will be a general consensus to keep it low. If inflation is high, however, the central bank faces a conflict between fighting inflation and minimizing the costs of disinflation. In such a situation, the central bank is likely to be under contrasting political pressure. This conflict may well result in an erratic stop-and-go policy, and thereby in increased inflation volatility. This explanation therefore implies causality running from inflation to inflation variability. In other words, by generating a low inflation rate, the central bank can limit inflation variability as an important cost factor of inflation.

In an alternative approach proposed by DEVEREUX (1989), causality runs the other way around. In the Devereux model, an increase in real, relative to nominal, shocks causes a decrease in the indexation level of wages and prices. Less indexation raises the real effects of an inflationary surprise, and thereby the incentive for the government to inflate. This results in a higher inflation rate. As the variability of real shocks increases inflation uncertainty in this model, inflation and inflation variability are positively correlated.

Another model in which increased inflation uncertainty leads to a higher inflation rate is CUKIERMAN and MELTZER (1986). In the Cukierman/Meltzer model, central banks with variable preferences tend to choose an imperfectly controllable monetary aggregate as target. This increases the uncertainty about the development of the monetary aggregate and the inflation rate. The imperfect control over the monetary target prevents expectations from adapting quickly. This, in turn, raises the real effects of an inflationary surprise and the incentive for the government to inflate. The size of inflation is thus a consequence of an imperfect controllability of the monetary target and increased inflation uncertainty.

The positive correlation between inflation and relative price variability, on the other hand, can also be explained by essentially three approaches (see GOLOB 1993). The first explanation goes back to the LUCAS (1973) model with imperfect information. In this model, individuals cannot distinguish between changes in the general price level and shifts in relative prices. The imperfect information on the change of the general price level causes shifts in the relative prices. The second approach is based on price rigidities due to long-term contracts or menu costs. The term of the contract and/or the size of the menu costs being different for every good or group of goods, the prices of these goods adapt to inflation with a different speed (see HESS/MORRIS 1996). In the third approach, finally, both inflation and relative price variability are driven by a common shock, for example an oil shock or a fiscal shock. These shocks increase the general price level and, by changing the composition of final demand, cause relative price shifts.

While the first two explanations have the same implications for causality and monetary policy as the above mentioned approach by OKUN and BALL, the third explanation leads to very different conclusions. If inflation and relative price variability are related through common shocks, there is no causality between the two variables. In this case, the central bank cannot lessen relative price variability by reducing inflation.

2. EMPIRICAL EVIDENCE

a) Inflation and inflation variability

In the empirical literature, the standard deviation is often used as a measure of inflation variability. However, FOSTER (1978) shows that the standard deviation is only a good measure of variability if the inflation rate fulfils certain conditions[1]. In the event that these conditions are not met, FOSTER proposes the absolute change of the inflation rate as an alternative measure of variability[2].

In addition, there is a discussion as to the extent to which inflation variability is a good proxy for inflation uncertainty. In general, significant fluctuations in the inflation rate tend to make inflation forecasts more difficult; BALL/CECCHETTI (1990) therefore consider that there is no big difference between inflation uncertainty and inflation variability. Other authors think that inflation variability is an imperfect proxy for uncertainty and argue in favour of an estimate of uncertainty through the use of inflation expectations (see, for example, NUGENT/GLEZAKOS 1984). The problem is that inflation expectations are not directly observable and have to be approximated (see KLEINEWEFERS LEHNER 1997, p. 121 ff.). In the empirical literature, inflation expectations are mostly estimated in two ways: through a model or by using survey data.

To model inflation expectations, hypotheses about the factors determining inflation and the way expectations are formed (autoregressive or rational expectations) are needed. Thus, the disadvantage of the model-based approach is that it requires both hypotheses about the structure of the economy and the information set of individuals. The use of survey data, on the other hand, is the most direct way to capture inflation expectations. The questions asked in a survey can be of qualitative or quantitative nature; however, the quantitatively oriented surveys needed here are relatively rare. GOLOB (1993) shows that the results obtained from studies on the relation between inflation and inflation uncertainty using model-based inflation expectations are not robust to the different models. If, on the other hand, survey data are used, results seem quite robust and mostly show a significant positive correlation.

1. The inflation rate must be an independent random variable from a stationary population with a finite variance.
2. A similar measure is the squared change of the inflation rate used by BALL/CECCHETTI (1990).

Besides using different proxies for inflation uncertainty, empirical studies differ in examining either a cross-country relation or a time-series relation for a certain country. The first cross-country study dates back to Okun (1971), who found a significant positive relation between the average inflation rate of 17 OECD countries and its standard deviation for the period 1951–68. Okun's paper was followed by many other cross-country studies. While most of them arrive at the same result, the results are not always robust to the time period, the country sample and the proxy for inflation uncertainty (for a survey see Golob 1993; for a later paper see Hess/Morris 1996).

An updated estimate for 23 OECD countries shows a significantly positive correlation between average inflation and its standard deviation (see graph 1 and table 1). Therefore, an equation of the form

$$SD_i = a + b\pi_i$$

is estimated, where SD is the standard deviation and π is the average inflation rate; i is the country index. The equation was estimated for the period since the breakdown of the fixed-exchange-rate regime of Bretton Woods 1973–96, and for the subperiod 1980–96. The subperiod excludes the oil shocks of the seventies that could possibly bias the results. Concerning the country sample, the estimate was carried out including and excluding the outlier Iceland (the point situated in the upper right corner of graph 1).

Graph 1: Inflation and inflation variability in 23 OECD countries, 1973–96

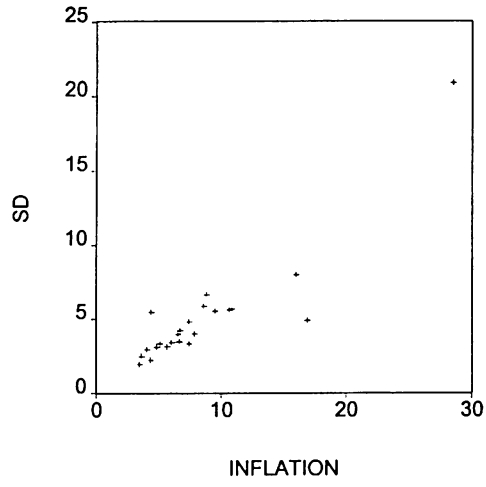


Table 1: Inflation and inflation variability in 23 OECD countries

	b	R^2
Ø 1973–96, incl. Iceland	0.609* (0.063)	0.81
Ø 1980–96, incl. Iceland	0.728* (0.085)	0.78
Ø 1973–96, excl. Iceland	0.322* (0.064)	0.56
Ø 1980–96, excl. Iceland	0.33* (0.062)	0.59

*significant at the 5%-level
Data source: OECD

As can be seen in table 1, the results hardly differ between the whole period and the subperiod. The exclusion of Iceland weakens the correlation, but the coefficient remains significant.

In time-series studies, most papers also find a positive relation between inflation and inflation uncertainty (for a survey see again GOLOB 1993; for a later paper see ARNOLD/DEN HERTOG 1995). Time-series studies usually work with quarterly data, of which averages and standard deviations (or another proxy for uncertainty) are calculated over 4–8 quarters. Then, an equation such as

$$SD_t = a + b\pi_t$$

is estimated, where t represents the time index.

The large majority of time-series studies refers to the USA. Thus, the result that most studies find a positive relation between inflation and inflation uncertainty could be country-biased. The results for countries other than the USA are less clear cut. For Switzerland, only KATSIMBRIS (1985) finds a significantly positive coefficient; KATSIMBRIS (1982, 1984) and NUGENT/GLEZAKOS (1984), on the other hand, do not find a significant relation.

b) Inflation and relative price variability

Compared to work on the relation between inflation and inflation uncertainty, empirical studies of the relation between inflation and relative price variability are more homoge-

nous. The measures for relative price variability do not fundamentally differ; relative price variability is defined as standard deviation (or variance) of the difference between the inflation rate of the various subindices and the total price index

$$SD = \sqrt{\sum_{i=1}^{n} W_{it} (\pi_{it} - \pi_t)^2},$$

where π_{it} represents the subindex for the group of goods i and π_t the total index. W is the weight of the subindices in the total index. Many studies make the simplifying assumption that the weight of all the subindices is equal, so that w = 1/n. The studies differ in the choice of the price index (mostly consumer prices, sometimes producer prices) and in the level of aggregation of the subindices (single goods or categories of goods).

Due to a lack of comparable data there are only a few cross-country studies of the relation between inflation and relative price variability (for an earlier paper see GLEJSER 1965, for a later paper see HESS/MORRIS 1996). HESS/MORRIS (1996) only had 13 countries with six comparable subindices to work with; in a second variant of their estimate, they increased the number of subindices to 14, but were left with only seven countries. Both HESS/MORRIS and GLEJSER found a positive cross-country correlation between inflation and relative price variability.

In contrast to cross-country studies, there is a large number of time-series studies on the relation between inflation and relative price variability for a certain country. Of all the papers listed in GOLOB (1993), only one does not find a significant positive relation. With this exception the results are robust to the choice of the country (USA, Great Britan, Germany, The Netherlands, Israel), the time period and the measure for relative price variability. In the study by HESS/MORRIS (1996), however, only six of 13 countries show a significant positive coefficient[3]. The case of Switzerland seems to have been analysed only by GRANZIOL (1984). However, the Granziol paper is not directly comparable to other contributions, as GRANZIOL examines the relation between relative price variability and unexpected inflation. GRANZIOL finds a significant positive relation in Switzerland for the period 1966–1981.

3. This might be explained by the fact that HESS/MORRIS include dummies for the oil shocks in their equations, while the other studies do not.

3. EMPIRICAL EVIDENCE FOR SWITZERLAND

a) Inflation and inflation variability

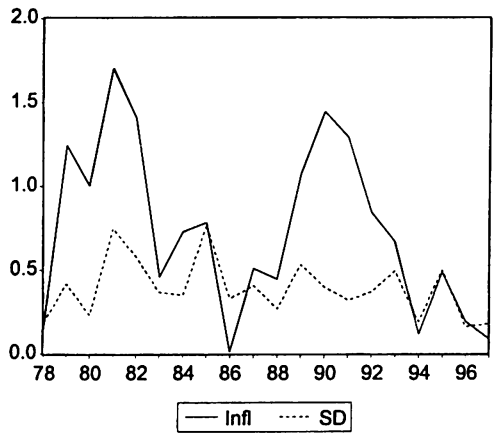
As mentioned above, all proxies for inflation uncertainty have their flaws. For reasons of simplicity and availability of data, the standard deviation will be used here. To test the robustness of the results, the absolute change in the inflation rate proposed by FOSTER will be used as an alternative measure.

One problem in time-series analysis is the availability of comparable data over a sufficiently long period of time. The Swiss Consumer Price Index (CPI), for example, has been redefined frequently over the years, so that the index in its present composition can be traced back only to 1978. The Swiss Wholesale Price Index (WPI) on the other hand is disposable in one and the same form from 1964–92. In the following, the relation between inflation and inflation variability will be analysed using both the CPI and the WPI (Data source: Federal Office for Statistics).

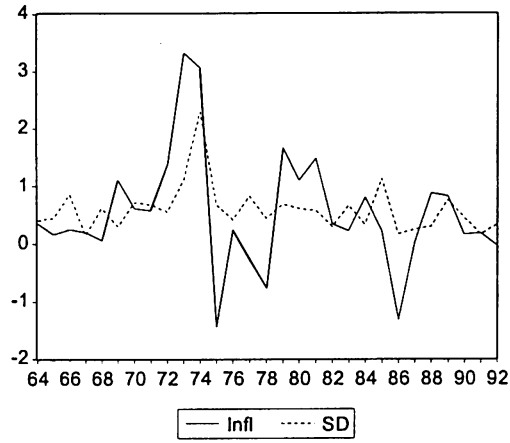
As in most of the literature, quarterly data are used. The robustness of the results is checked with monthly data. The inflation rate is defined as the percentage change in the price index from one quarter (month) to another. From these data, averages and standard deviations are calculated over non overlapping periods of 4 and 8 quarters (12 and 24 months) respectively. Graph 2 shows average inflation and its standard deviation over 4 quarters for the CPI and the WPI.

Graph 2: Inflation and inflation variability (standard deviation) in Switzerland

a) CPI



b) WPI



Both graphs show some, but no strong, evidence of a positive relation between inflation and inflation variability. Before testing the significance of this relation, the issue of stationarity of the variables shall be discussed. In general, empirical evidence points to a stationary inflation rate in industrialized countries (see for example the literature cited in KUGLER 1998). For a traditional low inflation country like Switzerland, the hypothesis of stationarity of the inflation rate, of its standard deviation and of the absolute change in its rate seems plausible in the longer run.

The stationarity of the variables is tested with the Augmented Dickey-Fuller test (ADF); table 2 shows the corresponding results.

Table 2: ADF test of the inflation rate, its standard deviation and its absolute change

	CPI	WPI
Inflation		
1. Ø 4 quarters	–1.68	–3.71*
2. Ø 12 months	–1.6	–3.78*
3. Ø 8 quarters	–2.69	–2.48
4. Ø 24 months	–2.49	–2.54
Standard deviation		
5. Ø 4 quarters	–2.58	–3.21*
6. Ø 12 months	–2.1	–3.66*
7. Ø 8 quarters	0.06	–1.76
8. Ø 24 months	–0.6	–1.86
Absolute change		
9. Ø 4 quarters	–1.97	–2.23
10. Ø 12 months	–2.28	–3.22*
11. Ø 8 quarters	–0.37	–2.39
12. Ø 24 months	–1.52	–1.9

*significant at the 5%-level

Overall, the ADF test yields unexpected results. The test is unable to reject the null hypothesis of a unit root for the variables based on the CPI, whereas some of the variables based on the WPI (those calculated over 4 quarters/12 months) are stationary. A likely reason for these results could be the relatively short time period, specially for the CPI-variables, and the small sample, specially for those series calculated over 8 quarters/24 months. However, the power of the ADF test is known to be low over shorter time periods, so that a rejection of the stationarity hypothesis might be premature. One way to overcome the methodological problems of the traditional unit root tests is to use tests testing directly the null hypothesis of stationarity. This approach is used by KUGLER (1998), who finds that the price level in Switzerland since 1973 is not only difference stationary, but even trend stationary.

In what follows, the stationarity of the variables is assumed. The possible non-stationarity, however, should be a caveat for the interpretation of the results.

Table 3 shows the estimation results of the equation

$$SD_t = a + b\pi_t .$$

Table 3: Inflation and inflation variability (standard deviation) in Switzerland

	b	DW	R^2
CPI			
1. Ø 4 quarters	0.21* (0.067) [0.053]	1.94	0.37
2. Ø 12 months	0.49* (0.075) [0.07]	2.14	0.7
3. Ø 8 quarters	0.19 (0.11) [0.15]	1.13	0.25
4. Ø 24 months	0.42* (0.09) [0.095]	1.74	0.73
WPI			
5. Ø 4 quarters	0.23* (0.06) [0.07]	1.95	0.32
6. Ø 12 months	0.32* (0.12) [0.13]	1.62	0.22
7. Ø 8 quarters	0.29 (0.25) [0.1]	1.95	0.1
8. Ø 24 months	0.26 (0.29) [0.05]	2.04	0.06

*significant at the 5%-level according to the standard errors in round brackets. Newey-West standard errors are shown in square brackets.

Table 3 shows some evidence for a positive relation between inflation and inflation variability in Switzerland, both for the CPI and the WPI. The evidence gets stronger if Newey-West standard errors are used, as the coefficients in equations 7 and 8 become significant. As the estimate for the WPI encompasses the seventies, these results could be biased by the oil shocks. The Chow test was run to test for a structural break in 1980, but the hypothesis of an identical coefficient for the period before and after 1980 could not be rejected.

Similar results are obtained if the absolute change in the inflation rate is used as a measure for inflation variability. Table 4 shows the results of the estimate for the equation

$$Diff_t = a + b\pi_t,$$

where Diff is the absolute difference in the inflation rate from one quarter (month) to another. Again, averages are calculated over 4 and 8 non overlapping quarters (12 and 24 months) respectively.

Table 4: Inflation and inflation variability (absolute difference) in Switzerland

	b	DW	R^2
CPI			
9. Ø 4 quarters	0.83* (0.36) [0.33]	0.8	0.24
10. Ø 12 months	0.55* (0.12) [0.11]	2.5	0.55
11. Ø 8 quarters	0.94 (0.8) [0.86]	1.43	0.17
12. Ø 24 months	0.45* (0.11) [0.09]	3.16	0.7
WPI			
13. Ø 4 quarters	0.19* (0.06) [0.06]	1.74	0.25
14. Ø 12 months	0.24* (0.09) [0.09]	1.27	0.23
15. Ø 8 quarters	0.28* (0.1) [0.05]	1.41	0.39
16. Ø 24 months	0.16 (0.16) [0.03]	1.82	0.08

*significant at the 5%-level according to the standard errors in round brackets. Newey-West standard errors are shown in square brackets.

The significance of the coefficient in equation 9, 12, and 14 is biased by autocorrelation. However, if an AR(1) term is added to the equations to eliminate autocorrelation, the coefficients all remain significant. If Newey-West standard errors are used, the results are the same, except for equation 16 whose coefficient now becomes significant. Again, the Chow test shows no structural break due to the oil shocks for the WPI. The use of absolute differences as a measure of variability thus also supports the result of a positive relation between inflation and inflation variability in Switzerland. This corresponds to the positive relation obtained by KATSIMBRIS (1985) for the period 1959–83 and contrasts with the earlier results found by KATSIMBRIS (1982, 1984) and NUGENT/GLEZAKOS (1984) for the period from 1950 or 1955 to 1970.

Finally, the direction of causality between inflation and inflation variability will be examined using the Granger causality test. The Granger causality test analyses the temporal order of two variables. If, in the question at issue, a higher inflation rate precedes a higher inflation variability, the inflation rate is said to «Granger cause» inflation variability. According to GOLOB (1993), a majority of the empirical work finds this direction of causality, lending support to the above mentioned theoretical explanation by OKUN and BALL (for a paper on causality in the USA see HOLLAND 1995).

The results of the Granger causality tests are shown in table 5. The numbering of the results from 1 to 16 corresponds to the numbering of the equations in tables 3 and 4. In all equations with yearly data (Ø 4 quarters and Ø 12 months), the tests are performed with 1 or 2 lags, while only 1 lag is used in the equations with data over Ø 8 quarters and Ø 24 months. First, it seems rather implausible that the variables could help predict each other with longer lags, and second, the number of lags is limited by the relatively small number of observations.

Table 5: Granger causality between inflation and inflation variability[1]

	inflation → variability		variability → inflation	
variability = standard deviation	1 lag	2 lags	1 lag	2 lags
1. CPI Ø 4 q.	1.32	0.94	6.2*	2.55
2. CPI Ø 12 m.	5.44*	4.88*	5.43*	2.81
3. CPI Ø 8 q.	1.26		0.77	
4. CPI Ø 24 m.	0.13		0.07	
5. WPI Ø 4 q.	16.56*	9.9*	7.06*	2.85
6. WPI Ø 12 m.	18.16*	7.14*	7.27*	3.21
7. WPI Ø 8 q.	5.35*		0.17	
8. WPI Ø 24 m.	7.96*		0.44	
variability = absolute differences				
9. CPI Ø 4 q.	0.18	0.17	0.74	0.39
10. CPI Ø 12 m.	2.59	5.15*	0.48	0.52
11. CPI Ø 8 q.	1.16		0.04	
12. CPI Ø 24 m.	3.95		0.52	
13. WPI Ø 4 q.	4.55*	2.47	0.21	0.01
14. WPI Ø 12 m.	12.97*	5.75*	5.47*	2.1
15. WPI Ø 8 q.	0.96		0.33	
16. WPI Ø 24 m.	14.23*		0.18	

[1] The values shown in the table are the F-statistics of the null hypothesis that inflation does not Granger cause variability or that variability does not Granger cause inflation. The asterisk indicates rejection of the null hypothesis at the 5%-level.

The results shown in table 5 are not clear cut. There is some more evidence of Granger causality from inflation to variability, but there is also a feedback from variability to inflation. Thus, the positive relation between inflation and inflation variability in Switzerland cannot be clearly explained by just one of the theoretical models surveyed in part 1. The different results possibly indicate that several theoretical approaches contribute to the explanation of the positive relation between inflation and its variability.

b) Inflation and relative price variability

Again, quarterly data of the consumer price index (CPI), the wholesale price index (WPI) and their respective subindices are used. The CPI consists of 8 and the WPI of 9 subindices[4]. Inflation rates are calculated as percentage changes of the price indices from one quarter to another. A check of the robustness of the results using monthly data can be usefully done only for the WPI, as some subindices of the CPI are not collected monthly.

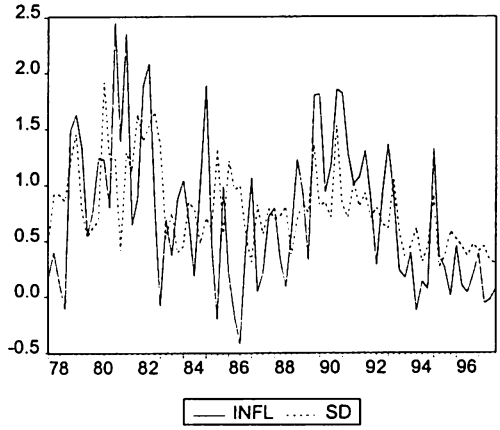
According to the literature, the measure for relative price variability is defined as follows (see point 2b)

$$SD = \sqrt{\sum_{i=1}^{n} W_{it} (\pi_{it} - \pi_t)^2},$$

and the different subindices π_{it} are all given the same weight (w = 1/n). The relation between inflation and relative price variability is analysed using the quarterly data, a yearly average over 4 non overlapping quarters, and monthly data (only for the WPI). Graphs 3 and 4 show inflation and relative price variability for the CPI and WPI, for quarterly data and an average of 4 quarters.

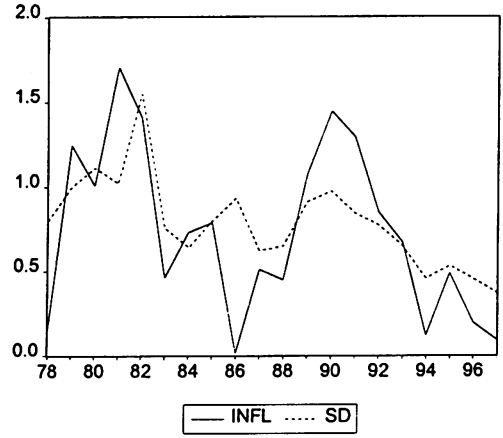
Graph 3: Inflation and relative price variability in Switzerland; CPI

a) quarters



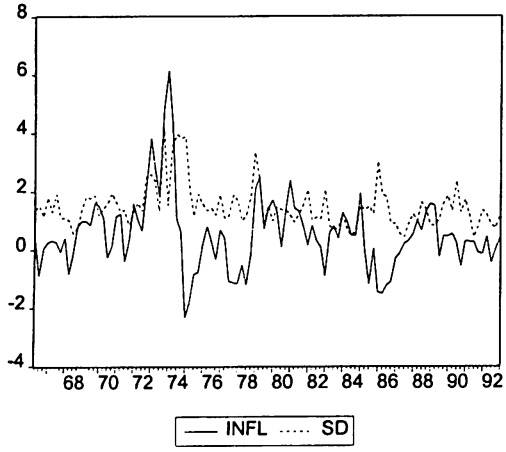
4. The subindices of the CPI are the following: 1. food, drinks, tobacco, 2. clothing and shoes, 3. rent and energy, 4. furniture, 5. health care, 6. transportation and communication, 7. Entertainment, leisure, education, culture, 8. Other goods and services. The WPI, on the other hand, is made up of the following subindices: 1. agricultural products and raw materials for food, 2. Energy and related substances, 3. food, drinks, tobacco, 4. textiles, 5. metals and metal goods, 6. wood and cork, 7. paper and paper goods, 8. Leather and plastics, 9. construction material, ceramics, glass.

b) Ø 4 quarters

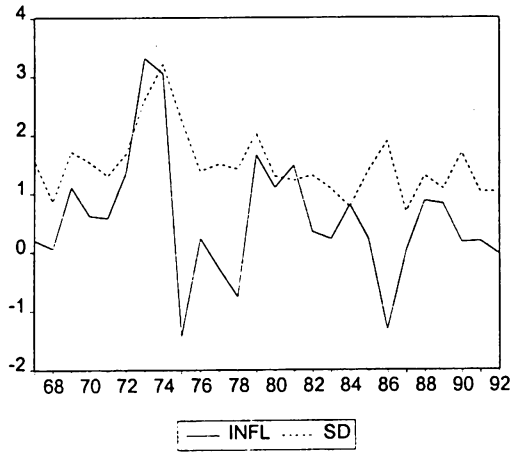


Graph 4: Inflation and relative price variability in Switzerland; WPI

a) quarters



b) Ø 4 quarters



Graph 3 shows a positive relation between inflation and relative price variability for the CPI. The relation seems to hold during the whole period and for quarterly data as well as for yearly averages of 4 quarters. For the WPI, however, graph 4 seems to indicate a positive relation only till about 1980. Concerning the question of stationarity of the series, the results of the ADF test are shown in table 6.

Table 6: ADF test of the inflation rate and relative price variability

	CPI	WPI
Inflation		
1. quarters	–3.04*	–4.42*
2. Ø 4 quarters	–1.68	–3.54*
3. months	–	–3.52*
Relative price variability		
3. quarters	–3.19*	–2.98*
4. Ø 4 quarters	–1.42	–2.59
5. months	–	–3.42*

*significant at the 5%-level

The null hypothesis of a unit root is rejected for almost all data based on the WPI, while for the CPI-based data, this is only true for the quarterly data. This difference is probably due to the shorter observation period of the CPI-based data and the correspondingly lower power of the test. For the same reasons as mentioned in point 3a), however, the stationarity of all variables is assumed here, and the same caveat for interpretation in case of non-stationarity applies.

Table 7 shows the estimation results of the equation $SD_t = a + b\pi_t$.

Table 7: Inflation and relative price variability in Switzerland

	b	DW	R^2
CPI			
1. quarters	0.23* (0.06) [0.07]	1.44	0.17
2. Ø 4 quarters	0.38* (0.09) [0.1]	1.88	0.497
WPI			
3. quarters	0.13* (0.055) [0.1]	1.037	0.05
4. Ø 4 quarters	0.23* (0.1) [0.126]	1.38	0.19
5. months	0.34* (0.05) [0.11]	1.42	0.13

*significant at the 5%-level according to the standard errors in round brackets. Newey-West standard errors are shown in square brackets.

All coefficients in table 7 are significant; however, significance is biased by autocorrelation in equation 1, 3 and 5. If an AR(1) term is added, the coefficients of equation 1 and 5 remain significant, while the coefficient in equation 3 looses its significance. If Newey-West standard errors are used, the coefficients in both equation 3 and 4 loose their significance. In general however, there is some evidence for the positive relation between inflation and relative price variability predicted by theory. For the WPI, the results seem to be biased by the oil shocks in the seventies; in fact, the Chow test cannot reject the hypothesis of a structural break in 1980.

Here too, it would be interesting to examine in which way causality runs. According to theory, causality for the CPI is expected to run from inflation to relative price variability, as there were no major common shocks during the period of observation. As regards the WPI, however, both inflation and relative price variability could be driven by the oil shocks of the seventies. In that case, there should be no causality between the two variables. According to GOLOB (1993), most empirical studies find a causality from inflation to relative price variability; the seventies, however, seem to be an exception (see also BLINDER 1982).

Table 8: Granger causality between inflation and relative price variability[1]

	inflation → variability			variability → inflation		
	1 lag	2 lags	4 lags	1 lag	2 lags	4 lags
1. CPI quarters	5.25*	3.39*	2.41	1.81	3.95*	0.96
2. CPI Ø 4 quarters	3.68	5.43*		0.55	0.51	
3. WPI quarters	5.12*	4.52*	4.37*	0.26	0.51	2.11
4. WPI Ø 4 quarters	6.69*	2.91		1.44	0.04	
5. WPI months	3.32	1.85	2.53*	0.66	3.29*	2.01

[1] The values shown in the table are the F-statistics of the null hypothesis that inflation does not Granger cause variability or that variability does not Granger cause inflation. The asterisk indicates rejection of the null hypothesis at the 5%-level.

In table 8, the number of lags was again chosen according to theoretic plausibility and taking into account the remaining degrees of freedom. The results mostly show Granger causality from the inflation rate to relative price variability (in addition, the two values in column 1 without asterisk are significant at the 10%-level). This holds both for the CPI and the WPI. For the WPI, the test was also applied to the subperiod from 1966 to 1979, and, surprisingly, the test results were similar to those for the whole period.

The positive relation between inflation and relative price variability and the causality from the former to the latter in Switzerland are therefore consistent with both the Lucas model emphasizing imperfect information and the explanations based on price rigidities due to long-term contracts or menu costs. These approaches imply that by generating a low inflation rate, the central bank can effectively limit relative price variability and therewith an important cost factor of inflation.

4. CONCLUSIONS

In keeping with most of the empirical work existing for other countries, this paper shows a positive relation between inflation, its variability and relative price variability in Switzerland. This result is interesting as Switzerland is a traditional low-inflation country. Thus, the above mentioned correlations seem to hold even at low inflation rates.

The positive correlation between inflation and inflation variability in Switzerland cannot be clearly explained by one of the theoretical models. Depending upon the specification of the data causality runs from inflation to inflation variability or the other way around. This possibly suggests that several theoretical approaches contribute to the explanation of the mentioned relation. The relation between inflation and relative price variability, on the other hand, mostly shows causality from the former to the latter, which is consistent with all theoretical models except the common shock explanation.

LITERATURE

ARNOLD I. J. M., R. G. J. DEN HERTOG (1995), European Time-Series Relationships between Inflation and Inflation Uncertainty: in Search of Threshold Levels, *De Economist* No. 143(3), 495–519.

BALL L., S. CECCHETTI (1990), Inflation and Uncertainty at Short and Long Horizons, *Brookings Papers on Economic Activity* No. 1, 215–254.

BALL L. (1992), Why does High Inflation Raise Inflation Uncertainty, *Journal of Monetary Economics* No. 29, 371–388.

BLINDER A. S. (1982), The Anatomy of Double-Digit Inflation in the 1970s, chap. 12 in: *R. Hall, Inflation: Causes and Effects*, NBER, University of Chicago Press.

CUKIERMAN A., A. MELTZER (1986), A Theory of Ambiguity, Credibility, and Inflation under Discretion and Asymmetric Information, *Econometrica* No. 54, 1099–1128.

DEVEREUX M. (1989), A Positive Theory of Inflation and Inflation Variance, *Economic Inquiry* No. 27, 105–116.

FOSTER E. (1978), The Variability of Inflation, *Review of Economics and Statistics* No. 60, 346–350.

FRIEDMAN M. (1977), Inflation and Unemployment, *Journal of Political Economy* No. 85, 451–471.

GLEJSER H. (1965), Inflation, Productivity and Relative Prices – A Statistical Study, *Review of Economic Studies* No. 47, 76–80.

GOLOB J. E. (1993), Inflation, Inflation Uncertainty, and Relative Price Variability: A Survey, *Federal Reserve Bank of Kansas City Research Working Paper,* November 1993.

GRANZIOL M. J. (1984), General Price Level Instability and the Variability of Relative Prices, *Empirical Economics* No. 9(1), 1–13.

HESS G. D., C. S. MORRIS (1996), The Long-Run Costs of Moderate Inflation, *Federal Reserve Bank of Kansas City Economic Review* No. 81(2), 71–88.

HOLLAND A. S. (1995), Inflation and Uncertainty: Tests for Temporal Ordering, *Journal of Money, Credit, and Banking* No. 27(3), 827–837.

KATSIMBRIS G. M., S. M. MILLER (1982), The Relation between the Rate and Variability of Inflation: Further Comments, *Kyklos* No. 35, 456–467.

KATSIMBRIS G. M., S. M. MILLER (1984), The Over-Time Relationship between Inflation and Its Variability Once Again: A Rejoinder, *Kyklos* No. 37, 110–112.

KATSIMBRIS G. M. (1985), The Relationship between the Inflation Rate, Its Variability and Output Growth Variability, *Journal of Money, Credit, and Banking* Vol. 17, No. 2, 179–188.

KLEINEWEFERS LEHNER A. (1997), Glaubwürdigkeitsaspekte der Geldpolitik in Deutschland, der Schweiz, den Niederlanden und Österreich, Diss. Bern 1997.

KUGLER P. (1998), Price Level Trend-Stationarity and the Instruments and Targets of Monetary Policy: An Empirical Note, Paper presented at the EEA-Congress, Berlin, September 1998.

LUCAS R. E. (1973), Some International Evidence on Output-Inflation Tradeoffs, *American Economic Review* No. 63, 326–334.

NUGENT J. B., GLEZAKOS C. (1984), The Over-Time Relationship between Inflation and Its Variability Once Again, *Kyklos* No. 37, 104–109.

OKUN A. M. (1971), The Mirage of Steady Inflation, *Brookings Papers on Economic Activity* No. 2, 485–498.

SUMMARY

In the discussion on the costs of inflation, inflation variability and relative price variability are usually qualified as being more harmful than the size of the inflation rate per se. However, there are strong theoretical and empirical doubts in literature that inflation, its variability and relative price variability are independent of each other. In keeping with most empirical work for other countries, this paper finds a positive relation between inflation, its variability and relative price variability in Switzerland. This result is interesting as Switzerland is a traditional low-inflation country. Thus, the above mentioned correlations seem to hold even at low inflation rates.

ZUSAMMENFASSUNG

In der Diskussion um die Kosten der Inflation werden die Inflationsvariabilität und die relative Preisvariabilität normalerweise als schädlicher beurteilt als die Höhe der Inflation an sich. In der Literatur wird allerdings bezweifelt, dass die Höhe der Inflation,

deren Variabilität und die relative Preisvariabilität von einander unabhängig sind. Im Einklang mit den meisten empirischen Arbeiten für andere Länder findet dieser Beitrag einen positiven Zusammenhang zwischen Inflation, Inflationsvariabilität und relativer Preisvariabilität in der Schweiz. Dieses Resultat ist insofern interessant, als es sich bei der Schweiz um ein ausgesprochenes Tiefinflationsland handelt. Die genannten Zusammenhänge können somit schon bei geringen Inflationsraten festgestellt werden.

RESUME

Dans la discussion des coûts de l'inflation, la variabilité de l'inflation et la variabilité des prix relatifs sont normalement jugées plus néfastes que la hauteur de l'inflation en tant que telle. Cependant, la littérature doute fortement de ce que l'inflation, sa variabilité et la variabilité des prix relatifs soient indépendantes l'une de l'autre. En accord avec la plupart des travaux empiriques concernant d'autres pays, cet article trouve une relation positive entre l'inflation, la variabilité de l'inflation et la variabilité des prix relatifs en Suisse. Ce résultat est intéressant du fait que la Suisse est un pays avec une inflation traditionellement basse. Les relations mentionnées peuvent donc être constatées même pour des taux d'inflation bas.