Chapter 13

BUSINESS CYCLES IN SWITZERLAND

An Empirical Analysis of the German and the U.S. Effects

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1. INTRODUCTION

Given its political neutrality stance and strategic geographic location, Switzerland plays an important role in both the political and economic stages in Europe. To maintain its sovereignty and neutrality, Switzerland has not joined the European Economic Community and the European Union.[1] Despite its political neutrality, Switzerland has close economic ties with member countries of the European Union. As a non-member country of the major economic organizations in Europe, Switzerland has incurred substantial economic costs. For instance, Switzerland has to negotiate as a single country with the European Union on tariff and non-tariff barriers.[2] Given the significant difference in market sizes, Switzerland's bargaining power is essentially weak.

Switzerland is a prototype of a small open economy, with exports and imports accounting for two-thirds of its gross domestic product. Over one-half of its trading activity is conducted with European Union countries. Historically, Switzerland has enjoyed tremendous economic success. Its per capita income is one of the highest in the world. Further, Switzerland is usually considered as synonymous with low inflation and stability. However, Switzerland's economic performance in the 1990s has raised some concerns. The economic growth has been almost stagnant since 1990 and, at the same time, the unemployment level is stuck at an unprecedented high level. The economic future of Switzerland is furthermore clouded by the European Union's Single Market initiative and the European Monetary Union. This raises the issue of how to revive the Swiss economy and pull it out of stagnation in the face of these challenges.

As a small open economy, Switzerland's output fluctuations are highly influenced by external forces. In fact, Bretschger (1989) and Genberg and Swoboda (1985) report that output variations in foreign countries help explain movements in Switzerland's economic growth. While it is generally accepted that business cycles in Switzerland are largely synchronized with the booms and recessions in the world economy, it is important to investigate the linkages between Switzerland and its neighbouring European Union countries in order to have a better assessment on whether Swiss economic policies should be targeting the domestic business cycle or foreign factors and an external balance target, as suggested by Bretschger (1989).

In the following sections, we examine the relationship between the German and Swiss output data. Germany is selected as the representative country of the European Union, given its prominent economic and political status in continental Europe. In fact, it is argued that the European Monetary System is a greater Deutsche mark zone (Giavazzi and Giovannini, 1989). Smaller countries such as Austria and the Netherlands are known to shadow the Bundesbank policy.[3] The analysis will shed insight on Switzerland's dependency on the German economy and the European Union in general.

The increasing integration of the world economy suggests that both Germany and Switzerland can be affected by and react to some external economic events. Our analysis will include the U.S. economy in evaluating the interaction between Germany and Switzerland. The U.S. is chosen partly because of its substantial size and its eminent position in the global economy. More importantly, the U.S. is the largest foreign investor and has played an important role on the economic development of Europe since World War II. It is necessary to account for such possible third party effects if one would like to gauge a more reliable inference about the interdependence of the German and Swiss economies.

Several advanced time series econometric techniques are used to study various types of comovements between industrial production in Germany, Switzerland, and the U.S. The cointegration technique is used to discern the short-term and long-term output comovements. The contributions of the German output shocks on Swiss output are assessed using impulse response and forecast error variance decomposition analyses. The recently developed common feature test is implemented to detect for the presence of common synchronized cycles among these economies.

To anticipate our results, we find that the German, Swiss, and U.S. industrial production indexes are not cointegrated; that is, these three national output series do not share an empirical long-run component. Using a vector-autoregression model, we show that both German and U.S. output Granger-

causes Swiss output. That is, movements in the German and U.S. output help explain variations in Swiss output. These results are supportive of the assertion that Switzerland is closely related to and affected by Germany even after controlling for external factors. However, as indicated by the forecast error variance decomposition analysis, Swiss shocks are largely responsible for the unexpected variability of Swiss output. The German and U.S. shocks account for about 20 percent of the unpredictable Swiss output fluctuation. Furthermore, we find evidence for synchronized serial correlation movements, indicating that industrial production growths in Germany, Switzerland, and the U.S. share a similar cyclical pattern. These findings are comparable to those between Austria, Germany, and the U.S. reported in Cheung and Westermann (1999, 2000).

The rest of the paper is organized as follows: Section 2 presents the preliminary data analysis and the cointegration test result. Section 3 reports the vector-autoregression estimation results and discusses the findings from the impulse response and forecast error variance decomposition analyses. The results of testing for common synchronized business cycles are given in Section 4. Section 5 contains some concluding remarks.

2. PRELIMINARY ANALYSIS

Quarterly indexes of industrial production are used as proxies for aggregate output. The sample period covers 1962:1 to 1994:4. The German data were provided by the Statistisches Bundesamt in Wiesbaden and were seasonally adjusted using the X-11 procedure. The seasonally adjusted U.S. data on industrial production were extracted from the OECD database and the Swiss data were from Konjunkturforschungsstelle (KOF) in Zurich. All data were transformed into logs.

The augmented Dickey and Fuller (ADF) test allowing for both an intercept and a time trend is employed to determine if there is a unit root in the data series. Let X be the industrial production index of country i (i = the U.S., Germany, and Switzerland) at time t. The ADF test is based on the regression equation:

$$\Delta X_{it} = \mu_0 + \mu_1 t + \alpha X_{i\,t-1} + \beta_1 \Delta X_{i\,t-1} + \beta_p \Delta X_{i\,t-p} + \varepsilon_t$$

where Δ is the first difference operator and ε_t is an error term. The Akaike information criterion is used to determine p, the lag parameter. Results of applying the ADF test to the data and their first differences are shown in Table 1. The null hypothesis of a null root is not rejected for the data series and is rejected for the first differenced data. Thus, there is one unit root in each of the three industrial production series, a result that is consistent with the literature. In the subsequent analysis, we assume the data are difference stationary.

Table 1. Unit Root results

Countries	Levels	First Differences
Germany	-2.21 (4)	-4.86* (2)
Switzerland	-1.37 (3)	-6.92* (2)
U.S.	-1.58 (4)	-4.60* (2)

Notes: ADF test statistics calculated from the levels and first differences of the industrial production indexes in logs. Lag parameters selected by the Akaike information criterion in parentheses. An asterisk indicates significance at the 5-percent level.

The sample correlation coefficients for the first differenced industrial production data are 0.28 (Germany and Switzerland), 0.32 (Switzerland and the U.S.), and 0.29 (Germany and the U.S.). These sample statistics suggest that the Swiss economy has close ties to both the German and U.S. economies. More vigorous analyses of the interactions between these output series are given in the following sections.

The cointegration technique is used to study the empirical long-run relationship among the national industrial production series. The long-run relationship is interesting for, at least, two reasons. First, it indicates whether permanent shocks in the three countries are common or idiosyncratic. Second, information about the long-run behaviour is essential for specifying an appropriate model to analyze short-run interactions. Statistically, a misspecified long-run relationship can lead to erroneous inferences on short-run dynamics.

The Johansen (1991) procedure is used to test for the presence of cointegration. Let X_t be the 3x1 vector (X_{it}), i = the U.S., Germany, and Switzerland. The Johansen test statistics are devised from the sample canonical correlations (Anderson, 1958; Marinell, 1995) between X_t and X_{t-p} adjusting for all intervening lags. To implement the procedure, we first obtain the least squares residuals from

$$\Delta X_t = \mu_1 + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \varepsilon_{1t} \text{ , and}$$

$$X_{t-p} = \mu_2 + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \varepsilon_{2t}$$

where μ_1 and μ_2 are constant vectors. The lag parameter, p, is identified by the AIC. Next, we compute the eigenvalues, $\lambda_1 \geq ... \geq \lambda_n$, of $\Omega_{21}\Omega_{11}^{-1}\Omega_{12}$ with respect to Ω_{22} and the associated eigenvectors, $v_1,...,v_n$, where the moment matrices

$$\Omega_{ij} = T^{-1} \sum_t \hat{\varepsilon}_t \hat{\varepsilon}_t'$$

for i, j = 1, 2, and n is the dimension of X_t (i.e., n = 3 in this exercise). λ_is are the squared canonical correlations between X_t and X_{t-p}, adjusting for all intervening lags. The trace statistic,

$$t = -T\sum_{j=r+1}^{n} \ln(1 - \lambda_j),$$

where $0 \leq r \leq n$, tests the hypothesis that there are at most r cointegration vectors. In testing the hypothesis of r against the alternative hypothesis of r+1 cointegration vectors, we use the maximum eigenvalue statistic,

$$\lambda_{r|r+1} = -T\ln(1 - \lambda_{r+1}).$$

The eigenvectors, $v_1,...,v_r$ are sample estimates of the cointegration vectors.

The Johansen test results are reported in Table 2. Both the trace and maximum eigenvalue statistics suggest there is no evidence of a cointegrating relationship.[4] That is, industrial production indexes of the U.S., Germany, and Switzerland are not cointegrated. The three economies do not share a common long-run component that determines the long-term swings in their industrial production data.

Table 2. Cointegration Test Results

H(0)	Trace Statistic	Max. Eigenvalue Statistic
r = 0	16.56	8.68
r ≤ 1	7.87	4.57
r ≤ 2	3.30	3.30

Notes: Trace and maximum eigenvalue statistics computed from the trivariate system consisting of German, Swiss, and U.S. industrial production indexes. The lag parameter is set to 2 according to the Akaike information criterion. All the statistics are not significant according to the finite sample critical values tabulated in Cheung and Lai (1993). Thus, the null hypothesis of no-cointegration is not rejected. The test results are the same for the one-lag and three-lag specifications.

The no-cointegrating result seems surprising as it implies the economies will drift apart over time. That is, there is no evidence on the existence of an empirical long-run relationship among the national output indexes. In fact, since the first oil crisis, Switzerland has experienced a growth rate lower than the average of the OECD countries. This may be the factor driving the no-cointegration result. Even though we do not rule out the theoretical possibility that the industrial production data are cointegrated, we will conduct the subsequent analysis using the vector-autoregression technique as cointegration is not an empirically relevant property for this data set.

3. SHORT-RUN INTERACTIONS

Given the cointegration result, we use a vector autoregression model to explore the effects of short-term variation on industrial production indexes. Specifically, the changes in industrial production indexes are modeled using

$$\Delta X_t = \mu + \sum_{i=1}^{p} \Gamma_i \Delta X_{t-i} + \alpha EC_{t-1} + \varepsilon_t ,$$

The responses of industrial production to short-term output movements are captured by the â coefficient matrices. The lag parameter p is again selected using the Akaike information criterion and the coefficient estimates of the model are presented in Table 3.

Table 3. The Vector Autoregression Model

	U.S.	Germany	Switzerland
ΔX_{t-1} (U.S.)	0.53**	0.18	0.33**
	(0.09)	(0.12)	(0.15)
ΔX_{t-2} (U.S.)	-0.12	0.05	-0.07
	(0.09)	(0.12)	(0.15)
ΔX_{t-1} (Germany)	0.08	0.02	0.32**
	(0.07)	(0.09)	(0.11)
ΔX_{t-2} (Germany)	0.06	0.02	0.20*
	(0.07)	(0.09)	(0.11)
ΔX_{t-1} (Switzerland)	-0.01	0.01	0.29**
	(0.05)	(0.07)	(0.09)
ΔX_{t-2} (Switzerland)	-0.07	0.04	-0.12
	(0.05)	(0.07)	(0.09)
Adjusted R	0.24	0.008	0.10

Notes: Coefficient estimates of the autoregression model. Heteroskedasticity consistent standard errors are given in parentheses. Significance is indicated by one asterisk (10-percent level) or two asterisks (5-percent level).

The German and Swiss industrial production changes have asymmetric effects on each other. In the presence of the U.S. variable, both lagged German industrial production terms help explain movements in Swiss output. The coefficient estimates are both positive and significant. That is, an increase in German output is likely to be followed by an upward swing in the

Swiss economy. On the other hand, the German variable is not explained by any lagged changes in Swiss industrial production. Interestingly, the Swiss economy appears to be affected only by the most recent developments in the U.S. industrial output. The first lagged U.S. industrial output variable is significant while the second lagged variable is not. Using the Granger causality terminology, the German industrial production causes the Swiss one after controlling for the U.S. effect.

So far, the empirical results are in accordance with the view that there are close linkages between the German and Swiss economies. On short-term variation, the Swiss economy appears to systematically respond to changes in German industrial output. The evidence seems convincing that Switzerland's economic growth depends on the strength of the German economy even after allowing for the influences from the U.S., which is the world's largest economy. The results highlight the relevance of German economic factors in designing the Swiss economic policy.

To obtain a better understanding of the effects of output shocks on Switzerland, we use the estimated vector autoregression model in Table 3 to compute the cumulative impulse responses of Swiss industrial production. One-standard-deviation shocks are considered. The rankings of the variables are the U.S., Germany, and Switzerland. The impulse responses mirror the coefficients of the moving average representation of the vector autoregression model and track the effects of a shock on the endogenous variables at a given point of time.

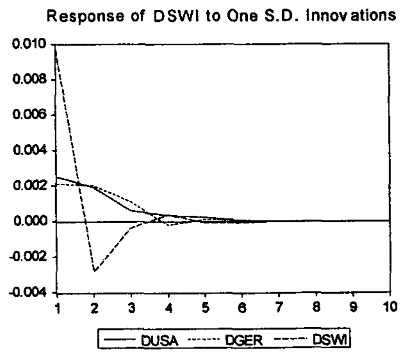

Figure 1. Impulse Responses of Swiss Industrial Production to one standard deviation Swiss (DSWI), German (DGER), and U.S. Shocks (DUSA).

The impulse responses are graphed in Figure 1. It is evident that industrial production in Switzerland reacts more strongly to shocks emanating from Switzerland than to those from the U.S. and Germany. Consistent with the vector-autoregression estimation results, output shocks originating from the U.S. and Germany have positive impacts on Switzerland. However, the effects of these external output shocks appear to be short-lived and last only for a few quarters.

While the impulse responses provide information on the effect of a standardized output shock, they do not indicate the extent to which a given shock contributes to the level of uncertainty in the Swiss industrial output. To further assess the relative importance of output shocks, we decompose the Swiss industrial output forecast error variance into components that are attributable to shocks emanating from the U.S., Germany, and Switzerland.

The proportions of the Swiss industrial output forecast error variance are graphed in Figure 2. For the horizons under consideration, the U.S. and German shocks account for a relatively small percentage of the total forecast error variance. Output shocks from the U.S. and Germany account for, approximately, 20 percent of the forecast uncertainty. That is, the uncertainty in Swiss industrial output growth is mainly generated by shocks to its own economy. External shocks, either originating from the U.S. or Germany, play a limited role in determining Swiss output uncertainty.

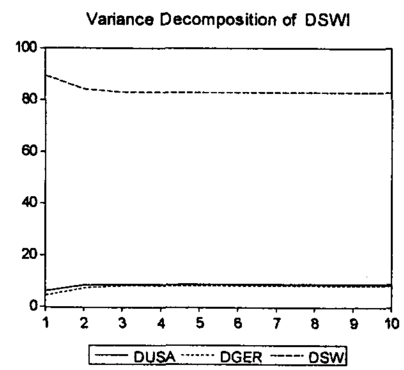

Figure 2. Forecast Error Variance Decomposition for Swiss Industrial Production.

Despite the close ties between Switzerland and Germany revealed by the preceding vector autoregression estimation, the impulse response and forecast error variance decomposition results manifest that Swiss, and not German, output shocks are the driving forces behind the Swiss output variability and uncertainty. While German output Granger-causes Swiss output, German shocks only contribute to a relatively small portion of Swiss output fluctuations.

4. COMMON BUSINESS CYCLE

For nonstationary series, cointegration describes the comovement between long-run nonstationary stochastic trends. The comovement among stationary series can be examined using the concept of common features (Engle and Kozicki, 1993). The intuition behind the common feature analysis is as follows. Suppose the temporal dynamics of (ΔX_{it}), i = the U.S., Germany, and Switzerland, are driven by a common stochastic process. The effect of this common stochastic component can be removed by choosing an appropriate linear combination of ΔX_{it}'s. Thus, the presence of a common serial correlation cycle implies the existence of a linear combination of ΔX_{it}'s that is not correlated with the past information set.

The procedure proposed by Vahid and Engle (1993) is adopted to test for common serial correlation features. The procedure amounts to finding the sample canonical correlations between ΔX_t and $W(p) \equiv (\Delta X_{t-1}', \ldots, \Delta X_{t-p}')'$. Specifically, the test statistic for the null hypothesis that the number of cofeature vectors is at least s is

$$c(p,s) = -(T-p-1)\sum_{j=1}^{s} \ln(1-\lambda_j),$$

where $\lambda_1 \geq \ldots \geq \lambda_n$ are the squared canonical correlations between ΔX_t and W(p) and n is the dimension of ΔX_t (i.e., n = 3 in this exercise). When s is the dimension of the cofeature space, n-s is the number of common cycles Under the null hypothesis, the statistic C(p,s) has a χ^2-distribution with s^2+snp-sn degrees of freedom. See Vahid and Engle (1993) for a detailed discussion of the statistic.

Table 4. Test for Common Feature

Null Hypothesis	Squared Canonical Correlation	Statistic C(p,s)	Degree of Freedom
s = 1	10.02	3.18	4
s = 2	20.16	17.28*	10
s = 3	30.32	78.72**	18

Notes: The degree of freedom of the C(p,s) is calculated with n=3 and p=2. Two asterisks indicate significance at the 1-percent level, one asterisk at the 10-percent level. The elements of the first cofeature vector are 1.00 (the U.S.), 0.08 (Germany), and 0.13 (Switzerland). The elements of the second cofeature vector are 1.00 (the U.S.), 1.61 (Germany), and 0.23 (Switzerland). The elements of the cofeature vectors are all statistically significant.

The common serial correlation feature test results are presented in Table 4. Given the lag structure reported in the previous sections, the common feature test is conducted with p=2. The null hypothesis of the existence of one common serial correlation cofeature vector is not rejected while the null of two cofeature vectors is rejected at the ten percent (but not five percent level). Thus, it is safe to conclude that there is at least one cofeature vector (which is the first cofeature vector reported in Table 4) among the U.S., German, and Swiss industrial production indexes.[5] This is in contrast to the findings of no-common national business cycles reported in Campbell and Mankiw (1989) and Cheung (1994).

The elements of the cofeature vector are all significantly different from zero. The German and Swiss variables have similar cofeature coefficients, implying that the two national industrial production indexes contribute to the common cycle relationship in a parallel manner. This evinces the resemblance of the German and Swiss output dynamics.

5. CONCLUDING REMARKS

Using advanced time series econometric techniques, we study the interaction between the German and Swiss economies controlling for the influence of the U.S. factor. Industrial production is used as a proxy for aggregate output. Based on the sample information we do not find an empirical long-run relationship between the Swiss and German industrial production data. In the short-run, Swiss industrial output is Granger-caused by the German one, even after allowing for the effects of the U.S. economy. This finding is supportive of the claim that the German economy has substantial influences on the Swiss economy. The German effect experienced by Switzerland is likely to be a manifestation of the dominant role of Germany in Europe and the likelihood that the Swiss economic policy is adjusted towards the German conditions.

The impulse response and forecast error variance analyses, on the other hand, indicate that German output shocks have limited effects on Switzerland as the effects tend to be short-lived. Indeed, the Swiss output uncertainty is largely attributable to shocks to its own economy. Thus, in light of this finding, one should qualify the German influences on Switzerland. Derived from trade activity, the Swiss and German economies are closely linked and the former one appears to react to the latter. However, shocks to Switzerland itself are mainly responsible for the unexpected variations in the Swiss output. It is also found that these countries have simultaneous cyclical comovements in their industrial production indexes. That is, these countries tend to react to shocks in a similar manner and have comparable experiences in economic upturns and down swings.

Overall, we find evidence of German (and U.S.) effects on the Swiss economy. However, shocks originating from Switzerland are the major

source of uncertainty in Swiss output. In designing economic policy in Switzerland, one has to consider external factors such as conditions related to Germany and the U.S. However, it is of paramount importance to incorporate domestic factors into the policy formulation process. A potential future research project is to investigate whether the linkages between Germany and Switzerland are through real or monetary channels. Also, it is interesting to examine the implications of synchronized responses to shocks for designing national polices to alleviate the impacts of system shocks.

NOTES

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1 In fact, when its electorates voted against joining the European Economic Area in 1992, Switzerland withdrew its application for membership in the European Union. Switzerland only officially joined the International Monetary Fund and the World Bank in 1992. It is perhaps the only industrialized nation that is not a member (though it has the observer status) of the United Nations.

2 Non-tariff barriers such as the adoption of technical standards and government procurement can have nontrivial effects on Switzerland's pharmaceutical and special equipment industries.

3 Genberg and Kohli (1997) suggest that Switzerland unofficially follows the policy of shadowing the Bundesbank. It is believed that German interest rates and the Swiss franc/Deutsche mark (SFR/DM) exchange rate are factors affecting the Swiss National Bank's monetary policy. For a brief period (1978-79), the Swiss National Bank took 0.80 SFR/DM exchange rate as the objective of its monetary policy.

4 The lag parameter is set to 2 according to the Akaike information criterion. The Johansen test results obtained from $p=1$ and $p=3$ also do not reject the no-cointegration hypothesis.

5 In fact, using the $p=3$ specification, there is evidence of only one cofeature vector (1, 0.10, 0.08). Thus, the second cofeature vector found under the $p=2$ specification may be spurious.

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