Sector Specific Impacts of Macroeconomic Fundamentals on the Swiss Stock Market

Martin K. Hess*
ITAM, Mexico

April 3, 2003

Abstract

A large body of evidence indicates that macroeconomic and financial variables are dynamically interrelated. In an international setup, we analyze the impacts of macroeconomic shocks on various sector indices of the Swiss stock market. We use a VECM model to disentangle local and foreign as well as macroeconomic and financial effects. Sector subindexes diverge to an important extent in their sensitivity to news about fundamental variables, a fact to be taken into account for asset allocation.

JEL codes: E44, G15

Keywords: Transmission of economic shocks, stock market responses, VECM, sector sensitivities.

1 Introduction

Economists have long understood that macroeconomic shocks heavily influence asset markets. In the last two decades, the causal dynamics between surprises in real activity, inflation and asset returns has become the subject of intensive research in financial economics (see e.g., Wasserfallen, 1989, Fama, 1990). As traditional factor models are static and struggle to isolate the news component of a variable they produce results of limited power. To overcome these shortcomings Lee (1992) advocates the use of vector autoregression (VAR) models. However, they frequently produce unstable and sometimes contradicting dynamic interactions of financial markets and economic variables (see e.g., Patelis, 1997). The lack of conclusive empirical results asks for a deeper analysis especially in a small open economy such as Switzerland where foreign influences may distort traditional analyses.

In the search for news variables relevant to the stock market output and inflation shocks have attracted high attention to researchers and were discussed

*Instituto Tecnológico Autónomo de México, División Académica de Administración, Av. Camino a Santa Teresa 930, Col. Héroes de Padierna, Del. Magdalena Contreras, 10700 México, D.F., MÉXICO, phone: +52-55-56-28-4000 ext. 6525, fax: +52-55-54-90-4665, email: mhess@itam.mx, http://ciep.itam.mx/˜mhess.

as early favorites. While the impact of an output shock on stock returns seems to be well explained by its impact on expected dividends and interest rates the reason for the negative relation between inflation and stock returns has never been conclusively discussed. A large part of the discussion has focused on two fundamental views by Fama (1981) whose arguments base on money demand theory and Geske and Roll's (1983) reversed causality model. More recently however, the work of researchers has shifted to analyzing the role of monetary policy shocks in the process of asset pricing.

Using a VAR analysis, Lastrapes (1998) finds that the stock markets in six G-8 countries exhibit significant positive short-term responses to money supply shocks. Thorbecke (1997) interprets the large effects on stocks as reflecting important real effects as stock prices simply represent claims to expected future cash flows. Patelis (1997) investigates the behavior of long horizon returns and finds that the influence of monetary policy mainly via the risk premium and the expected dividend growth and less through a change of real returns. Mishkin (2001) argues that expansionary monetary policy makes stocks more attractive relative to bonds and therefore exerts a positive influence on equity prices.

While most of the research focuses on describing particular interrelations between stock markets and one fundamental variable a strand of the literature includes a number of macroeconomic main indicators and the financial market in one model. Lee (1992), for instance, includes output, inflation and interest rates in the same model but detects only weak impacts of fundamental shocks on stock markets. Canova and De Nicoló (2000) argue that this may be due to neglecting the transmission of international shock and proposes a two country model for four large economies. They conclude that economic policy actions in different countries may have offsetting or amplifying effects and therefore suggest a policy harmonization. However, the signal-to-noise ratios for foreign shocks turn out to be relatively small. Not surprisingly, Hess (2002) detects much stronger interactions if a small open economy with a very high degree of trade openness, international investment and world integration is analyzed instead[1]. He also shows that part of the obscured stock market reactions are due to asymmetric information signals across the stages of the business cycle.

The existing literature has mainly focused on the behavior of the market index and hence, just provided information on the general effects of fundamental shocks. For asset managers, however, these general studies may be of little guidance as to how portfolios should be ideally structured and tactical positions chosen as macroeconomic shocks impact the equity market. We argue that due to their particular characteristics different sector indices may be affected to a different extent by various fundamental shocks. Hence, the actual literature overlooks a source of information that is potentially valuable for sector allocation in the aftermath of macroeconomic shocks.

This paper attempts to fill this gap in the literature and calculates the

[1] Moreover, as postulated by gravity models of international trade, Ammer and Mei (1996) observe that geographically close countries tend to be more tightly linked than distant ones and Dellas and Hess (2002) show that countries get economically more integrated as they move up the ladder of financial development.

importance of various macroeconomic shocks for sector indices of the Swiss stock market. To tackle this task we build upon a vector error correction model (VECM) proposed by Hess (2002) that accounts for the long-term equilibrium relations between the variables. We analyze variance decompositions derived from the model that we estimate both, in a closed and an open economy context in order to take the increasing economic and financial cross-country integration into account.

Our variance decomposition results reflect the share to which the volatility of a stock market sector is sensitive to surprises in macroeconomic or foreign variables. As we propose a time-series analysis we do not make statements about the covariances between sectors and hence, about the optimal portfolio composition. However, we quantify relevant elements in sector allocation that are not captured by conventional factor models. The analysis of the impact of an unexpected macroeconomic fluctuation allows a portfolio manager to take particular factor bets after the observation of a shock. In addition, the inertia in volatility makes it possible to draw inferences on future expected volatility. For instance, a sector with a large proportion of capital may experience a higher volatility in response to a sudden change in interest rates whereas stocks of a cyclical industry are expected to be strongly influenced by output shocks.

The results are particularly valuable for international portfolio management. Traditionally, the management process usually splits up into a strategic (i.e. country selection) and a tactical asset allocation (i.e. sector allocation). We claim that our method allows to relax this strict and ordered segmentation. Namely, by varying positions among sector subindexes in the tactical asset allocation we may alter the foreign exposure of our portfolio as different sectors exhibit different sensitivities towards foreign shocks. This feature directly flows into the sector allocation in the equity market and two basic examples may illustrate the benefits of taking into account the different international exposure of sectors. First, any domestic portfolio in an open economy is sensitive to foreign influences to a certain degree. Thus, holding domestic sector portfolios with a high international sensitivity is a cheap way to increase foreign exposure. Second, an internationally operating firm might want to avoid additional foreign risk of their financial investments and hence, should invest in sectors with a low exposure.

The results show significant impacts of domestic output and inflation shocks as well as monetary surprises on the variance of the sector indices. As predicted by economic intuition we find huge differences in the reactions of different sectors. They yield valuable insights for sector allocation in order to manage portfolio risk, especially in turbulent periods with numerous unforeseen events. An extension to an international perspective allows to quantify the difference in exposure to foreign shocks between closed and open sectors.

The paper is organized as follows. Section 2 motivates the fundamental variables that we will include in the model. In section 3, we present the methodology and the data. Section 4 presents and discusses the results of the closed and open economy analyses and section 5 concludes.

2 Impact of Fundamentals on Stock Markets

For the sake of a high information content of the results we ideally choose macroeconomic news variables that have proven to be of great interest in the literature and that have provided the high forecasting power for stock returns. The role of inflation and the reason for the observed contemporaneous negative correlation with stock returns has been outlined by Fama (1981) and Geske and Roll (1983). Based on money demand theory, Fama argues that an anticipation of an increase in real activity leads to higher real money balances inducing the price level to fall at a given nominal money stock. Geske and Roll's reversed causality model starts with a negative real shock which signals higher unemployment and finally, lower tax revenues. At a given level of government expenditures, the budget deficit increases. If it is 'monetized' inflation picks up while stock markets plunge. Danthine and Donaldson (1986) show that the source of the inflation matters. Stocks provide a perfect hedge against inflation of monetary origin whereas this is not the case for nonmonetary inflation. This view is contradicted by Marshall (1992) claiming that output generated inflation exhibits a more strongly negative correlation with stock returns than money induced inflation.

The inflation expectation channel also transmits output shocks to asset prices, for example in a situation of overheating. Further transmission channels influencing the discount rates and, hence, the stock prices are caused by a reaction of monetary authorities or by an adjustment of agents' savings to such a situation. The effect of a positive output shock on stock prices is not a priori clear as the positive discount rate change may offset the increase in future dividends. This might be the reason why despite the considerable attention that real activity variables receive from financial market agents and in economic theory, the empirical evidence of an impact on the stock market is not very pronounced. Nevertheless, using announcement data Flannery and Protopadakis (2002) show that real activity variables are priced risk factors for stock returns. In his overview about the financial assets transmission function of monetary shocks Mishkin (2001) argues that expansionary money supply lowers interest rates which leads investors to prefer stocks over bonds. Gilchrist and Leahy (2002) show that the monetary environment matters for the sensitivity of equity prices to real economy shocks. Finally, Rigobon and Sack (2002) find positive responses of asset prices to changes in monetary policy by looking at the heteroskedasticity in high-frequency data.

As it is important to disentangle a reaction of monetary policy to real economic shocks and exogenous money supply shocks we need to explicitly introduce a variable for the latter. We follow the arguments of Frankel (1995) and Goodfriend (1998) and use the term spread as an indicator of monetary policy. The theoretical foundations for its use are twofold. On one hand, it is based on the expectations theory of the term structure. An action of the central bank is transmitted via long-term rates influencing aggregate demand whereby the long bond yield is expected to equal the average level of the short-term interest rates plus a term and a default premium. A steeper yield curve therefore indicates the markets expectation of a tighter monetary policy implied by higher path of short term interest rates in the future and persistently higher real interest rates[2]. On the other hand, the Fisher equation divides nominal bond rates into expected inflation and expected real return. In this case, a larger term spread could indicate a decreasing confidence in the central bank's commitment in fighting inflation in favor of a loose policy to push the economy.

3 Methodology and Data

To analyze the impact of surprises in macroeconomic fundamentals on the Swiss stock market we first estimate a vector autoregression type model[3]. The main advantage of procedures that involve the regression of a vector of variables $\mathbf{x}_t$ on its own lags relative to univariate regressions is that all variables are endogenized. Hence, it is not necessary to a priori define which variables are dependent and which are independent. This reflects the empirical observations that variables are mutually and temporally interacting, and it allows to model that, for instance, the stock market may affect the economic activity and vice versa. We then calculate and interpret the variance decomposition of the k-step ahead forecast error of the stock prices. A variance decomposition separates the variation in an endogenous variable into its components, i.e. shocks in explanatory variables that cause that variation. In the result section, we report the relative importance of the innovations in fundamental variables for the volatility in sector returns.

The employed variables in vector $\mathbf{x}_t$ must be able to reproduce fundamental influences on the stock market thereby keeping the base model parsimonious to avoid the risk of overfitting. A simple model leaves sufficient degrees of freedom to augment it for an international analysis, which requires doubling the input variables. The above arguments suggest using real GDP (y^s), price level measured by CPI (p^s), a monetary policy indicator (m^s) measured as term spread finally, the stock market index (s^s) or one of its sector indices (s_i^s) in a four variable VECM setup.

To investigate the nature of external influences to a small open and integrated economy such as Switzerland we augment the vector by the foreign counterpart variables y^g, p^g, m^g and s^g. In order to maximize the signal they ideally stem from a close trade partner such as Germany[4]. We also include the exchange rate (q) to account for the change in purchasing power and to capture

[2]Besides this liquidity effect causing higher real interest rates, a monetary shock can also affect inflation expectations. An expected increase in inflation leads to higher nominal interest rates which has the same effect on stocks prices. In practice, it is difficult to disentangle these two effects.

[3]Due to the presence of cointegrating relations we estimate the model in vector error correction form. See appendix for a more detailed description of the estimation procedure.

[4]By choosing Germany we follow the strand of international finance literature that advocates that regional shock propagation is initiated by 'locomotive' countries such as the US, Germany or Japan. However, the debate (see e.g., Kwark, 1999) whether 'locomotive' countries initiate the transmission of fluctuations or whether the countries are affected by common shocks is ongoing.

external nominal influences. This may highlight the question whether the effects of foreign economic innovations to the domestic stock market, transmitted via trade or financial channel, are similar to the closed economy case. Given the particular setup of analyzing a small open economy and a large trade partner based on international finance theory, we expect that the results may be generalized to countries similarly open as Switzerland with a large number of export oriented firms (e.g. Canada or the Netherlands).

As in Canova and De Nicoló (2000) we perform the dynamic structural analysis using a recursive methodology which depends on the order of variables in the vector. Due to the relative openness of the countries we consider German variables as contemporaneously exogenous to the corresponding Swiss variables. Very naturally, real variables are exogenous to financial variables as stock markets or interest rates adapt much faster to news than output or goods prices and German variables are placed first. Due to a large period of exchange rate targeting as identified by Cuche (2000) we consider German monetary policy as exogenous to the Swiss monetary policy. These arguments lead to the ordering $y^g, y^s, p^g, p^s, q, m^g, s^g, m^s, s^s$.

In the empirical analysis we use data from Datastream between 1975:01 and 2000:12. The term spread is obtained by subtracting the 1-month Euro interest rate from an index for a yield of confederation bonds with maturity greater than 5 years and from the yield of an index of 7 to 15 years public sector bond index for Germany. The stock markets are represented by the Datastream index and for the sector analysis we use its 18 subindices for Switzerland. All prices are deflated and expressed in local currency. We perform a robustness check of the results by replacing the German variables by the corresponding G-7 variables[5].

To determine the order of integration of the variables in the empirical analysis we use the augmented Dickey-Fuller Test (ADF). We also check for the robustness of the results using the unit root test by Kwiatkowski et al. (1992) (KPSS). We perform all tests with an intercept and a linear trend in the test equations and the number of lags is chosen based on the Akaike information criterion (AIC).

Table 1: Unit Root Tests

The unit root test results are displayed in table 1 and indicate that all level series exhibit non-stationary behavior in all subsamples according to both tests. The series thus follow a trend such that a robust mean and variance does not exist and so invalidates any standard regression analysis. To verify that the series are not integrated of higher order than one we also run the test on first differences which generally turn out to be stationary. Only for the exchange rate and Swiss inflation the KPSS test weakly indicates non-stationary. However, based on the ADF test and following common use we conclude that all series are integrated at most of order one which is a requisite for cointegration analysis[6].

[5]The variables of all G-7 countries are indexed and weighted by the countries' exports to Switzerland.

[6]The test results for the sector indices and the G-7 variables (not displayed) expectedly report $I(1)$ behavior for all series.

Next, in order to identify the accurate estimation method, we test for the existence of multiple cointegrating vectors in separate analyses for the four Swiss variables in the closed economy model and for the nine variables in the international open economy models. Given that the analyzed series are non-stationary there exists the possibility that they are cointegrated, i.e. that a linear combination of the series is stationary. Cointegration means that although many factors can cause changes in the individual variables of vector $\mathbf{x}_t$ there exists an economic long-run equilibrium relation tying the individual components together[7]. Not accounting for an existing cointegration (i.e. using first differences in a standard VAR model) means throwing away valuable information and hence, misspecifying the estimated model.

To perform their trace and maximum eigenvalue cointegration test, Johansen (1988) and Johansen and Juselius (1990) consider a model arranged in an unrestricted error-correction form (see equation (2) in the appendix). To check for robustness of the results we repeat the analysis by using a Lagrange Multiplier-based test proposed by Lütkepohl and Saikkonen (LS) (2000). As for parsimonious models their test is locally more powerful than the more traditional likelihood ratio tests we also report the number of cointegrating vectors based on the LS test. All tests include an intercept and a trend. As the cointegration rank of the Johansen test is sensitive to the lag length we use AIC to determine the optimal number of lags. In table 2 we report the results from all cointegration tests in the models including the Swiss stock market index in the vector[8].

Table 2: Cointegration Tests

The test results coincide for both, the closed and the open economy model in observing cointegration among the series. For the closed economy model the Johansen tests identify at least one cointegrating equation at a 5% level. Although the LS test weakly rejects the hypothesis of maximally one cointegrating relation it is economically reasonable to assume one cointegrating equation[9].

In the open economy model the number of cointegration equations expectedly increases but due to the lower test power in large models and reasonable samples the results diverge across both Johansen tests. While the trace test reports at least four cointegrating relations the maximum eigenvalue test reports two. Based on the lesson from the closed economy model and on economic intuition we assume that there exist three cointegration equations. Economically, there may be a common trend among the macroeconomic variables of each country plus one fixed cross-border relation between Germany and Switzerland.

[7] In the economic literature there exist numerous examples of cointegration relations. In the field of finance the relation between expected future stock prices and forward prices are frequently mentioned. These nonstationary series may substantially differ in the short run but they both ultimately move together in the long run.

[8] Qualitatively, the results do not deviate when subindices are included instead.

[9] Moreover, eliminating the trend from the regression the LS test also reports one cointegration relation.

4 Results

Table 3 reports the variance decomposition of the 24-month forecast error variance from the VECM estimation for the model including the market index and the 18 subindices. While the first four columns report the variance decomposition of the closed economy model the last column provides a summary of the open economy model. For the impacts of each of the three fundamental shocks in the closed economy model we observe huge differences of up to a factor of more than 100 in the reaction across the sector indices. This result requires a deeper analysis of the mechanism that leads to such a dispersion. Moreover, it illustrates that a unique focus on the market index is too narrow to capture all dynamic links and thus, may contribute to a more accurate risk management.

Table 3: Variance Decomposition Results

In the reactions to output shocks we observe a clear distinction between the subindices of a very sensitive industrial sector and a service sector that generally seems to be immune. The variance decompositions hence reflect the cyclical behavior of the industrial sector with the metallurgy, electricity and utility indices that are strongly susceptible with figures of 15.6%, 6.9% and 6.9%, respectively. The extent of the pharmaceutical sector sensitivity may surprise. The figure of 16.0% may be somewhat distorted due to the shortcoming of the closed economy setup which does not take the international orientation of this sector into account. It is notable that many firms of the more sensitive sectors underwent severe structural changes during the recession in the 1990's due to the fierce international competition and technological progress[10]. This is much less the case for the firms in the insensitive subindices (i.e. food retailers, department stores, hotels, packaging and paper and transportation). Portfolio managers that take these result into account choose to shift financial assets to stocks in the service sector in turbulent times in order not to cumulate financial and business risk.

Surprisingly, the service sector tends to react more sensitively to inflation surprises than the capital intensive industrial sector. This may be due to theoretical and empirical findings that the relative price between nontraded and traded goods increases over time. Hence, a positive inflation shock stems from overproportionately rising nontradables prices and thus lower also their business prospects overproportionately. Our results suggest that this mechanism more than outweighs the interest rate argument that firms with a higher proportion of physical capital react more strongly to inflation surprises[11]. As the separation of the subindices into a service and an industrial sector is largely overlapping with

[10] Hess (2002) shows that the reactions to positive output shocks may be negative as the increase in interest rates due to higher money demand may more than just offset the positive effect on future dividends.

[11] Three main reasons for this phenomenon appear in the literature (see e.g. Canzoneri et al., 2000). First, the relatively higher inflation in nontraded goods are due higher productivity growth in the traded good sector. Second, relative price changes exceeding predictions by the productivity hypothesis are attributed to an increasing demand for home goods which possibly comes from a growing public sector demand. This theory is referred to as the relative

the traded and nontraded goods sectors, our model extension for Switzerland confirms earlier results in the literature.

A detailed analysis shows that the reaction to inflation shocks is more than twice as strong for the hotels than for any other sector. This may be due to the highly leveraged financial structure of these firms that have experienced some troubles in recent years. Hence, they are overly affected by a positive inflation shock that may give rise to expectations of an upcoming tightening of monetary policy and higher interest rate. On the other hand such shocks are usually followed by demands for wage increases to which this labor intensive sector is particularly sensitive. Although there is no clear tendency for the other sectors it appears that retail related sectors are quite sensitive to inflation shocks probably due to consumer behavior. Despite of their business being related to fluctuations in interest rates banks are only moderately sensitive to inflationary surprises. This is an indicator of the quality of how banks manage their interest rate exposures.

Industrial sectors tend to be capital intense and thus, susceptible to fluctuations in interest rates which is reflected by a higher sensitivity to the term spread as a measure of monetary policy. For the interest rate related reasons mentioned above the figures of some of the service sectors (i.e., financial sector, hotels) are nonnegligible. In the financial sector, however, the impact may appear lower than expected. Few are the subindices that are not affected. In particular, retail related firms do not seem to react to monetary policy as this does not seem to influence consumer behavior. While portfolios with a bias in industrial stocks provide a better hedge against unexpected inflation, they are more sensitive to monetary surprises, a determinant of future (expected) inflation.

The part of variance explained by own movements is a residual of the fundamental impacts and therefore, the reasons for low figures lie in the above explanations of high sensitivities to innovations in fundamental factors. High figures on the other hand indicate that the firms are not sensitive to commonly priced factors as the ones reported. Rather, it seems that factors specific to the sectors must be held responsible for the apparent indifference to fundamentals. The value of 92.9% for the transportation sector, for instance, tops the ranking of forecast error variances explained by own movements. This subindex, mainly made up of Swissair shares, presumably strongly reacts to oil price shocks. However, as commodity prices do not appear to be a commonly priced factor they are not included. Similar arguments may apply for breweries and the paper industry. Other indices with high figures are related to the retail business that experiences relatively few fluctuations and therefore exhibits a low signal-to-noise ratio.

In the open economy setup, German variables expectedly tend to affect export oriented sectors more than the other subindices. Following the proposition by Dellas and Hess (2002) we use the sum of the percentage influence of the

demand hypothesis. Finally, the labor absorption hypothesis states that with an increasing competition in the traded good sector the excessive labor supply was absorbed by the relatively well protected nontraded good sector and by government employment.

three German fundamentals on subindex return variances as a general measure of stock price sensitivity to foreign economic influences. We observe that the effect of foreign shocks to the forecast error variance of returns varies by a factor of almost 10 between the least and the most sensitive sector. This is smaller than the difference to the individual fundamentals due to the absence of the very small values in the closed economy model. Nevertheless, the difference is still very important and thus contains valuable information for investors. Based on the reported figures they may take appropriate sector positions in order to improve the foreign exposure profile of a domestic portfolio.

The results expectedly show a higher sensitivity to foreign shocks for export oriented firms such as pharmaceutical sector, metallurgy and hotels which are the most sensitive subindices with 14.3%, 11.7% and 10.9%, respectively. These sectors are for instance recommendable for a domestic investor who may want to get foreign exposure at a low cost. Financial intermediaries (i.e. banks, insurance) that are also strongly internationally diversified, however, only exhibit an average exposure to German shocks. This may be due to active risk management and to their exposure to shocks from many countries that lead the German influence to be limited. On the lower end of the table we find strongly nationally oriented sectors such as electricity and consumer goods with 1.5% and 1.9%, respectively. An internationally operating firm might be interested in investing in these insensitive sectors in order not to accumulate foreign risk. It is noteworthy that the stock market index as a whole exhibits a high sensitivity to German news while it is somewhat lower with respect to aggregate economic surprises in the G-7 countries.

Of the 18 subindices 15 are more sensitive to an aggregate G-7 than to a German shock. While the foreign exposure of most sectors slightly increases we observe some dramatic changes. In particular, there is a considerable jump in the sectors that exhibit very low sensitivity to German surprises (i.e. building materials, diversified industries, electricity, general industrials and consumer goods). Potentially, a G-7 shock is more powerful than a one country shock as the signal is not an isolated country-specific event and therefore almost certainly directly affects the firms directly by influencing business opportunities or indirectly via the economic environment in Switzerland (e.g. expected inflation etc.)[12]. However, there is an economic argument predicting a lowering of the influence of an innovation in G-7 variables in comparison to a one-country shock. Contrarian movements of economic variables in different countries may cancel out each other and a G-7 shock is merely a blurred signal and hard to interpret for investors. This may be the reason why compared to the binational case the sensitivity of sectors decreases in some instances.

[12]A detailed analysis shows that the average value across all sectors is 8.5%. Except metallurgy and engineering the sectors are hardly directly influenced by output shocks with an average of 1.2%. Monetary and inflationary surprises on the other hand have a strong sector impact.

5 Conclusions

The analysis of sector sensitivities to news in fundamental variables has so far been overlooked by academics. To fill this gap we analyze variance decompositions for Swiss sectors derived from a vector error correction model containing three main macroeconomic indicators. To account for the openness of the Swiss market we extend the model by alternatively including fundamental variables of Germany and the G-7 countries.

The results show important divergences of stock subindex sensitivities to innovations in various fundamental variables. While the ranking of the sector sensitivities follows economic intuition the big quantitative difference in sector sensitivities may surprise. This suggests that the sector analysis of variance decompositions may contain important information for tactical asset allocation in order to control portfolio risk by investing in sectors with the desired exposure. While export oriented sectors expectedly react susceptibly to foreign shocks, other sectors seem to be largely unaffected and thus appear to contain desirable diversification properties in international portfolios in the aftermath of foreign shocks.

References

[1] Ammer, J. and J. Mei, 1996, Measuring international economic linkages with stock market data, Journal of Finance 51, 1743-1763.

[2] Canova, F. and G. De Nicoló, 2000, Stock returns, term structure, inflation and real activity, Macroeconomic Dynamics 4, 343-72.

[3] Canzoneri, M.B., Cumby, R., Diba, B., Eudey, G., 2000. Trends in European Productivity and Real Exchange Rates: Implications for Real Exchange Rates, Real Interest Rates & Inflation, Unpublished Manuscript.

[4] Cuche, N.A., 2000, An alternative indicator of monetary policy for a small open economy, Study Center Gerzensee working paper 00-12.

[5] Danthine, J.P. and J. Donaldson, 1986, Inflation and asset prices in an exchange economy, Econometrica 54, 585-606.

[6] Dellas, H. and M.K. Hess, 2002, Financial development and the sensitivity of stock markets to external influences, Review of International Economics 10, 525-538.

[7] Fama, E.F., 1981, Stock Returns, Real activity, inflation and money, American Economic Review 71, 547-565.

[8] Fama, E.F., 1990, Stock returns, expected returns and real activity, Journal of Finance 45, 1089-1108.

[9] Flannery, M.J. and A.A. Protopadakis, 2002, Macroeconomic factors do influence aggregate stock returns, Review of Financial Studies 15, 751-782.

[10] Frankel, J.A., 1995, Financial markets and monetary policy (MIT Press, Cambridge, Mass).

[11] Geske, R. and R. Roll, 1983, The fiscal and monetary linkage between stock returns and inflation, Journal of Finance 37, 1-33.

[12] Gilchrist, S. and J.V. Leahy, 2002, Monetary policy and asset prices, Journal of Monetary Economics 49, 75-97.

[13] Goodfriend, M., 1998. Using the term structure of interest rates for monetary policy, in: I. Angeloni and R. Rovelli, eds., Monetary policy and interest rates (Macmillan Press, London) 272-289.

[14] Hess, M.K., 2002, Dynamic and asymmetric impacts of macroeconomic fundamentals on an integrated stock market, unpublished manuscript.

[15] Johansen, S., 1988, Statistical analysis of cointegrating vectors, Journal of Economic Dynamics and Control 12, 231-254.

[16] Johansen, S. and K. Juselius, 1990, Maximum likelihood estimation and inference on cointegration - with applications to the Demand for Money, Oxford Bulletin of Economics and Statistics 52, 169-210.

[17] Kwark, N.-S., 1999, Sources of international business fluctuations: Country-specific shocks or worldwide shocks?, Journal of International Economics, 367-385.

[18] Kwiatkowski, D., P.C.B. Phillips, P. Schmidt and Y. Shin, 1992, Testing the null hypothesis of stationarity against the alternative of a unit root, Journal of Econometrics 54, 159-178.

[19] Lastrapes, W.D., 1998, International evidence of equity prices, interest rates and money, Journal of International Money and Finance 17, 377-406.

[20] Lee, B.-S., 1992, Causal relations among stock returns, interest rates, real activity, and inflation, Journal of Finance 47, 1591-1603.

[21] Lütkepohl H. and P. Saikkonen, 2000, Testing for the cointegration rank of a VAR process with a time trend, Journal of Econometrics 95, 177-198.

[22] Marshall, D.A., 1992, Inflation and asset returns in a monetary economy, Journal of Finance 47, 1315-1342.

[23] Mishkin, F.S., 2001, The transmission mechanism and the role of asset prices in monetary policy, NBER 8617.

[24] Patelis, A.D., 1997, Stock return predictability and the role of monetary policy, Journal of Finance 52, 1951-1972.

[25] Rigobon, R. and B. Sack, 2002, The impact of monetary policy on asset prices, NBER 8794.

[26] Thorbecke, W., 1997, On stock market returns and monetary policy, Journal of Finance 52, 635-654.

[27] Wasserfallen, W., 1989, Macroeconomic news and the stock market, Journal of Banking and Finance 13, 613-626.

6 Appendix

The analytical framework adopted here involves the estimation of a reduced form vector error correction model (VECM). This method is preferable to a standard vector autoregression (VAR) model which is misspecified in the presence of cointegration among the variables. Let $\mathbf{x}_t$ be an $(N \times 1)$ vector containing a set of N endogenous variables that are $I(0)$ when differenced once. Assume that $\mathbf{x}_t$ follows a VAR process containing p lagged values.

$$\mathbf{x}_t = \mathbf{c} + \sum_{i=1}^{p} \Gamma_i \mathbf{x}_{t-i} + \mathbf{e}_t \tag{1}$$

where Γ_i are $(N \times N)$ coefficient matrices.

Provided that in addition the variables in $\mathbf{x}_t$ are cointegrated of order r we may write this unrestricted process in the following VECM form:

$$\Delta \mathbf{x}_t = \mathbf{c} + \sum_{i=1}^{p} \Phi_i \mathbf{x}_{t-i} + \sum_{i=1}^{r} \mathbf{A}_i \Theta_{t-i} + \mathbf{e}_t \tag{2}$$

where Φ is a parameter matrix, Δ is a difference operator, $\mathbf{A}_i$ denotes a vector of impulses which represent the unanticipated movements in $\mathbf{x}_t$ where Θ contains the r individual error-correction terms derived from the r long run cointegrating vectors, and $\mathbf{e}_t$ are independently and normally distributed with mean zero and variance Σ.

Table 1: Unit Root Tests

Variables in Levels									
	y^g	p^g	m^g	s^g	q	y^s	p^s	m^s	s^s
ADF	-2.00	-2.82	-3.07	-2.23	-3.24*	-2.27	-2.09	-2.64	-1.50
KPSS	0.15**	0.24**	0.13*	0.22**	0.18**	0.13*	0.14**	0.19**	0.26**
Variables in First Differences									
	y^g	p^g	m^g	s^g	q	y^s	p^s	m^s	s^s
ADF	-5.02**	-4.64**	-9.60**	-10.69**	-6.78**	-5.59**	-3.84**	-4.29**	-11.82**
KPSS	0.08	0.07	0.05	0.05	0.14*	0.08	0.13*	0.08	0.08

Notes: The displayed figures represent unit root test results for the following variables: y = gross domestic product, p = consumer price index, m = term spread, q = exchange rate CHF/100 DEM, s = stock market index. Superscript ^{s} and ^{g} denote Swiss and German variables, respectively. The augmented Dickey Fuller Test and the Kwiatkowski et al. (1992) test are denoted by ADF and KPSS. For both tests the number of included lags is identified by the Akaike information criterion. The test regressions contain an intercept and a trend. The MacKinnon critical values for ADF at a 5% and 10% level are -3.46 and -3.15, respectively. The critical values for the KPSS test are 0.15 and 0.12 at a 5% and 10% level, respectively. Significance is denoted by ** and *, respectively. The sample period is 1975:01-2000:12.

Table 2: Cointegration Tests

Closed Economy Model			
CE	TR	ME	LS
0	90.67**	51.11**	78.26**
<1	39.57	21.18	27.20*
<2	18.39	12.66	5.97
<3	5.73	5.73	0.24
Open Economy Model			
CE	TR	ME	
0	332.14**	89.35**	
<1	242.79**	68.47**	
<2	174.31**	47.71	
<3	126.60**	39.73	
<4	86.87	26.87	
<5	60.01	22.37	
<6	37.64	17.56	
<7	20.08	10.9	
<8	9.18	9.18	

Notes: The displayed figures represent cointegration test results for the closed and open economy model with German variables, respectively. The vector contains the stock market index as financial variable. The trace and the maximum eigenvalue test results of Johansen (1988) and the Lütkepohl and Saikkonen (2000) test are denoted by TR, ME and LS, respectively. The number of hypothesizes cointegration equations is denoted by CE. For all tests the number of included lags is identified by the Akaike information criterion. The test regressions contain an intercept and a trend. Critical values by Lütkepohl and Saikkonen (2000, table 1) are simulated for small systems up to five variables only. Significance at a 5% and 10% level is denoted by ** and *, respectively. The sample period is 1975:01-2000:12.

Table 3: Variance Decomposition in Sectors

		Closed Economy Model				Open Economy Models	
VD of		Innovations in				Joint Influence of	
		y^s	p^s	m^s	s^s/s_i^s	German Variables	G-7 Variables
Stock Market		6.49	0.58	10.94	81.99	11.58	8.39
Banks	S	2.34	4.39	7.34	85.93	7.62	6.99
Building Materials	I	3.07	5.64	8.62	82.67	7.23	13.54
Breweries	I	2.97	3.94	1.05	92.04	4.67	5.18
Diversified Industries	I	1.61	2.46	15.84	80.09	2.02	9.30
Electricity	I	6.91	1.45	2.75	88.88	1.54	8.95
Engineering	I	1.60	2.05	11.05	85.31	2.97	3.80
Food Retailers	S	0.12	9.69	0.20	89.99	5.35	10.30
Food Producers	I	2.20	8.78	8.78	80.23	7.98	11.37
General Industrials	I	3.01	1.33	21.00	74.66	4.50	14.30
Hotels	S	0.95	20.38	6.47	72.20	10.91	7.31
Insurance	S	4.97	6.42	13.04	75.57	7.48	8.80
Department Stores	S	0.76	6.33	2.13	90.78	5.38	7.18
Pharmaceuticals	I	15.99	0.50	23.29	60.22	14.32	8.78
Metallurgy	I	15.61	8.10	8.09	68.20	11.68	13.85
Other Business	S/I	2.15	8.87	0.67	88.32	2.79	5.41
Paper and Packaging	I	1.51	5.67	2.45	90.37	4.54	7.72
Transportation	S	1.57	0.21	5.28	92.94	3.60	3.20
Consumer Goods	I	6.91	1.45	2.74	88.90	1.86	7.05

Notes: The figures represent percentages of the 24-month forecast error variance of the Swiss stock market and its sector indexes explained by innovations in each variable. y = gross domestic product, p = consumer price index, m = term spread, s = stock market index, s_i = stock index for sector i. Superscripts ^{s} denote shocks originating in Switzerland. The joint influence of foreign variables is calculated as the sum of p, y and m. The G-7 variables are calculated as the average of the economic variables of the G-7 countries weighted by their exports to Switzerland. S and I stand for service and industrial sector, respectively. The estimation sample period is 1975:01-2000:12.