

**Is the Swedish Market Becoming More Integrated with Those of Germany and France?**

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# IS THE SWEDISH STOCK MARKET BECOMING MORE INTEGRATED WITH THOSE OF GERMANY AND FRANCE?

## 1. INTRODUCTION

We test for integration of the Swedish stock market with those of France and Germany. Sweden has a high degree of economic interaction with these two countries and thus, it is expected that the Swedish stock market will be integrated with those of France and Germany. Previous studies have shown that the more integrated economies are, the more integrated financial markets will be. We also investigate whether Sweden's entry into the EU in 1995 affected the level of equity market integration of Sweden with France and Germany. Since membership in the EU is supposed to result in Sweden's being more economically integrated with EU countries of which Germany and France had been early members, it is expected that the Swedish stock market will become more integrated after Sweden joined the EU. In this study, we examine whether indeed these expectations materialised.

The issue of financial integration is one that is important theoretically, practically and policywise. Theoretically, integration is an important input to Mundell-Fleming models of open macroeconomy and to the international portfolio diversification models. Practically, the extent of integration between markets is important to investors in their pursuit of international diversification. As dictated by international portfolio theory, the level of portfolio diversification benefits depends on the extent of linkages between national markets. Policywise, knowledge about integration is important to financial market regulators. If national markets are integrated, then there is the possibility of spillover effects and financial contagion.

Unfortunately, in spite of its importance, there is yet no clear conclusion as to the extent of integration between equity markets. Previous studies have come up with mixed results depending on the markets, methodology and time period used. Our study extends the literature on financial integration by new evidence put forward on this important issue in terms of a combination of markets previously

little studied particularly in the context of the impact of the European Union membership. Furthermore, it is well-known that financial data are characterised by ARCH effects and non-normalities and, as a consequence, use of asymptotic methods leads to biased statistical inference when these characteristics are present. To circumvent these characteristics in this study, we make use of an econometric methodology that overcomes problems of non-normality and ARCH effects in the data which have beset previous studies. We perform a causality test between the Swedish market, on one hand, and the German and French equity markets, on the other hand, based on leveraged bootstrap procedures developed by Hacker and Hatemi-J (2006) which they demonstrated to be robust to ARCH effects and non-normalities.

In the next section, we provide a brief review of the literature on equity market integration. Then, in Section 3 we provide a discussion of the leveraged bootstrap causality test. In Section 4, we provide some details to illustrate the level of economic interaction of Sweden with France and Germany based on trade. In this section, we also discuss how the EU can possibly impact the linkage between stock market prices. Section 5 presents the empirical results while section 6 provides the conclusion of the study.

## 2. BRIEF LITERATURE REVIEW

There is now a voluminous literature on equity market integration. Different approaches have been used to test integration ranging from the use of simple correlations, asset pricing models to cointegration. However, there is still no clear consensus on the extent of integration between markets. Depending on the data, methodology, and theoretical models used, some studies have found that markets are integrated (see Agmon, 1972; Hillard, 1979; Ibbotson *et al.*, 1982; Wheatley, 1988; Hamao *et al.*, 1990; Espitia and Santamaria, 1994, among others) while others have arrived at the opposite conclusion (see, for example, Grubel, 1968; Makridakis and Wheelwright, 1974; Adler and Dumas, 1983; Jorion and Schwartz, 1986; Levy and Lerman, 1988; Jorion, 1989; Smith *et al.*, 1995, among others).

Furthermore, of these equity market integration studies, very few have been done in relation to the Swedish stock market and its interaction with those of other countries. These very few studies have focused mainly on Sweden's integration with the other Nordic countries. One of these is that by Booth and Chowdhury (1997) which showed that there is volatility spillovers among these markets. Others

are by Liljeblom *et al.* (1997) and Haavisto and Hanson (1992) who found that these markets provide diversification benefits. A study by Mathur and Subrahmanyam (1990) also found these markets to be less than fully integrated. Oxelheim (2001) showed that tax factors are hindering the integration of these markets but other factors such as the multinationalisation of industries and foreign investments are making them integrated. As far as we know, no study has been done yet specifically on the Swedish equity market integration with Germany and France and the effect on this of the entry of Sweden into the EU.

Thus, there is scope for this study to contribute to the further understanding of the general issue of equity market integration and to the specific issue of the Swedish market integration with other markets. There is also scope for this study to make a contribution to the understanding of the effect of the EU on the integration of European equity markets to which Sweden, Germany and France belong. Very little that has been done in this area. Chelley-Steeley and Steeley (1999), using vector autoregression variance decomposition and impulse response analyses found that the removal of exchange controls was a major contributor to the increased integration among the European markets. Their study, however, did not include Sweden. Fratzscher (2002), focusing on the EU countries and utilising a GARCH model with time varying coefficients, reported an increase in European equity market integration starting in 1996<sup>1</sup>. The focus of this study, however, was on the European market as a whole rather than on each European market.

Given therefore that there is scope for a study focusing on Sweden, Germany and France, we seek to provide further robust evidence on equity market integration through the use of a methodology that overcomes statistical problems in relation to non-normality and ARCH effects in the data. We discuss in detail this methodology in the next section.

### 3. METHODOLOGY

It is common knowledge that it is important to test for unit roots when time series data is utilized in empirical research. For this purpose we make use of the Perron (1989) test for unit roots, which has better power properties compared to standard tests for

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<sup>1</sup> See also Hatemi-J and Roca (2004a, b).

unit roots. This test for unit roots of variable  $z$  is based on the following regression:

$$z_t = c_1 + c_2 D_t + d_1 t + d_2 D_t t + g J_t + \gamma z_{t-1} + \sum_{i=1}^k b_i \Delta z_{t-i} + \omega_t \quad (1)$$

where  $t$  is a linear trend term, the dummy variable  $D_t$  undertakes value zero for the time period before break and one for the rest of the period,  $J_t$  is equal to one if time period  $t$  is the first period after that of the structural break, and it is zero for the rest of observations. The sign  $\Delta$  is representing the change (first difference) operator and  $\omega_t$  is an error term with expected properties. The null hypothesis of one unit root is  $\gamma = 1$  against the alternative hypothesis of stationarity ( $\gamma < 1$ ). The optimal number of lagged differences ( $k$ ) is chosen based on tests for autocorrelation, which is done by the LM test at the 10% significance level. We use this test because it has better size properties compared to alternative tests (see Hatemi-J, 2004). The next step in our study is to investigate the causal relationship between the variables. By causality, we mean causality in the Granger sense. That is, we are interested to find out whether the past history of one variable has significant impact on the forecast of another variable or not. Granger causality tests are usually conducted by running the following vector autoregressive model of order  $p$ , VAR( $p$ ):

$$y_t = v + A_1 y_{t-1} + \dots + A_p y_{t-p} + \varepsilon_t, \quad (2)$$

where  $y_t$ ,  $v$ , and  $\varepsilon_t$  are  $n$ -dimensional vectors ( $n$  is the number of variables in the model, which is three in our case) and  $A_r$  is an  $n \times n$  matrix of parameters for lag  $r$ . An issue of paramount importance in this regard is the choice of the optimal lag order ( $p$ ) since all inference is based on the chosen lag order. To this end, we apply a new information criterion suggested by Hatemi-J (2003), which is described below:

$$\text{HJC} = \ln \left( |\Pi_j| \right) + j \times n^2 \left( \frac{\ln T + 2 \ln(\ln T)}{2T} \right), \quad j = 0, \dots, p, \quad (3)$$

Here  $\ln$  signifies the natural logarithm,  $|\Pi_j|$  is the determinant of the estimated variance-covariance matrix of the error terms in the VAR model for lag order  $j$ ,  $n$  stands for the number of variables and  $T$  is the number of observations used to estimate the VAR model. Hatemi-J (2003) shows through Monte Carlo simulation experiments that this new information criterion performs well, particularly if variables are integrated. The optimal lag order is obtained by minimizing equation (3). Hatemi-J (2008) shows that this information

criterion has very good forecasting properties even in situation when ARCH effects exist in the underlying data.

It is well recognized in the literature that standard distributions are generally not valid if the variables in the model are integrated. Toda and Yamamoto (1995) suggest the following augmented VAR( $p+d$ ) model to be used for tests of causality if the variables are integrated:

$$y_t = v + A_1 y_{t-1} + \dots + A_p y_{t-p} + \dots + A_{p+d} y_{t-p-d} + \varepsilon_t, \tag{4}$$

where  $d$  is equal to the integration order of the variables.

The  $f$ th element of  $y_t$  does not Granger-cause the  $j$ th element of  $y_t$  if the following hypothesis is not rejected:

$$H_0: \text{the row } j, \text{ column } f \text{ element in } A_r \text{ equals zero for } r = 1, \dots, p. \tag{5}$$

It should be clarified that the parameters for the extra lag(s), i.e.,  $d$ , are unrestricted in testing for Granger causality. According to Toda and Yamamoto (1995), these unrestricted parameters ensure that the asymptotical  $\chi^2$  distribution can be used. In order to describe in a compact way the modified Wald test statistic, let us define the following denotations for a sample size  $T$ :

$$\begin{aligned} Y &:= (y_1, \dots, y_T) \quad (n \times T) \text{ matrix,} \\ B &:= (v, A_1, \dots, A_p, \dots, A_{p+d}) \quad (n \times (1+n(p+d))) \text{ matrix,} \\ Z_t &:= \begin{bmatrix} 1 \\ y_t \\ y_{t-1} \\ \vdots \\ y_{t-p-d+1} \end{bmatrix} \quad ((1+n(p+d)) \times 1) \text{ matrix, for } t = 1, \dots, T, \\ Z &:= (Z_0, \dots, Z_{T-1}) \quad ((1+n(p+d)) \times T) \text{ matrix, and} \\ \delta &:= (\varepsilon_1, \dots, \varepsilon_T) \quad (n \times T) \text{ matrix.} \end{aligned}$$

By means of this notation, the estimated VAR( $p+d$ ) model is written compactly as:

$$Y = \hat{B}Z + \hat{\delta}. \tag{6}$$

We continue by estimating  $\hat{\delta}_U$ , the  $(n \times T)$  matrix of estimated residuals from the regression (6) without imposing the null hypothesis of non-causality. Then the variance-covariance matrix of these residuals

are computed as  $S_U = \frac{\hat{\delta}_U' \hat{\delta}_U}{T}$ . Let us now define  $\hat{\beta} = \text{vec}(\hat{B})$ . The modified Wald (MWALD) test statistic for testing the null hypothesis

of non-Granger causality is then written as

$$MWALD = (C\hat{\beta})' [C((Z'Z)^{-1} \otimes S_U)C']^{-1} (C\hat{\beta}) \sim \chi_p^2 \quad (7)$$

where the notation  $\otimes$  is the Kronecker product (element by all element matrix multiplication), and  $C$  is a  $p \times n(1+n(p+d))$  indicator matrix, which is used to define the parameters that should take value zero. Via these notations, the null hypothesis of no Granger causality is defined as the following:

$$H_0: C\hat{\beta} = 0.$$

The MWALD statistic is asymptotically distributed as  $\chi^2$  with degrees of freedom equal to the number of restrictions to be tested under the null, which is equal to  $p$  in this case. However, the simulation experiments conducted by Hacker and Hatemi-J (2006) demonstrate that the MWALD test statistic overrejects the null hypothesis if it is based on asymptotical distributions. The authors introduce a bootstrap method with leveraged adjustments to remedy the poor performance of the causality test. Their paper shows that the inference based on leveraged bootstrap distributions is much more precise, especially when non-normality or ARCH effects exist as is common in financial data. On these grounds, we will make use of the bootstrap method to improve the correctness of the inference. Another advantage of the mentioned bootstrap method is that it is based on the empirical distribution of the underlying data set and that it is not sensitive to the degree of normality in the distribution. Since the probability of extreme events is usually much higher in financial markets compared to the normal distribution, the application of the bootstrap method is justified.

The bootstrap simulation is conducted in the following manner following the procedure introduced by Hacker and Hatemi-J (2006). We first run regression (6) with the null hypothesis of no Granger causality imposed. For each bootstrap simulation we generate the simulated data,  $y_t^*$ , based on the coefficient estimates from this regression,  $\tilde{v}, \tilde{A}_1, \dots, \tilde{A}_p$ ; the original  $y_{t-1}, \dots, y_{t-p}$  data; and  $\tilde{\epsilon}_t^*$  (the bootstrapped residuals). These residuals are based on  $T$  random draws with replacement from the regression's modified residuals, each with equal probability of  $1/T$ . The bootstrap residuals are adjusted to have the expected value of zero. The bootstrap residuals are also modified to have constant variance, through the use of *leverages*<sup>2</sup>.

<sup>2</sup> For more details on leverage adjustment, see Davison and Hinkley (1999) and Hacker and Hatemi-J (2006). The latter authors introduce this adjustment for multivariate equation cases.

The empirical distribution for the MWALD is generated based on conducting the bootstrap simulation 10000 times and then producing the MWALD test statistic each time. Then we obtain the  $(\alpha)th$  upper quantile of the distribution of bootstrapped MWALD statistics, which is the  $\alpha$ -level 'bootstrap critical values' ( $c_{\alpha}^*$ ). We generate the bootstrap critical values for 1%, 5% and 10% significance levels. The next step is to calculate the MWALD statistic using the original data, i.e. the non-bootstrapped simulated data. The null hypothesis of no Granger causality is rejected on the  $\alpha$ -level of significance based on bootstrap method if the actual MWALD is higher than  $c_{\alpha}^*$ . The simulations are conducted by a program procedure in GAUSS, which is available from the authors on request.

#### 4. MARKET CHARACTERISTICS AND DATA PROPERTIES

The stock market indexes are of weekly frequency based on end-of-week observation and are collected from EcoWin. The equity index for Sweden is the OMX-index, for Germany the DAX-index, and for France the CAC40-index<sup>3</sup>. To see if there is a specific EU-effect over and above a general world-wide integration effect, the UK FTSE All-share index, the USA S&P 500 index, and the Norway Oslo SE-index will be used<sup>4</sup>. The data covers the period from the first week January, 1988 to the first week March, 2006 with a total of 848 observations. For comparison purposes, the sample period is broken into two different sub-periods. The first sub-period covers the period up to the last week of June, 1994 representing the Swedish pre-EU membership period. The second sub-period covers the first week of January, 1995 and onwards determined as the Swedish post EU-membership period. The period in-between the two sub-periods are deemed as the period for Sweden concerning the implementation

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<sup>3</sup> The OMX-index contains the 30 most traded companies in terms of exchange turnover at the Stockholm stock exchange. The DAX-index measures the share performance of the German blue chip segment comprising the 30 largest companies in terms of exchange turnover and market capitalization. The CAC40-index is a benchmark index based on a selection of 40 stocks traded companies in terms of exchange turnover and structured to reflect the full range of equities traded on Euronext Paris.

<sup>4</sup> The UK has been an EU-member for the full sample period and is a major international financial centre. The USA is not a member and also a major international financial centre and Norway is not a member and like Sweden a small international financial centre in relative terms.



of the internal market reforms including those pertaining to the free mobility of capital within the EU<sup>5</sup>.

The sub-periods were chosen to reflect the most crucial periods concerning integration-convergence between the countries, i.e. the entrance of Sweden as a full EU-member<sup>6</sup>. During the post EU-membership period, two major events that could have affected the degree of integration occurred. It was the Asian crisis<sup>7</sup> and the introduction of the single currency where Germany and France are participans but not Sweden. It should be noted that the European countries coped with the Asian crisis without significant problems reflecting their relatively limited direct trade with the crisis-countries and the strong financial positions of most banks with an Asian exposure. Direct effects on the EU-countries in fact included some favourable ones, such as terms of trade gains from lower prices of oil and raw materials, lower yields in capital markets, and downward pressure on prices owing to enhanced competition from Asia. Moreover, slowing exports to Asia did help to prevent overheating in European countries at an advanced position in the business cycle (Depler, 1998). For the European Monetary Union (EMU), one the most challenging aspects of economic integration is the possibility of asymmetric shocks. However, the EMU in itself has eliminated some of the major sources of asymmetric shocks – namely, inconsistent national monetary policies and speculative attacks on national currencies. Moreover, EMU members have less scope for implementing destabilizing national fiscal policies. Hence, the probability of asymmetric shocks depends upon the economic

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<sup>5</sup> The referendum in Sweden to become an EU-member was held November 13<sup>th</sup>, 1994 and Sweden became a full EU-member January 1<sup>st</sup>, 1995. During the period from the referendum to the entrance as a full EU-member, Sweden did change the relevant legislation to support the free mobility of goods, services, labour, and capital as part of the process towards an internal integrated market.

<sup>6</sup> Different sub-periods were used in the paper such as a sub-period taking into account the third and final step of the introduction of the single currency in Europe including the fixing of the exchange rates for the EMU-countries and the introduction of the European System of Central Banks (ESCB) performing a single monetary policy as of January 1<sup>st</sup>, 1999. The results were not different than those reported for the sub-periods in this paper.

<sup>7</sup> The Asian crisis was not related to the EU-integration process but has proven to significantly increase the degree of integration between countries with a high exposure towards that region. See e.g. Baharumshah *et al.* (2003), and Yang *et al.* (2003).

structures – and their development over time – of countries participating in a currency union. In most EU countries, i.e. both members and non-members of the EMU, estimates in Soltwedel *et al.* (2000) suggest that regional specialization increased in the early 1980s but decreased in the early 1990s and with it the possibility of not being able to absorb an asymmetric shock and asymmetric effects on trade and investments. Furthermore, as noted in Weber and Taube (2000), the EU restricted the member countries scope for autonomous policy choices, given the need for policy convergence. Hence, the policy convergence and the capability to absorb asymmetric shocks within the EU have increased during the period.

The trade and investment activity between Sweden and Germany and France has naturally been intense over the past history. This openness and well-developed trade and investment activity between the countries has slowly improved since the Swedish entrance into the EU January 1<sup>st</sup>, 1995 where the internal market implies free mobility of goods and services, labour and capital between the member-states. During 2003, Germany was the second largest trading partner for Sweden in terms of exports and the largest trading partner in terms of imports concerning goods and services. France, in turn, was the seventh largest trading partner both in terms of exports and imports (Statistical Yearbook of Sweden, 2004). The flow of financial capital between the countries as means of payment for traded goods and services and as a consequence of foreign direct investments is very active as indicated by Table 1 and Figure 1. For the period 1978-2002, the average import-share is as high as 19.09 percent for Germany and 5.14 percent for France where the corresponding export-share is 12.23 percent and 5.23 percent, respectively. The export as well as import in real terms has increased continuously over the period with occasional pullbacks as indicated by Figure 1 reflecting the current account effect of capital flows over the balance of payments and its link to the capital account. For the period 1980-2000, the share of Swedish direct investments in France relative to total Swedish direct investments abroad is 8.33 percent on average, in Germany it is 6.90 percent, and the share of German direct investments in Sweden relative to total direct investments in Sweden is 10.19 percent<sup>8</sup>.

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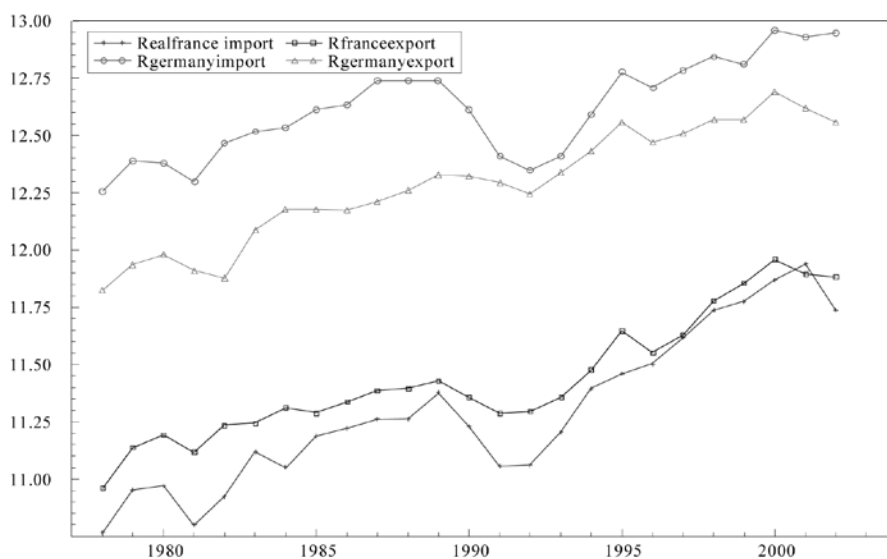
<sup>8</sup> Central Bank of Sweden (<http://www.riksbank.se>) and own calculations. The share of France direct investments in Sweden relative to total direct investments in Sweden is not available from this source.

TABLE 1 - *Some Important Features Concerning Trade and Foreign Direct Investment between the Markets during 1978-2002 and 1980-2000, respectively*

Country	Mean	S.D.	Max	Min
France import	5.14%	0.73%	6.50%	3.85%
France export	5.23%	0.30%	5.85%	4.68%
German import	19.09%	1.42%	22.59%	17.28%
German export	12.23%	1.37%	15.17%	10.05%
Swedish FDI in France	8.33%	12.49%	44.43%	0.20%
France FDI in Sweden	n.a.	n.a.	n.a.	n.a.
Swedish FDI in Germany	6.90%	7.50%	30.40%	0.06%
Germany FDI in Sweden	10.19%	13.27%	63.57%	0.89%

Source: Statistical Yearbook of Sweden, 2004; Central bank of Sweden (<http://www.riksbank.se>); (a) S.D. denotes standard deviation; (b) France (German) import denotes France (German) import from Sweden relative to total imports from Sweden abroad; (c) France (German) exports denotes France (German) exports to Sweden relative to total exports to Sweden from abroad; (d) Swedish FDI in France (Germany) denotes Swedish FDI in France (Germany) relative to total Swedish FDI abroad; (e) France (German) FDI in Sweden denotes France (German) FDI in Sweden relative to total FDI in Sweden from abroad.

FIGURE 1 - *Export and Import between Sweden and Germany and France in Real Domestic Currency*



Furthermore, GDP *per capita* measured in the same currency is one of the main indicators used to measure convergence over time. However, it does not necessarily reflect the actual purchasing power of each national currency as the converted GDP is a function not only of the level of goods and services produced but also of the general price level. Hence, in order to remove the distortions due to price level differences, transitive GDP *per capita* purchasing power parities<sup>9</sup> are calculated and used as a factor of convergence as illustrated in Figure 2. The convergence and catching-up effect over time between Sweden and France relative to Germany is rather weak implying a more advanced business-cycle in Germany during the time-period. As a consequence of the trade and investment activities between the countries, we expect that the markets are more dependent on each other after the Swedish EU-membership. Furthermore, due to the equal dominance of the German and French markets in terms of capitalisation as outlined in Table 2, we expect those markets to be equally influential on the Swedish market.

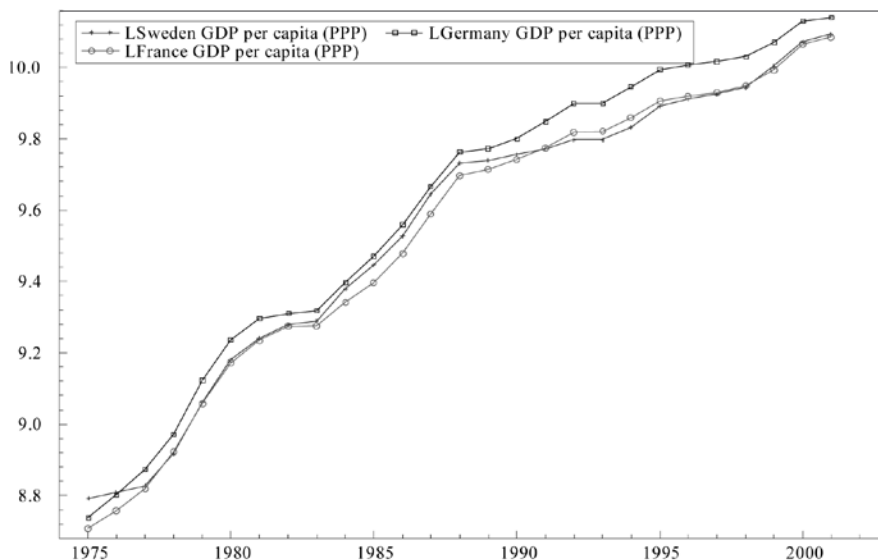
TABLE 2 - *Some Important Features of the Equity Markets, 1990 and 2001 or 2002*

Market	Market capitalisation		Value traded		Turnover ratio (value of shares traded as percentage of capitalisation)		Number of listed domestic companies			
	\$US million	% of GDP	% of GDP	% of GDP	1990	2002	1990	2002		
Sweden	97 929	232 561	41.1	110.8	7.4	143.7	14.9	129.7	258	285
Germany	355 073	1 071 749	21.0	58.1	29.7	76.9	139.3	132.4	413	988
France	314 384	1 174 428	25.9	89.7	9.6	82.3	n.a.	91.7	578	791

Source: World Development Indicators (2003).

<sup>9</sup> Data are collected from World Economic Outlook (2003) and World Development Indicators (2003). The data indicates no temporary pullback over time e.g. as a consequence of the German unification in 1990.

FIGURE 2 - *Per capita GDP PPP-Adjusted in Logarithm Beginning of Year Related to US Dollars*



The stock market return is constructed as the logarithm and first difference of each equity index. Descriptive statistics in relation to the returns generated in each market are presented in Table 3 for the total period and each sub-period, which show the existence of non-normality in the data for all cases. The null hypothesis of normality is rejected for each market at the one percent significance level except for Germany in the first sub-period which is rejected at the five percent level. Table 4 presents the correlation coefficients between the markets for the total period and each sub-period. During the total period, the correlation between Sweden and Germany was 0.65 and it was 0.60 between Sweden and France. The corresponding correlations in the first sub-period are 0.43 and 0.32, and 0.76 and 0.75 in the second sub-period. The correlations between the markets have increased from the first sub-period to the second sub-period, i.e. from the pre-entrance to the post-entrance EU-membership period. Correlations, however, cannot capture the long-term interactions between the markets in a reliable way if they are time varying. Hence, these results regarding the linkages between the markets based on the correlation coefficients should be taken with caution if the equity indexes contain a unit root, which will be tested and outlined in the empirical section below. What is needed, if this is the case, is a long-

term causality analysis between the markets. This is undertaken with the use of the Hacker and Hatemi-J (2006) leveraged bootstrap test which was described in section 3.

TABLE 3 - *Descriptive Statistics Associated with Returns in each Market for the Full Sample Period and Each Sub-period*

Market	Mean	S.D.	Min	Max	Skewness	Excess Kurtosis	JB
Total period (1988:M1:W1-2004:M9:W1)							
Sweden	0.212%	3.13%	-16.5%	17.9%	-0.036	2.793	159.16**
Germany	0.153%	3.03%	-14.1%	12.9%	-0.308	1.761	68.76**
France	0.146%	2.82%	-12.1%	11.0%	-0.116	0.931	26.75**
Sub-period (1988:M1:W1-1994:M6:W4)							
Sweden	0.253%	3.00%	-16.5%	15.6%	-0.088	4.456	132.90**
Germany	0.203%	2.47%	-8.0%	6.3%	-0.344	0.407	6.92*
France	0.177%	2.53%	-9.4%	9.9%	-0.125	1.096	15.73**
Sub-period (1995:M1:W1-2004:M9:W1)							
Sweden	0.173%	3.24%	-12.1%	17.9%	-0.006	1.935	55.16**
Germany	0.126%	3.38%	-14.1%	12.9%	-0.291	1.590	36.44**
France	0.132%	3.02%	-12.1%	11.0%	-0.099	0.775	12.42**

Notes:

(a) S.D. denotes standard deviation; (b) JB denotes Jarque-Bera test for normality; and (c) the notation \*\* and \* means that the null hypothesis of normality is rejected at the 1 percent or 5 percent significance level, respectively.

TABLE 4 - *Correlation between the Stock Markets in the Different Countries for the Full Sample Period and Each Sub-period*

Total period (1988:M1:W1-2004:M9:W1)			
Market	Sweden	Germany	France
Sweden	1.0		
Germany	0.654	1.0	
France	0.602	0.767	1.0
Sub-period (1988:M1:W1-1994:M6:W4)			
Market	Sweden	Germany	France
Sweden	1.0		
Germany	0.430	1.0	
France	0.320	0.625	1.0
Sub-period (1995:M1:W1-2004:M9:W1)			
Market	Sweden	Germany	France
Sweden	1.0		
Germany	0.763	1.0	
France	0.750	0.833	1.0

## 5. EMPIRICAL RESULTS

Before causality analysis, we first perform the Perron (1989) tests for unit roots on the data. These tests have better power properties because they allow for a shift in the mean value as well as a shift in the trend for the underlying variable. The estimation results from these tests are reported in Table 5. For the null hypotheses of I(1), i. e. integration of the first order, the estimated test statistics are found to be less than the critical values at the conventional significance levels. Hence, the null hypothesis that each variable is I(1) cannot be rejected. The next step is to investigate whether each variable becomes stationary after taking the first difference. Nevertheless, the null hypothesis that each variable is I(2), is rejected at the one percent significance level. Hence, we can conclude that each variable contains one unit root. This implies that we have to pay attention to the integration properties of the data in order to avoid spurious and false inference. The next step in our empirical enquiry was to choose the optimal lag order in the VAR model. The optimal lag order was set equal to one in the first sub-period and two in the second sub-period by minimizing equation (3). It should be mentioned that we also tested for multivariate normality and multivariate ARCH effects<sup>10</sup>. The results, not presented but available on request, showed that neither the assumption of multivariate normality nor the assumption of no multivariate ARCH effects could be sustained. Thus, it appears to be necessary to apply the leveraged bootstrap causality test in this situation in order to draw valid inference.

TABLE 5 - *Test for Unit Roots Using the Perron Test*

$H_0: I(1), H_1: I(0)$	TEST VALUE	$H_0: I(2), H_1: I(1)$	TEST VALUE
$SP_{FRA}$	-1.416 (0)	$SP_{FRA}$	-13.880 (0) ***
$SP_{GER}$	-2.270 (0)	$SP_{GER}$	-13.610 (0) ***
$SP_{SWE}$	-3.289 (11)	$SP_{SWE}$	-7.263 (10)***

*Notes:*

The critical value is -4.78 and -4.24 at the 1% and 5% significance level, respectively.

The notation \*\*\* implies significance at the one percent significance level. The numbers in the parentheses indicate the number of lags required to remove potential autocorrelation in the Perron regression (equation 1) at the 10% significance level using the LM test.

<sup>10</sup> We used Doornik and Hansen (1994) test to test for multivariate normality. A test introduced by Hacker and Hatemi-J (2005) was used to test for multivariate ARCH effects.

The causality test results are presented in Table 6. As can be seen in this table, during sub-period one, the estimated MWALD statistics were less than the critical values at the 1%, 5% and 10% levels for both Germany and France. Thus, both the null hypotheses that Germany does not Granger-cause Sweden and that France does not Granger-cause Sweden cannot be rejected. This indicates that the Swedish stock market was not integrated with the German and French markets during the period that Sweden was not a member of the EU. However, for sub-period two, the estimated MWALD statistics were greater than the critical values at the one percent of significance for France and at the ten percent level for Germany. Thus, the Swedish equity market became integrated with those of Germany and France after it joined the EU. These results seem to be consistent with the increased intensity of Sweden's economic interaction with France and Germany as discussed in section 4. These results are also in line with those of Fratzscher (2002) who found that the European equity markets became more integrated starting in 1996.

TABLE 6 - *Results of Causality Test Based on Bootstrap Simulation Techniques*

THE NULL HYPOTHESIS	THE ESTIMATED TEST VALUE	1% BOOTSTRAP CRITICAL VALUE	5% BOOTSTRAP CRITICAL VALUE	10% BOOTSTRAP CRITICAL VALUE
First Sub-Period ((1988:M1:W1-1994:M6:W4)				
$SP_{GER} \neq SP_{SWE}$	4.544	12.088	7.731	6.149
$SP_{FRA} \neq SP_{SWE}$	4.032	10.345	7.231	6.254
Second Sub-Period (1995:M1:W1-2004:M9:W1)				
$SP_{GER} \neq SP_{SWE}$	8.420*	14.676	9.667	7.738
$SP_{FRA} \neq SP_{SWE}$	14.656***	13.917	9.759	8.037

Notes:

The notation  $SP_{GER} \neq SP_{SWE}$  implies that  $SP_{GER}$  does not Granger cause  $SP_{SWE}$ . The lag order of the VAR model,  $p$ , was set to one for this sub-period and two in the second sub-period. Also the augmentation lag,  $d$ , was set to one since each variable contains one unit root.

FRA=France, GER=Germany, SWE=Sweden.

\*, \*\*, \*\*\* implies that the null hypothesis is rejected at 10%, 5% and 1% significance level.

## 6. CONCLUSIONS

This paper aims at investigating the causal impact of German and French financial markets before and after the Swedish membership



in the EU. We have applied a new method that is robust to non-normality and ARCH effects. Since financial data usually exhibit these properties, we believe that it is necessary to use this method in order to be able to draw correct inferences. This is the case because methods based on asymptotic distributions do not work precisely in such situations. In fact, we tested for multivariate normality and multivariate non-ARCH effects and the results showed that the null hypothesis in each case could be strongly rejected.

Our empirical results (presented in Table 6) based on causality test which applies the Hacker and Hatemi-J (2006) leveraged bootstrap method showed that neither German nor French financial markets caused the Swedish market for the period before Swedish EU membership. However, it seems that both of these financial markets caused the Swedish financial market for the period of Swedish EU membership. These empirical findings are interpreted as supportive of increasing integration of the Swedish financial market with the rest of the EMU area represented by German and French financial markets. This also implies that international portfolio diversification possibilities for Swedish investors might not exist in German and French financial markets. Furthermore, the increased integration may imply an increased spill-over effect of economic stabilization policy conducted in the EMU area represented by Germany and France resulting in a more accommodating economic policy for Sweden in the post-entrance EU-membership period.

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## ABSTRACT

This paper tests for equity market integration between Sweden and EU countries represented by Germany and France. A new causality test method developed by Hacker and Hatemi-J (2006) is applied. This method performs better than the other methods because it is robust to non-normality and the presence of ARCH effects in the financial data. The results show that Sweden did not have a significant causal relationship with Germany and France during the period before Swedish membership in the EU. However, for the period after Sweden joined the EU (in 1995), we find that Sweden became significantly linked with both Germany and France. We interpret these empirical findings as supporting the proposition that the Swedish financial market has become more integrated with the EMU area.

Keywords: Equity Price, Exchange Rates, Leveraged Bootstrap Technique

JEL Classification: C32, F31, G15

## RIASSUNTO

*Il mercato azionario svedese si è integrato con quello di  
Germania e Francia?*

Si esamina l'integrazione tra il mercato azionario svedese e quelli dei paesi dell'Unione Europea, qui rappresentati da Germania e Francia, attraverso l'applicazione di un nuovo test di causalità elaborato da Hacker e Hatemi-J (2006). Tale metodo si è rivelato robusto alla non-normalità ed alla presenza di effetti ARCH nei dati finanziari. I risultati non hanno dimostrato una relazione causale significativa tra i mercati di Svezia, Germania e Francia durante il periodo precedente l'entrata della Svezia nell'UE. Per il periodo successivo a tale entrata (avvenuta nel 1995) risulta la esistenza di una stretta relazione sia con la Francia che con la Germania. Secondo la nostra interpretazione queste evidenze empiriche avvalorano l'ipotesi che il mercato finanziario svedese si è integrato con l'area dell'Unione Monetaria Europea.