How integrated are the exchange markets of the Baltic Sea Region?
An examination of market pressure and its contagion

Scott W. Hegerty

Abstract
In the two decades since independence, the Baltic nations’ re-integration with Western Europe has resulted in close linkages to the Euro. While only Estonia has as of yet joined the common currency, Latvia and Lithuania maintain currency pegs in preparation for membership. But although the Eurozone’s pull is unmistakable, it is possible that the Nordic countries on the Baltic Sea—with which the Baltics have enjoyed economic ties for centuries—might also have an important influence on the region’s exchange markets. In particular, currency crises might more easily spread through the Baltic Sea region than to and from the Eurozone. This study investigates this relationship by generating indices of Exchange Market Pressure (EMP) for the three Baltic countries, Denmark, Sweden, and the Eurozone, before testing for contagion using Vector Autoregressive (VAR) methods. Granger causality tests and impulse-response functions show that pressure on the Scandinavian currency markets, as well as stock price declines, lead to increased Baltic EMP more than do events in the Eurozone.

JEL Classification: F31, F41
Keywords: Exchange Market Pressure, Contagion, Vector Autoregression, Baltics, Scandinavia

1. Introduction
As they continue their path toward economic integration with Western Europe that resumed after the Soviet Union collapsed in 1991, the three Baltic nations of Estonia, Latvia, and Lithuania either have joined or plan to join the Euro. Firm pegs or currency boards form a strong link until accession has completed. Rather than sever these economic connections, the global financial crisis of 2008 seems only to have strengthened policymakers’ resolve to join the common currency, as Latvia’s refusal to devalue — and subsequent painful macroeconomic adjustment — attests.

But the German- and French-led currency union is not the only economic entity that enjoys close ties with the Baltic countries. As far back as the 13th century, Scandinavia and the Baltic Sea region have formed an important trading bloc. Even today, Sweden and Denmark serve as key sources of investment capital, banking centers, and export and import partners. In addition, Finland has enjoyed a particularly close relationship with Estonia, which joined its northern neighbor as a fellow Euro member in 2010.

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The other four countries in this study, however, still enjoy their own national currencies, even if the degree of flexibility is limited. Denmark, as a member of the European Exchange Rate Mechanism (ERM-II), is pegged to the Euro with a 2.25 percent band. Latvia and Lithuania joined this system in 2004, and the latter country has implemented a Euro-backed currency board. As a result, the real and financial linkages among these countries might lead to interconnections among their currency markets. In particular, since maintaining a fixed exchange-rate regime introduces stress on a country’s currency following a crisis or a shock, it is possible that pressure in one might be transmitted to other countries in the region. This study examines transmissions of Exchange Market Pressure (EMP) among the Baltic and Scandinavian countries, generating indices of this pressure for five individual countries and for the Euro area. In addition, spillovers from Nordic stock prices to the region’s currencies helps uncover any linkages among the foreign exchange and asset markets.

**Measuring EMP and its contagion in transition economies**

Explained in detail below, Exchange Market Pressure (EMP) captures a weighted combination of both currency depreciations and central bank action to avoid them. In short, an outright loss of value indicates an increase in market pressure, but so does a loss of foreign exchange reserves or an interest-rate hike. This index can be represented as a quarterly or monthly time series, which can then be analyzed via standard empirical methods. In particular, connections among different countries might be examined to find evidence of “contagion” and the transmission of currency crises. This is particularly important in light of the Euro’s ongoing turmoil; it is possible that this can travel outside the common currency. Or, in the specific case of the Baltic countries, events outside the Eurozone might be relatively more significant.

So far, a fairly limited number of studies have examined exchange market pressure in the countries of the former Soviet bloc. Often, studies use an alternative measure for “crises” in currency markets, and in addition, many of these focus primarily on the domestic determinants of these crises rather than their transmission of crises. For example, Gelos and Sahay (2001) examine interlinkages among the stock markets and currency markets of a set of transition economies, as well as their macroeconomic linkages, up to 1998. Gibson and Tsakalotos (2004) study whether capital inflows increase the probability of a successful speculative attack in the ten new EU members that joined that year. Using panel methods, they find that the 1998 Russian crisis (proxied as a dummy variable) increased this probability.

Studies that generate a pressure index include Van Poeck et al. (2007), who use regression analysis to conclude that credit growth and current account deficits increase this pressure in a sample of eight transition economies. Hegerty (2009) finds that a withdrawal of portfolio capital increases EMP in the fixed-rate regimes of Bulgaria and the Baltics, but again, does not examine any cross-country transmission. Stavárek (2011) includes domestic determinants (such as domestic credit and the money multiplier) in his study of EMP in eight EU members, as well as foreign disturbances (such as Eurozone money supply). These external factors are shown to be influential, suggesting that further study of international transmission with the region, and particularly with the West, is warranted.

As Dornbusch et al. (2000) notes, and Hegerty (2011) explains, contagion can be caused by real, financial, or psychological factors. First, trade linkages are clearly affected by currency movements, particularly if one country’s exports are harmed by a neighbor’s depreciating currency. The importer’s resulting economic contraction can put pressure on its own currency
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to depreciate. Second, one country’s currency depreciation, whether expected or merely antici-
thed, can lead to a flow of capital out of that economy and into another as investors seek
to maximize their rates of return. This could lower EMP in the second country as pressure in
the first increases. On the other hand, if investors expect neighboring countries to share re-
gional characteristics, they might pull their capital out of additional nations and increase EMP
throughout the region. Finally, psychological factors, such as “panic” selling or the tendency
for uninformed investors to alter their investment behavior after an event in an unrelated
country can in fact create a connection among countries where fundamentals are lacking.

Studies that do address the issue of contagion use a number of time-series methods. The most
common of these include measuring correlations (as in Forbes and Rigobon, 2002) and Vec-
tor Autoregressive (VAR) methods. While it is important to note that uncovering statistical
interrelationships often follows outside the narrow definition of “contagion” (such as that
of Forbes and Rigobon, 2002), these interrelationships can in fact uncover important interna-
tional connections. VAR analysis provides an important tool to examine the responses to
shocks.

Notably, Boschi (2005) estimates a vector that includes six emerging markets’ (including
Russia’s) exchange rates, stock returns, and sovereign debt spreads, but does not find much
evidence of contagion. This method was extended by Hegerty (2011), who directly places
seven transition economies’ EMP series into a VAR. Granger causality tests and impulse-
response functions show that Russia has unexpectedly little influence on the region, while
Hungary and Latvia have a stronger effect on the region’s currency markets. This study does
not include any outside currencies or any measure of external shocks, however. In a study of
Latin American EMP, Hegerty (2012) includes a measure of Brazilian stock prices and finds
that stock-price declines increase EMP throughout the region.

As a result, we conclude that a study of EMP in the Baltic region must include some measure
of global or regional market activity to better isolate events among the exchange markets in
question. To that end, we measure contagion among the three Baltic countries (two if we
exclude Estonia after it joined the Euro in 2011), two Scandinavian countries, the Eurozone,
and a measure of Nordic stock prices. We find that the three Baltic countries respond more
strongly to shocks to Scandinavian EMP or asset prices than they do to EMP in the Eurozone.
This paper proceeds as follows. Section II outlines the EMP index used in the empirical study.
Section III describes the results. Section IV concludes.

2. Methodology

In the face of excess demand for foreign exchange, a central bank can either do nothing, or
take action. Our EMP measure captures both options as a weighted average. As mentioned
above, exchange market pressure indices capture currency depreciations, which are usually
measured as percentage changes in a country’s bilateral exchange rate. Since central banks
can intervene to thwart these movements, an EMP index captures the loss of reserves, and
often interest-rate increases, as well. While a number of older methods (such as that of Girton
and Roper, 1977) have modeled this pressure, one of the most commonly used approaches is
that of Eichengreen et al. (1996):
Exchange-rate depreciations result in an increase in units per dollar, and thus have a positive sign in the index. Since reserves are depleted to reduce pressure on a currency, this component has a negative sign. Likewise, interest-rate increases are also used to thwart depreciations, so the third component has a positive sign.

In this model, the three components that comprise EMP are weighted by their own standard deviations so that the most volatile component does not dominate the series. The exchange rate and interest-rate changes are \( \text{vis-à-vis} \) the U.S., even though many countries peg to the Euro, because an EMP index is also created for the Eurozone. This allows for a consistent reference point for all countries. Bilateral rates are used (instead of effective ones, for example) not only because this is standard in the literature, but also because changes in bilateral rates capture only events in the exchange market of the country in question, once those in the reference country—which are common to all—are factored out. The currencies and weights used in constructing effective rates differ from country to country. Changes in reserves are scaled by the previous month’s monetary base. Monthly data from 2001m:11-2012m06 are taken from the International Financial Statistics of the International Monetary Fund. The variables are: \( e \): nominal exchange rate (per US dollar); \( RES \): foreign reserve stock, converted into domestic currency; \( MB = \) Monetary base, in domestic currency, deseasonalized with the Census-X12 procedure\(^2\); and \( r \): short-term interest rate (money market rate).

While Weymark (1998) used model-dependent weights for the EMP components, the standard deviation has proven to be more empirically tractable. Nonetheless, the weighting scheme and other attributes of this EMP measure have begun to be questioned in the literature. Studies include Pentecost et al. (2001), who use principal components to generate an alternative measure of EMP; Pontines and Siregar (2008), who try a number of methods but do not find a clear alternative; Bertoli et al. (2010), who question the weighting scheme of the EMP index; and Klaassen and Jager (2011), who also construct a new index. Because no suitable alternative has yet been found, we choose the standard measure for our empirical analysis.

Once these EMP series are generated, we examine their statistical properties by entering them in a VAR:

\[
EMP_t = \frac{1}{\sigma_{e_{i}}} \left( \ln e_t - \ln e_{i_{-t}} \right) - \frac{1}{\sigma_{RES_{i}}} \Delta RES_{i} + \frac{1}{\sigma_{r}} \Delta r_{i_{US}} 
\]

(1)

\( EMP \) is a measure of Nordic stock process that is calculated as the first principal component of (log differenced) stock prices in Denmark, Sweden, and Finland, which were drawn from the IFS. The precise method is described below.

After choosing the appropriate VAR order by minimizing the Schwarz Information Criterion, connections among the variables are analyzed in two ways. First, Granger causality (block exogeneity) tests evaluate whether the addition of a variable has a significant impact on a country’s EMP. Should such an effect be shown, we can say that EMP in one country leads to pressure in another, and that a crisis originates that can spread to its neighbor. We next generate impulse-response functions (IRFs) using the generalized VAR methodology of Pesaran

\(^2\) M1 is used for Estonia and the Eurozone.
and Shin (1998). This approach is invariant to the ordering of variables, which is useful for a model where there is no obvious ordering. This leads us to select this approach over the orthogonalized VAR technique of Sims (1980).

Using these two time-series methods, we can answer two key questions. First, we can see which countries are most vulnerable to currency shocks that are generated abroad, and which countries are most likely to cause a contagious crisis. It is possible that Scandinavia and the Eurozone, as two competing financial poles, might have differing influence on the region. Secondly, we can examine the role of asset-price movements and external events on the region’s currency markets. These results are detailed below.

3. Results

Using monthly data from the International Financial Statistics of the International Monetary Fund, we generate EMP series according to Equation (1) for three Baltic and two Scandinavian countries, as well as the Euro area. These series begin in 2002m1 and are depicted in Figure 1. As expected, there are “spikes” in the series that correspond to the 2008 crisis and its aftermath; low or even negative EMP often immediately follows these increases, as central banks respond to this macroeconomic turmoil. As was noted by Hegerty (2009, 2011), the mid- to late 2000s was also a period of below-zero EMP values. During this period, large capital inflows and corresponding current account deficits helped lead to reserve accumulation under the Baltics’ fixed exchange-rate regimes. Denmark, which is also fixed to the Euro under ERM-II, also registers similar patterns during 2008 and beforehand. Sweden, with its floating kronor, also sees its EMP spike in 2008 and exhibits fluctuations throughout the period. And the Euro, floating against the dollar, appears to experience similar events in its EMP series. This study hopes to uncover the relationships among these movements in the countries’ currency markets.

While most of the countries in this study currently peg their currencies to the Euro (although Lithuania switched from a dollar peg in 2004), the fact that dollar exchange rates are used in this study will introduce some fluctuation to the EMP series. The use of variance-smoothing weights should eliminate excess variability, however. Table 1 shows the weight (standard deviation) used for each of the three components in each country’s EMP series. We find that reserve changes have the largest variance in the series, particularly in Denmark. Latvia’s rate spike in 2009 might contribute to the large variance that is reflected in this table.

In addition to generating Exchange Market Pressure series, we also create a single measure of Nordic stock prices. The purpose of including this series is twofold: First, we capture external events in world markets (such as the 2008 financial crisis). Second, we can assess whether investor behavior causes asset-price movements to spill over to the region’s currency markets. While it is possible to include Baltic stock prices as well, we choose to use an index that lies completely outside the Baltics. We thus proxy these prices as the first principal component of log changes to Danish, Swedish, and Finnish stock prices. The results of our principal components analysis are provided in Table 2.

1 Note that the series vary slightly from Hegerty (2009, 2011) due to variations in the weighting scheme and choice of interest rate, and from Stavárek (2011) due to a different modeling strategy.
2 Hegerty (2009) avoids this problem by assuming exchange-rate movements to be zero.
We see that the first principal component explains 78 percent of the series’ variance, and that the other two components have eigenvalues below one. This confirms the choice of a single index using this method. We also find that the three countries make a roughly equal contribution to the series. Finland and Denmark are the most closely correlated to one another, and have the highest factor loadings in the principal components.

The combined stock index is shown in Figure 2. Clear drops occur, as expected, during the 2008 financial crisis and the Euro crisis that followed a few years later. The VAR analysis will tell us whether these stock declines are related to increases in EMP in the region.

Table 3 gives the results of Phillips-Perron stationary tests on the EMP indices and (log differenced) stock price series. It also provides summary statistics for each variable used in our analysis. Since these variables are shown to be stationary, we enter them into our VARs without any further differencing. Our VAR analysis continues below.

Granger causality test results are provided in Table 4. We include two variations of our model. The first (Panel A) includes Estonia—even though the kroon no longer exists—to show a historical relationship that might still be of economic value. This estimation must, by necessity, end with Estonia’s independent currency in 2011. The second analysis (Panel B) excludes Estonia and runs to 2012. Both panels show similar results, indicating that the relationships are robust to the inclusion of Estonia or the shortening of the sample period.

Our most important finding is that the Nordic countries carry a stronger influence on the Baltic currency markets than do events in the Eurozone. Stock price changes Granger-cause EMP in Estonia and Lithuania, as well as in Denmark and Sweden. Danish EMP has an influence on Estonia and (to a lesser extent) in Lithuania, while Swedish EMP has a strong effect on pressure in the Latvian foreign exchange market. EMP in the Eurozone Granger-causes EMP in Denmark and Sweden, and seems also to affect Nordic stock prices. Two other findings are significant: First, the inclusion of external forces in the model eliminates many of the bilateral relationships between Baltic EMP series that were uncovered by Hegerty (2011). Secondly, there is some evidence that market pressure in the Baltics leads to increased EMP in the Eurozone—perhaps due to psychological factors such as confidence, as investors become concerned with wider crisis—but these results are not consistent across specifications. These findings are confirmed via the Generalized Impulse-Response Functions (GIRFs) that are depicted in Figure 3.

We see that Estonian EMP registers a lasting increase after a one-standard-deviation shock to Danish EMP, and increases after a Nordic stock decline. Responses to increases in Eurozone EMP are much weaker and occur only after the passage of months. Latvia, likewise, sees its EMP index increase after a shock to the Swedish currency market, as was foreseen by the Granger causality tests. Again, Latvia is less sensitive to stock declines than its Baltic neighbors. Lithuania responds strongly to the Danish krone and to Nordic asset depreciations; here, perhaps surprisingly, we see Eurozone EMP cause a significant response to Lithuania’s pressure series. Again, since the Baltics were at the center of the European and global financial crises, it is no surprise that attention might be drawn to the Euro as a result.
4. Conclusion

As it struggles with maintaining its common currency, the Eurozone continues to serve as the epicenter of a potential crisis that could spread around the world. But perhaps no region is as susceptible as the new EU members on its periphery, which not only enjoys strong trade ties with its wealthy neighbors, but also includes countries that have chosen to peg to the Euro as a precursor to joining the common currency. It is thought that as pressure on the Euro spikes, these neighbors could fall victim to a “contagious” currency crisis. But, if linkages with other partners prove to be stronger, these effects will be relatively muted.

This study examines this proposition for the Baltic nations, observing their strong economic connections with the Scandinavian countries of the larger Baltic Sea region. Creating a monthly measure of exchange market pressure (EMP) for Latvia, Lithuania, Denmark, and Sweden, as well as Estonia (before its Euro accession) and the Eurozone itself, we use time-series methods to examine the relationship among these currency markets. Also incorporating a single proxy for stock-price movements in Denmark, Sweden, and Finland—to proxy global events as well as to look at spillovers between two different asset markets—we conduct Granger causality tests and generate impulse-response functions to arrive at a few key conclusions.

First, Scandinavia appears to have a stronger influence on the Baltics than does the Eurozone. This is shown by significant responses by Baltic EMP to shocks in stock prices and foreign EMP. Second, Eurozone EMP affects EMP in Denmark and Sweden, as well as stock prices. Finally, there is also evidence of causality running the other direction, originating in the Baltic and spreading to the Euro itself. It is possible that such small countries might affect their larger neighbor due to their effects on expectations, leading investors to adjust their behavior regarding the common currency as they witness events on the periphery. But the strength of Nordic influence on the Baltics, relative to that of the Eurozone, is the main finding of this study.

These results carry important implications for regional integration. It shows the Baltic Sea region to be a highly integrated economic space, and confirms that the Baltic countries maintain strong linkages within it as well as with the currency to which their currencies are pegged. Even when Latvia and Lithuania join the Euro, these linkages are expected to persist. In particular, asset price movements will continue to have strong effects throughout the region. Policymakers should be wary of any assumption that the Baltic nations are solely tied to the Euro.
References:
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**Figure 1.** Exchange-Market Pressure Indices, 2002-2012

- **Denmark**
- **Estonia**
- **Eurozone**
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Table 1. Standard Deviations of EMP Components.

<table>
<thead>
<tr>
<th></th>
<th>E</th>
<th>RES</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>0.025</td>
<td>0.202</td>
<td>0.002</td>
</tr>
<tr>
<td>Estonia</td>
<td>0.026</td>
<td>0.041</td>
<td>0.004</td>
</tr>
<tr>
<td>Eurozone</td>
<td>0.026</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>Latvia</td>
<td>0.024</td>
<td>0.099</td>
<td>0.025</td>
</tr>
<tr>
<td>Lithuania</td>
<td>0.025</td>
<td>0.104</td>
<td>0.006</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.029</td>
<td>0.093</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Table 2. Principal Components Analysis of Scandinavian Stock Prices.

<table>
<thead>
<tr>
<th>Eigenvalues</th>
<th>Factor Loadings</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Value</td>
<td>Difference</td>
</tr>
<tr>
<td>1</td>
<td>2.339</td>
<td>1.883</td>
</tr>
<tr>
<td>2</td>
<td>0.456</td>
<td>0.251</td>
</tr>
<tr>
<td>3</td>
<td>0.205</td>
<td>---</td>
</tr>
</tbody>
</table>

Figure 2. Percent Changes in “Scandinavian” Stock Prices

Calculated as the first principal component of percentage changes in Danish, Finnish, and Swedish stock prices.
Source: IFS

Table 3. Phillips-Perron Stationarity Test Results and Summary Statistics.

<table>
<thead>
<tr>
<th>Country</th>
<th>Statistic (p-value)</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estonia</td>
<td>-10.370 (0.000)</td>
<td>-0.25</td>
<td>1.72</td>
<td>-3.91</td>
<td>6.71</td>
<td>108</td>
</tr>
<tr>
<td>Latvia</td>
<td>-11.992 (0.000)</td>
<td>-0.21</td>
<td>1.92</td>
<td>-13.64</td>
<td>6.34</td>
<td>126</td>
</tr>
<tr>
<td>Lithuania</td>
<td>-10.532 (0.000)</td>
<td>-0.25</td>
<td>1.56</td>
<td>-5.66</td>
<td>4.77</td>
<td>126</td>
</tr>
<tr>
<td>Denmark</td>
<td>-8.158 (0.000)</td>
<td>-0.34</td>
<td>1.83</td>
<td>-6.86</td>
<td>8.95</td>
<td>126</td>
</tr>
<tr>
<td>Sweden</td>
<td>-9.102 (0.000)</td>
<td>-0.20</td>
<td>1.50</td>
<td>-4.24</td>
<td>10.06</td>
<td>126</td>
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<tr>
<td>Eurozone</td>
<td>-8.596 (0.000)</td>
<td>-0.09</td>
<td>1.23</td>
<td>-6.18</td>
<td>5.64</td>
<td>126</td>
</tr>
<tr>
<td>Stock Prices</td>
<td>-7.399 (0.000)</td>
<td>0.00</td>
<td>1.54</td>
<td>-7.05</td>
<td>4.16</td>
<td>126</td>
</tr>
</tbody>
</table>

Bandwidth = 5 for Newey-West standard errors in all cases.
### Table 4. Granger Causality (Block Exogeneity) Test Results.

#### Panel A: Including Estonia (2002-2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Estonia Excluded</th>
<th>Latvia</th>
<th>Lithuania</th>
<th>Denmark</th>
<th>Sweden</th>
<th>Eurozone</th>
<th>Stock Prices</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Chi-sq (Prob.)</td>
<td>Chi-sq (Prob.)</td>
<td>Chi-sq (Prob.)</td>
<td>Chi-sq (Prob.)</td>
<td>Chi-sq (Prob.)</td>
<td>Chi-sq (Prob.)</td>
<td>Chi-sq (Prob.)</td>
</tr>
<tr>
<td>Estonia</td>
<td>0.859 (0.354)</td>
<td>3.225 (0.068)</td>
<td>5.825 (0.016)</td>
<td>0.797 (0.372)</td>
<td>7.703 (0.006)</td>
<td>2.174 (0.140)</td>
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<tr>
<td>Latvia</td>
<td>0.743 (0.389)</td>
<td>0.230 (0.631)</td>
<td>0.429 (0.512)</td>
<td>1.969 (0.161)</td>
<td>4.246 (0.039)</td>
<td>1.696 (0.193)</td>
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<tr>
<td>Lithuania</td>
<td>0.898 (0.343)</td>
<td>1.588 (0.721)</td>
<td>0.128 (0.869)</td>
<td>0.027 (0.869)</td>
<td>2.825 (0.093)</td>
<td>2.053 (0.152)</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>3.021 (0.082)</td>
<td>0.335 (0.563)</td>
<td>3.098 (0.078)</td>
<td>7.101 (0.008)</td>
<td>0.625 (0.429)</td>
<td>0.000 (0.999)</td>
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<tr>
<td>Sweden</td>
<td>2.364 (0.124)</td>
<td>0.015 (0.902)</td>
<td>0.060 (0.806)</td>
<td>1.021 (0.312)</td>
<td>2.603 (0.107)</td>
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<tr>
<td>Eurozone</td>
<td>2.580 (0.108)</td>
<td>0.374 (0.541)</td>
<td>0.833 (0.362)</td>
<td>3.314 (0.069)</td>
<td>5.729 (0.017)</td>
<td>7.694 (0.006)</td>
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<tr>
<td>Stock Prices</td>
<td>7.758 (0.005)</td>
<td>0.905 (0.342)</td>
<td>2.288 (0.130)</td>
<td>3.639 (0.057)</td>
<td>7.688 (0.006)</td>
<td>0.694 (0.405)</td>
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<tr>
<td>All</td>
<td>35.165 (0.000)</td>
<td>12.821 (0.046)</td>
<td>14.526 (0.024)</td>
<td>13.658 (0.034)</td>
<td>21.563 (0.002)</td>
<td>15.818 (0.015)</td>
<td>15.939 (0.014)</td>
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Panel A: N = 107; Lag = 1, AIC = 24.371 (Akaike Information Criterion)

#### Panel B: Excluding Estonia (2002-2012)

<table>
<thead>
<tr>
<th>Country</th>
<th>Latvia Excluded</th>
<th>Lithuania</th>
<th>Denmark</th>
<th>Sweden</th>
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<th>Stock Prices</th>
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<td>Chi-sq (Prob.)</td>
<td>Chi-sq (Prob.)</td>
<td>Chi-sq (Prob.)</td>
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<tr>
<td>Latvia</td>
<td>0.709 (0.400)</td>
<td>1.269 (0.227)</td>
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<td>2.184 (0.140)</td>
<td>2.148 (0.143)</td>
<td>1.935 (0.164)</td>
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<td>Lithuania</td>
<td>0.494 (0.482)</td>
<td>1.972 (0.160)</td>
<td>0.119 (0.009)</td>
<td>6.883 (0.730)</td>
<td>0.119 (0.730)</td>
<td>0.989 (0.320)</td>
</tr>
<tr>
<td>Denmark</td>
<td>4.917 (0.027)</td>
<td>0.114 (0.921)</td>
<td>1.156 (0.736)</td>
<td>0.119 (0.009)</td>
<td>1.156 (0.028)</td>
<td>4.116 (0.043)</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.909 (0.340)</td>
<td>3.801 (0.428)</td>
<td>5.193 (0.051)</td>
<td>4.116 (0.043)</td>
<td>5.193 (0.051)</td>
<td>8.680 (0.003)</td>
</tr>
<tr>
<td>Eurozone</td>
<td>1.228 (0.268)</td>
<td>2.994 (0.084)</td>
<td>3.412 (0.065)</td>
<td>10.632 (0.001)</td>
<td>10.632 (0.001)</td>
<td>0.557 (0.456)</td>
</tr>
<tr>
<td>Stock Prices</td>
<td>12.378 (0.030)</td>
<td>12.670 (0.027)</td>
<td>10.442 (0.064)</td>
<td>22.903 (0.000)</td>
<td>22.903 (0.000)</td>
<td>7.725 (0.172)</td>
</tr>
</tbody>
</table>

Panel B: N = 125; Lag = 1, AIC = 20.653
How integrated are the exchange markets of the Baltic Sea Region?

An examination of market pressure and its contagion

**Figure 3.** Generalized Impulse-Response Functions to a One-Standard Deviation Shock, With ±2 Standard Error Bands.
Lithuania: Response to Estonia

Denmark

Eurozone

Stock Prices

Responses to Stock Price changes

Denmark

Sweden