Asset Fire Sales and Purchases and the International Transmission of Funding Shocks

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September 2009
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Recent episodes associated with contagion:

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Several economists have emphasized that financial frictions are important.
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Theory: How is asset market liquidity (and hence prices) affected by funding available to intermediaries?


- Mutual (and hedge) funds are often forced to redeem investments in response to funding shocks from their investor base.
- Correlated forced redemptions (or ‘fire sales’) across institutions holding a particular stock lead to significant (but temporary) price falls.
Focus of This Paper

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  - Do correlated fire sales across global funds that own a market lead to significant price movements in that market?
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  - Do global funds that experience outflows (inflows) liquidate (increase) country holdings significantly? *(Fire sales (and purchases))*
  - Do correlated fire sales across global funds that own a market lead to significant price movements in that market?
- Does this mechanism help predict when correlations between developed and emerging markets will increase?
Approach

1. Employ monthly portfolio allocation and investor flow data on over 1,000 global funds from EPFR Inc.

2. Sorting fund-months by inflows and outflows, document the incidence of global fund fire sales (and purchases).

3. Measure the quantum of emerging market capitalization that is At-Risk of fire sales.

4. Document price effects on emerging markets from being At-Risk.

5. Check how upside and downside correlations with developed markets are affected by being At-Risk.

4. Robustness checks.

1. Estimate predicted At-Risk to see if we can anticipate the impacts.

2. Estimate regime-switching model to evaluate correlation changes.

5. Do global funds attempt to offset the price impact of fire sales?
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7. Ramadorai (SBS, Oxford-Man, CEPR)

8. NIPFP-DEA Research Meeting 9/2009 6/21
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The Data

- Global fund data from Emerging Portfolio Fund Research (EPFR)
  - Monthly data, on 1,097 global funds which invest in emerging markets, domiciled predominately in the U.S.(50-60%), U.K.(8-9%) and Luxembourg (15-25%).
  - Total net asset values (TNA); fund returns; inflow or outflow from the funds; percentage of fund assets allocated to each country.
  - TNA and return data compared to CRSP mutual fund database, cross-sectional correlation close to 1.

- S&P Emerging Markets Database (EMDB) and the World Bank’s World Development Indicators Database.
  - Country index return, market capitalization, and trading volume.
Comparison with US Treasury (TIC) Data

**Hong Kong**

**Russia**
<table>
<thead>
<tr>
<th>Country</th>
<th>Number of Funds</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>248</td>
<td>2.55</td>
<td>2.54</td>
</tr>
<tr>
<td>Brazil</td>
<td>352</td>
<td>4.00</td>
<td>1.29</td>
</tr>
<tr>
<td>Chile</td>
<td>253</td>
<td>1.95</td>
<td>0.73</td>
</tr>
<tr>
<td>China</td>
<td>614</td>
<td>1.40</td>
<td>1.02</td>
</tr>
<tr>
<td>Colombia</td>
<td>139</td>
<td>0.69</td>
<td>0.62</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>246</td>
<td>3.88</td>
<td>2.23</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>646</td>
<td>2.30</td>
<td>0.85</td>
</tr>
<tr>
<td>Hungary</td>
<td>275</td>
<td>9.22</td>
<td>3.69</td>
</tr>
<tr>
<td>India</td>
<td>518</td>
<td>3.82</td>
<td>1.28</td>
</tr>
<tr>
<td>Indonesia</td>
<td>461</td>
<td>3.77</td>
<td>1.56</td>
</tr>
<tr>
<td>Israel</td>
<td>269</td>
<td>1.62</td>
<td>0.87</td>
</tr>
<tr>
<td>Jordan</td>
<td>32</td>
<td>0.11</td>
<td>0.11</td>
</tr>
<tr>
<td>Malaysia</td>
<td>450</td>
<td>1.83</td>
<td>0.93</td>
</tr>
<tr>
<td>Mexico</td>
<td>315</td>
<td>5.83</td>
<td>1.62</td>
</tr>
<tr>
<td>Morocco</td>
<td>55</td>
<td>0.38</td>
<td>0.25</td>
</tr>
<tr>
<td>Pakistan</td>
<td>118</td>
<td>1.18</td>
<td>1.27</td>
</tr>
<tr>
<td>Philippines</td>
<td>348</td>
<td>2.73</td>
<td>1.08</td>
</tr>
<tr>
<td>Poland</td>
<td>262</td>
<td>5.20</td>
<td>2.65</td>
</tr>
<tr>
<td>Russia</td>
<td>358</td>
<td>3.92</td>
<td>1.32</td>
</tr>
<tr>
<td>South Africa</td>
<td>271</td>
<td>1.59</td>
<td>0.62</td>
</tr>
<tr>
<td>South Korea</td>
<td>567</td>
<td>4.98</td>
<td>2.04</td>
</tr>
<tr>
<td>Taiwan</td>
<td>569</td>
<td>2.88</td>
<td>1.46</td>
</tr>
<tr>
<td>Thailand</td>
<td>468</td>
<td>3.86</td>
<td>1.46</td>
</tr>
<tr>
<td>Turkey</td>
<td>285</td>
<td>3.44</td>
<td>1.53</td>
</tr>
<tr>
<td>Venezuela</td>
<td>151</td>
<td>2.35</td>
<td>2.34</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>307</strong></td>
<td><strong>3.02</strong></td>
<td><strong>1.41</strong></td>
</tr>
</tbody>
</table>
How do movements in fund flows affect funds’ allocation decisions?

First, sort fund-months into deciles according to fund flows. Then, look at reallocations relative to a buy-and-hold benchmark. Positions can be expanded, reduced or eliminated. Also compute predicted (not just realized) flows to see if forced reallocations are predictable (so not driven by information).

Standard model (see Sirri and Tufano (1998)):

$$flow_{j,t} = a + 12 \sum_{k=1}^{12} b_k flow_{j,t-k} + 12 \sum_{h=1}^{12} c_h R_{j,t-h}$$

of 27%, using Fama-Macbeth (1973) regressions.
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    - \(R^2\) of 27%, using Fama-Macbeth (1973) regressions.
<table>
<thead>
<tr>
<th>Decile</th>
<th>Flow (%)</th>
<th>% Countries Expanded</th>
<th>% Countries Reduced</th>
<th>% Countries Eliminated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Inflows)</td>
<td>13.55</td>
<td>78.58</td>
<td>19.91</td>
<td>1.50</td>
</tr>
<tr>
<td>2</td>
<td>3.35</td>
<td>62.77</td>
<td>35.72</td>
<td>1.50</td>
</tr>
<tr>
<td>3</td>
<td>1.13</td>
<td>53.95</td>
<td>44.75</td>
<td>1.30</td>
</tr>
<tr>
<td>4</td>
<td>0.16</td>
<td>47.86</td>
<td>50.97</td>
<td>1.17</td>
</tr>
<tr>
<td>5</td>
<td>-0.05</td>
<td>47.47</td>
<td>51.42</td>
<td>1.11</td>
</tr>
<tr>
<td>6</td>
<td>-0.54</td>
<td>45.43</td>
<td>52.90</td>
<td>1.67</td>
</tr>
<tr>
<td>7</td>
<td>-1.29</td>
<td>42.38</td>
<td>55.71</td>
<td>1.91</td>
</tr>
<tr>
<td>8</td>
<td>-2.39</td>
<td>37.89</td>
<td>60.29</td>
<td>1.83</td>
</tr>
<tr>
<td>9</td>
<td>-4.41</td>
<td>32.50</td>
<td>65.55</td>
<td>1.95</td>
</tr>
<tr>
<td>10 (Outflows)</td>
<td>-12.61</td>
<td>21.58</td>
<td>75.10</td>
<td>3.31</td>
</tr>
</tbody>
</table>

1-10      | 26.16    | 57.00                | -55.19             | -1.81                  |

\(t\)-statistic | -- | (40.36) | (-39.63) | (-5.17)
### Predicted Asset Fire Sales and Purchases

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>1 (Inflows)</td>
<td>4.64</td>
<td>59.09</td>
<td>39.45</td>
<td>1.46</td>
</tr>
<tr>
<td>2</td>
<td>1.57</td>
<td>53.17</td>
<td>45.26</td>
<td>1.57</td>
</tr>
<tr>
<td>3</td>
<td>0.53</td>
<td>50.08</td>
<td>48.61</td>
<td>1.31</td>
</tr>
<tr>
<td>4</td>
<td>-0.07</td>
<td>48.44</td>
<td>50.14</td>
<td>1.42</td>
</tr>
<tr>
<td>5</td>
<td>-0.55</td>
<td>46.00</td>
<td>52.57</td>
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<td>1-10</td>
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<td>19.82</td>
<td>-18.87</td>
<td>-0.94</td>
</tr>
<tr>
<td>t-statistic</td>
<td>--</td>
<td>(11.66)</td>
<td>(-11.35)</td>
<td>(-4.10)</td>
</tr>
</tbody>
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Do coordinated fire sales of a market affect prices?

\[
\text{At-Risk}_k, t = \sum_{j=1}^{N} \text{flow}_j, t \cdot \text{allocation}_j, k, t \cdot \text{TNA}_j, t
\]
Do coordinated fire sales of a market affect prices?

We measure country-capital At-Risk as the product of three ingredients.
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(Say) Fidelity’s TNA at December 2007 is 100 MM USD.
Do coordinated fire sales of a market affect prices?

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1. (Say) Fidelity’s *TNA* at December 2007 is 100 MM USD.
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In maths, \( \text{At-Risk}_{k,t} = \sum_{j=1}^{N} \text{flow}^*_j \cdot \text{allocation}_{j,k,t-1} \cdot \text{TNA}_{j,t-1} \)
## At-Risk Across Country-Months: Magnitudes

<table>
<thead>
<tr>
<th>At-Risk Quintile</th>
<th>At-Risk Measured as % of Market Capitalization</th>
<th>At-Risk Measured as % of Average Monthly Volume</th>
<th>Holding of Sample Funds as % of Market Capitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Positive)</td>
<td>0.219</td>
<td><strong>8.055</strong></td>
<td><strong>4.814</strong></td>
</tr>
<tr>
<td>2</td>
<td>0.049</td>
<td>2.451</td>
<td>2.733</td>
</tr>
<tr>
<td>3</td>
<td>0.008</td>
<td>0.586</td>
<td>1.380</td>
</tr>
<tr>
<td>4</td>
<td>-0.012</td>
<td>-0.758</td>
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<tr>
<td>5 (Negative)</td>
<td>-0.109</td>
<td><strong>-3.375</strong></td>
<td><strong>3.879</strong></td>
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<td>1-5</td>
<td><strong>0.328</strong></td>
<td>11.430</td>
<td>0.935</td>
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<tr>
<td>$t$-statistic</td>
<td>--</td>
<td>(24.39)</td>
<td>(5.32)</td>
</tr>
<tr>
<td>Quintile Calendar Portfolio</td>
<td>Average Return (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>G7 Premium &gt; 0</td>
<td>G7 Premium &lt; 0</td>
</tr>
<tr>
<td>1 (Positive)</td>
<td>1.91</td>
<td>5.35</td>
<td>-2.83</td>
</tr>
<tr>
<td>2</td>
<td>1.38</td>
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<td>-2.98</td>
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<td>3.76</td>
<td>-3.92</td>
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<tr>
<td>4</td>
<td>0.63</td>
<td>3.82</td>
<td>-3.78</td>
</tr>
<tr>
<td>5 (Negative)</td>
<td>0.63</td>
<td>4.04</td>
<td>-4.09</td>
</tr>
<tr>
<td>1-5</td>
<td>1.28</td>
<td>1.30</td>
<td>1.26</td>
</tr>
<tr>
<td>t-statistic [t]</td>
<td>(2.58)</td>
<td>(2.37)</td>
<td>(1.62)</td>
</tr>
</tbody>
</table>
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Q1 and Q5 portfolio returns have a strong link to the sign of the G-7 return.

When G-7 returns are positive, Q1 portfolio outperforms Q5 portfolio by 130 bp per month.

When G-7 returns are negative, Q1 still outperforms Q5 by 126 bp per month.

Switching beta: Q1-Q5 long-short portfolio has positive beta in good times, negative beta in bad times. More formal calendar-time regressions confirm this.
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- Related to Calvo’s (2005) argument about leveraged foreign investors.
- Similar findings (and explanation) in Boyer, Kumagai and Yuan (2006) for correlations of returns on investable emerging market indices with G-7 returns.
## Calendar-Time Regressions

<table>
<thead>
<tr>
<th></th>
<th>At-Risk Sort</th>
<th>At-Risk Sort</th>
<th>Predicted At-Risk Sort</th>
<th>Predicted At-Risk Sort</th>
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</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.013**</td>
<td>-0.001</td>
<td>-0.001</td>
<td>-0.017*</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.008)</td>
<td>(0.006)</td>
<td>(0.009)</td>
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<tr>
<td>G7 Risk Premium</td>
<td>0.005</td>
<td></td>
<td>-0.038</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.091)</td>
<td></td>
<td>(0.160)</td>
<td></td>
</tr>
<tr>
<td>Positive G7 Risk Premium</td>
<td>0.510***</td>
<td>0.542**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.191)</td>
<td>(0.261)</td>
<td></td>
<td></td>
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<tr>
<td>Negative G7 Risk Premium</td>
<td>-0.324**</td>
<td>-0.400*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.140)</td>
<td>(0.241)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$N$</td>
<td>150</td>
<td>150</td>
<td>139</td>
<td>139</td>
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<tr>
<td>R-squared</td>
<td>0.00</td>
<td>0.04</td>
<td>0.00</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Ramadorai (SBS, Oxford-Man, CEPR)
Robustness Checks

1. Is this driven by fund holdings or fund flows?
   a. We repeat analysis for portfolios of countries that are most (Q1) and least (Q5) held by global funds.
   * Positive beta in both states (upside and downside), and no alpha. Different mechanism.

2. Perhaps dividing into positive and negative G-7 returns does not actually capture times of ‘distress’.
   a. We estimate a two-state regime-switching model for the G-7 risk premium to check if our results still hold up.
   * Results are robust.
Do Global Funds Try to Offset These Price Effects?


<table>
<thead>
<tr>
<th>Decile</th>
<th>Flow (%)</th>
<th>Countries Expanded</th>
<th>Countries Reduced or Eliminated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Inflows)</td>
<td>13.55</td>
<td>56.16</td>
<td>61.32</td>
</tr>
<tr>
<td>2</td>
<td>3.35</td>
<td>55.36</td>
<td>57.67</td>
</tr>
<tr>
<td>3</td>
<td>1.13</td>
<td>55.90</td>
<td>56.85</td>
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<tr>
<td>4</td>
<td>0.16</td>
<td>57.63</td>
<td>58.39</td>
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<tr>
<td>5</td>
<td>-0.05</td>
<td>58.21</td>
<td>58.21</td>
</tr>
<tr>
<td>6</td>
<td>-0.54</td>
<td>56.36</td>
<td>55.82</td>
</tr>
<tr>
<td>7</td>
<td>-1.29</td>
<td>56.72</td>
<td>55.28</td>
</tr>
<tr>
<td>8</td>
<td>-2.39</td>
<td>58.36</td>
<td>55.73</td>
</tr>
<tr>
<td>9</td>
<td>-4.41</td>
<td>58.66</td>
<td>56.22</td>
</tr>
<tr>
<td>10 (Outflows)</td>
<td>-12.61</td>
<td>61.33</td>
<td>55.78</td>
</tr>
<tr>
<td>1-10</td>
<td>26.16</td>
<td>-5.17</td>
<td>5.54</td>
</tr>
<tr>
<td>t-statistic</td>
<td>--</td>
<td>(-4.56)</td>
<td>(5.65)</td>
</tr>
</tbody>
</table>
1 Global funds facing significant outflows (inflows) reduce/eliminate holdings in 78% (21%) of the markets in which they invest.
Conclusion

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2. Global funds facing significant inflows (outflows) expand holdings in 79% (22%) of the markets in which they invest.

3. We measure the quantum of emerging market capitalization that is At-Risk from such fire sales.

4. Emerging markets severely At-Risk significantly underperform those that are likely to be purchased (15.4% annualized).

5. Asymmetric betas: When G-7 returns are positive (negative), countries with positive (negative) At-Risk capital have significantly larger G-7 betas.

6. Findings are robust to a variety of changes in specifications.

7. Also find that global funds attempt to offset price impact of fire sales. Clearly they are unable to offset this completely.
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