The Curse of Olympian Spending with International Borrowing

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This Research Insight examines the impact of the unfolding European sovereign debt crisis, focusing on Greece, Portugal, Ireland, Spain, and Italy (GPISI). We use the new, short-horizon Barra Integrated Model (BIM Daily) to measure sovereign bond investment risk and provide insight into this market development.

First, we highlight the background of this emerging crisis, in particular the links to government debt, fiscal deficits, maturity distribution, and levels of external borrowing. Then, we show how the recent volatility in European sovereign debt markets was reflected in BIM risk forecasts and led to high risk concentrations in a European government bond portfolio. Finally, we provide an historical and qualitative perspective to evaluate the potential widening of credit contagion.

Introduction

The past two years have been characterized by unprecedented volatility in European government bond and CDS spreads. In 2008, the increase in global risk aversion benefited the core euro area sovereigns. As the banking crisis unfolded, countries with financial systems that were hit hardest by the crisis began to come under more scrutiny. Later, sovereigns stepped in with increased public spending and support to the banking system. The transmission of risks from private sector to sovereign balance sheets shifted the spotlight to the sovereign fiscal positions. The current crisis in the GPISI countries has focused investors' attention toward the sovereign debt of highly indebted countries, especially European countries with near-term refinancing needs.

Figures 1 and 2 highlight the fiscal positions, as well as the degree of short-term vulnerability, for the GPISI countries and other developed nations. Figure 1 shows the debt and structural deficit[1] positions of the countries in proportion to their GDPs. Greece stands out on this chart in terms of both debt and deficit, but note that a number of other developed countries appear to have unattractive fiscal positions. We see that this is the case with respect to most GPISI countries, in particular Italy and Portugal, as well as some other developed nations, notably the UK and Japan.[2]

Figure 1: Government Debt and Deficit

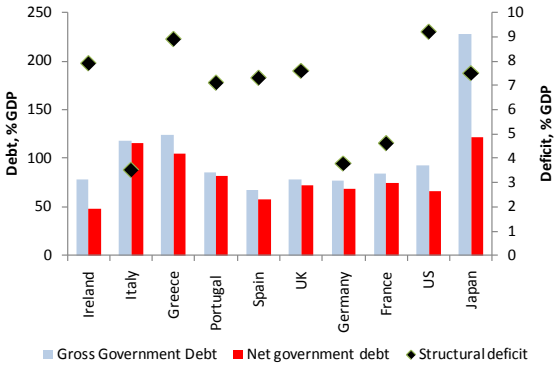
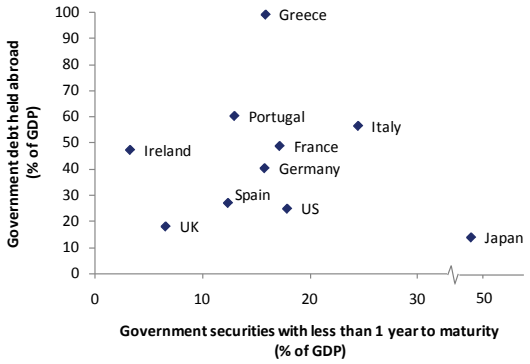


Figure 2: Short-Term Vulnerability



Source: National Government Treasuries or Debt Offices, IMF

[1] "Structural deficit" is defined as the actual budget deficit minus the effects of cyclical deviations from potential output. In other words, the calculation adjusts the reported deficit numbers for the effects that are due to the business cycle. It is arguably a better measure than the latest deficit figure, as it takes the state of the economy into account. (The estimation was done by the International Monetary Fund.)

[2] While the US has the highest structural deficit, it enjoys a special position in world government bond markets as a safe-haven asset.

Figure 2, by plotting government debt held abroad (as a percentage of GDP) against government securities with less than one year to maturity (also as a percentage of GDP), looks at the short-term refinancing vulnerability of selected sovereigns. The maturity profile of the debt exposes short-term refinancing risks. The proportion of debt held abroad is important, as there is evidence that foreign involvement in domestic currency bond markets can lead to higher volatility (see Peiris, 2010)[3]. An intuitive reason for this is that non-resident buyers can be more attuned to sovereign risk and may be inclined to reduce further purchases in times of market stress. Assessed together, these measures give an indication of the likelihood of standoffs developing between the governments and investors.

As Figures 1 and 2 show, Greece ranks high on both fundamental fiscal imbalances and the perceived short-term vulnerability, with a large proportion of debt held abroad. Japan, on the other hand, looks much less susceptible to a short-term crisis. While its debt as a proportion of GDP is high, and the amount coming up for refinancing in the next year is also substantial, most of its debt is held by the more stable domestic investor base (for additional discussion, see Tokuoka, 2010). Similarly, the UK, Ireland, and Spain (to some extent) appear to have favorable debt maturity profiles relative to Portugal and Italy.

Bond Market Risk through the Lens of the Barra Integrated Model (BIM)

Table 1 illustrates the change in risk forecasts for the Citigroup Salomon Government Bond Index for each country between October 2009, when concerns about the Greece budget deficit began to surface, and May 2010. We present forecasts from two variants of the Barra Integrated Model: the standard version, with a 24-month half-life; and the new, BIM Daily version, for which we use a half-life of 21 days.

The standard version of BIM was developed to assess risk at long investment horizons (in excess of one year). Analytics computed with a shorter half-life are useful to monitor the risks of a portfolio in a fast-changing environment. Monitoring short-term analytical measures in conjunction with risk forecasts from the long-term Barra Integrated Model may enhance the responsiveness of the risk management process. We chose a half-life of 21 days for BIM Daily, as this half-life is a reasonable trade-off between responsiveness (reacting to new information) and stability (risk forecasts that do not change dramatically from one day to another).[4]

Table 1: BIM and BIM Daily Risk Forecasts for Government Bond Portfolios (Citigroup Salomon Government Bond Indices, % annualized)

	14-May-10		01-Oct-09			14-May-10		01-Oct-09	
	Half-life					Half-life			
	21 days	24 Months	21 days	24 Months		21 days	24 Months	21 days	24 Months
Greece	31.05	10.51	3.66	4.53	UK	5.15	5.55	6.45	6.45
Portugal	14.63	5.52	3.41	4.20	Germany	3.14	3.76	3.25	3.96
Ireland	8.98	5.51	3.87	4.72	France	2.81	4.08	3.48	4.27
Spain	5.30	4.00	3.73	5.20	Japan	1.26	2.41	1.65	2.53
Italy	4.47	3.83	3.24	4.15					

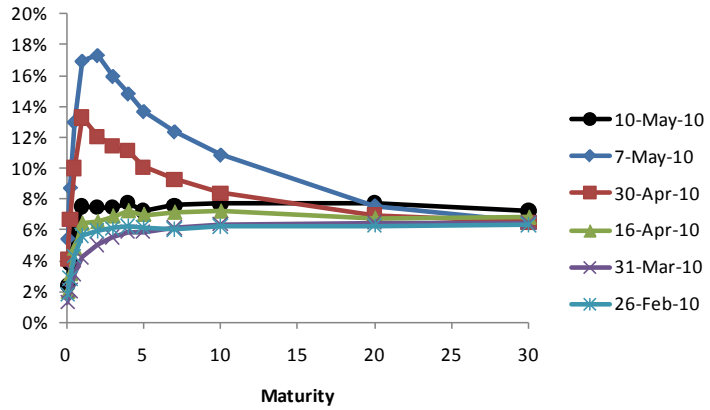
[3] Also note that Tokuoka (2010) argues that the strong home bias in the holdings of JGBs contributes to the low risks associated with Japan's elevated public debt.
[4] See Barbieri et al. (2009) to learn more.

As expected, Greece experienced the largest change in volatility, with the BIM Daily forecast rising almost 10 times, from 3.66% on October 1, 2009 to 31.05% on May 14, 2010. Portugal and Ireland also experienced significant increases in volatility. Note that the large differences between the BIM Daily and standard BIM forecasts for Greece, Portugal, Ireland, Spain, and Italy highlight that the recent volatility is unusual compared with longer term history.

To translate the volatility forecast into potential portfolio losses, we could make a simplifying assumption of normally distributed returns.[5] Under this assumption, the Greece government bond portfolio would be expected to lose no more than 31.05% in the next year with approximately 85% probability, and to lose no more than 50% in the next year with approximately 95% probability. However, the assumption of normally distributed returns is not correct in the case of bonds as an asset class, because bonds have a negatively skewed return distribution. Under current conditions, we can show that the left tail of the empirical return distribution is much heavier than implied by the assumption of the normal distribution.[6]

Increasing risk forecasts for government bonds reflected the increasing volatility in the government term structures. Figures 3, 4, and 5 illustrate the recent evolution of the shape of the term structures of the GPISI countries. In Figure 3, we see that the Greece sovereign curve became severely inverted over a period of just three weeks, from April 16 to May 7, with short-term yields reaching close to 18%, while 20- and 30-year yields remained at around 6%. On May 10, the first trading day after the EU rescue package announcement, the term structure approached a flat line.

Figure 3: Greece Term Structure



For the other countries on the GPISI watchlist, we highlight in Figure 4 the Portugal and Ireland term structures, which were almost flat on May 7, similar to the Greece term structure a few weeks ago. This could indicate the spillover of sovereign debt worries from Greece to other countries. The term structures reflect the market premiums to lend short-term to Portugal, Ireland, Spain, and Italy, listed in decreasing order. On May 10, the day after the announcement of the rescue package, the differentiation between the countries reduced greatly, as the term structures of Portugal and Ireland fell at the short end and steepened.

[5] Note also that no assumption of normality is required in the computation of the volatility forecasts in any of the Barra models.
[6] One way to see this is to compare the expected shortfalls computed using the empirical distribution of factor returns in Table 2 with the expected shortfalls computed using the assumption of normally distributed returns (see Goldberg and Hayes, 2009).

Figure 4: PISI Term Structures as of May 7

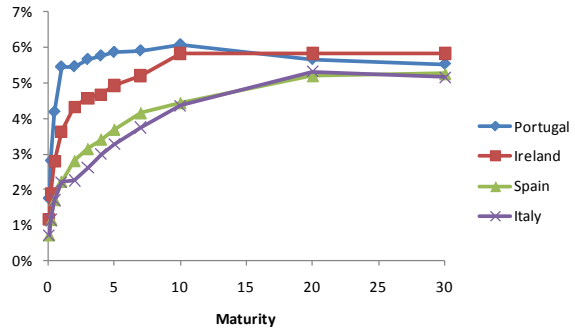


Figure 5: PISI Term Structures as of May 10

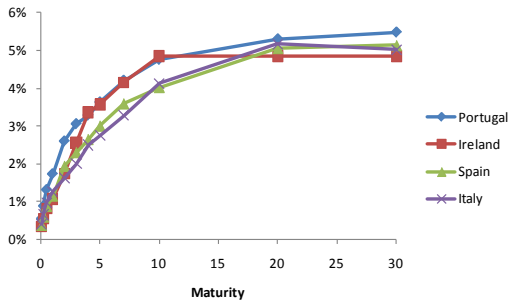


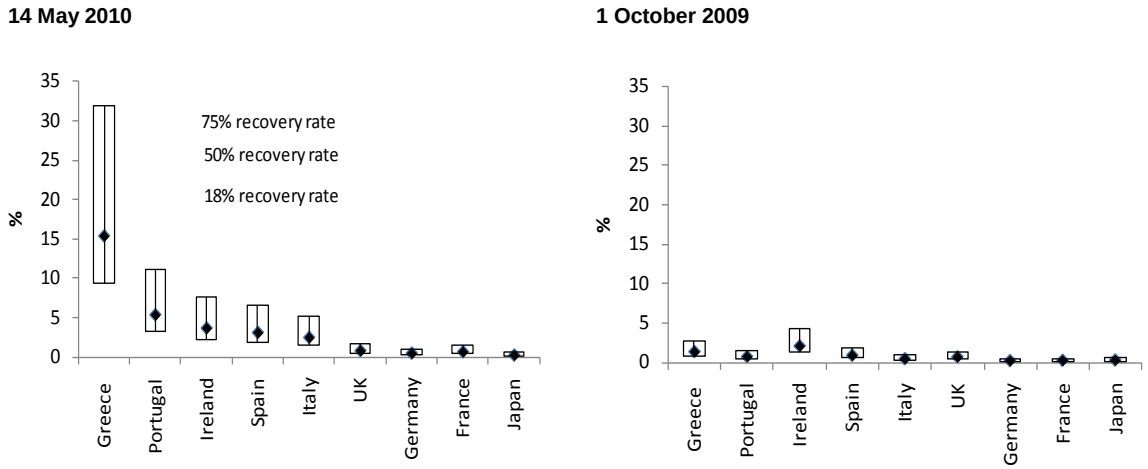
Table 2 shows the 95% expected shortfall for each country in the Citigroup Salomon Government Bond Index, computed with empirical factor return distributions using the methodology outlined in Barbieri et al. (2009). Expected shortfall is the average loss beyond a threshold that distinguishes an everyday loss from an extreme loss, and it is a measure of extreme risk. The threshold is known as the Value at Risk (VaR) and is specified by a confidence level. The 95% one-day shortfall is an average, or expected value, for the loss on the 5 worst days out of 100. Shortfall provides information that complements volatility, which is a measure of the average return dispersion. One-day 95% expected shortfall had increased sharply, from approximately 0.5% for all GPISI countries in October 2009 to 0.72-5.67% in May 2010, mirroring increases in volatility. In other words, as of May 2010 there was a 5% probability that an investor might lose an average of 5.67% on the Greece government bond portfolio over the next day.

Table 2: Expected Shortfall for Government Bond Portfolios (Citigroup Salomon Government Bond Indices, % one-day loss)

	Greece	Portugal	Ireland	Spain	Italy	UK	Germany	France	Japan
14-May-10	5.67	2.61	1.49	0.89	0.72	0.71	0.45	0.37	0.21
1-Oct-09	0.55	0.49	0.55	0.53	0.46	0.94	0.51	0.50	0.22

Figure 6 shows the risk-neutral probabilities of default implied from one-year sovereign CDS spreads for different assumptions about the recovery rate. Consistent with the volatility forecasts, we observe that implied probabilities of default rose substantially for all GPISI countries. Note that the assumed recovery rate has a large impact in the calculation, creating wide error bands for the implied default probabilities, especially as CDS spreads rise. There have been only a handful of sovereign defaults since the 1980s, with a wide range of recovery rates: between 18% at the low end and 75-90% at the high end (see Moody's, 2008). Moreover, note that the risk-neutral probabilities of default estimated from CDS spreads will be higher than the actual default probabilities if investor risk aversion is positive.

Figure 6: Implied, Risk-Neutral Probabilities of Default, Calculated from One-Year Sovereign CDS Spreads



It is interesting to examine the impact of the crisis on the corporate sector in GPISI countries, in particular, to compare the information that can be implied from the relatively liquid equity markets in these countries with the information implied from sovereign debt markets. There are a number of ways in which the creditworthiness of a country's government may affect the cashflows of private sector companies, even though, as noted by Borensztein, Cowan, and Valenzuela (2007), these externalities are not widely recognized or discussed in the academic literature or policy circles. For instance, when a sovereign is in distress or default, economic and business conditions may become hostile for firms: the economy may be contracting while interest rates rise, and the banking sector is likely to be distressed. As noted by Peter and Grandes (2005), the banking sector is particularly vulnerable in the event of sovereign distress, due to the banks' typically high leverage compared to other corporates, the volatile valuation of their assets and liabilities in a crisis, and their typically large exposure to the sovereign. On the asset side, an abrupt drop in sovereign debt prices can generate losses for banks holding large portfolios of government bonds. On the liability side, wholesale funding costs may rise in concert with sovereign spreads. Moreover, as noted by the IMF (2010), the perceived value of any sovereign guarantees to the banking system may erode when the sovereign comes under stress, thus raising funding costs still higher. Empirically, a number of studies have found that sovereign risk is an important determinant of corporate default premia. Specifically, Durbin and Ng (2005), Borensztein, Cowan, and Valenzuela (2007), and Cavallo and Valenzuela (2007) support this finding for the external debt of emerging market corporates, while Peter and Grandes (2005) find that sovereign risk is the most important determinant of local currency corporate default premia in South Africa.[7]

Figure 7 shows the Barra Default Probabilities (BDPs) for companies that are part of the MSCI equity indices for the GPISI countries, as well as companies that are part of the MSCI equity indices for the UK, Germany, and France. These are default probabilities computed with a structural first passage model of default, using equity market data as input. These weighted average BDPs provide a rough measure of the equity market assessment of the default risks in the corporate bond sector. Note that BDPs fell between October 2009 and May 2010 for all observed markets except Greece, where they rose slightly.

[7] Note that there is also some evidence that this effect may be diminishing.

Figure 8 shows how the ratios of equity market volatility to government debt market volatility (as measured by MSCI equity indices and Citigroup Salomon Government Bond Indices, respectively, for each country) changed between October 2009 and May 2010, using BIM Daily. We see that the ratio of equity-to-government bond volatility in Greece fell dramatically from 7.5 to 1.7, as equity market volatility, though growing, did not keep pace with increasing bond market volatility. Portugal and Ireland also experienced falls in equity to government bond volatility ratios, although they were less pronounced than for Greece. In the other countries, equity market volatility rose faster (or fell less) than bond market volatility, and the ratios between the two increased. Taken together, these observations may imply that the assessment of the current crisis in the equity markets of Greece, Portugal, and Ireland may have been somewhat more benign than the assessment in the government bond markets.

Figure 7: Barra Default Probabilities

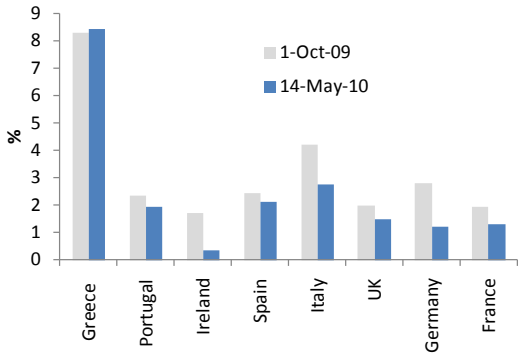
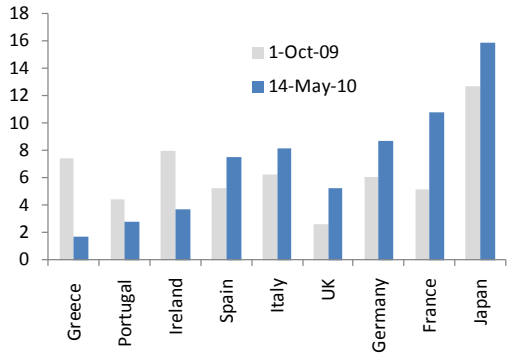


Figure 8: Equity-to-Government Bond Market Volatility Ratios



The Impact of the Crisis on a Developed Market Bond Portfolio

To illustrate the impact of these events on a developed market bond portfolio, we show the contributions of individual country sovereign bonds to the risk of the Citigroup Salomon Europe Government Bond Index. Table 3, using BIM Daily, shows how the risk concentration in GPISI countries shifted completely in the last half-year. Whereas the sum of the GPISI countries contributions was 31.6% at the beginning of October 2009, similar to the sum of the country weights (33.7%), it rose to 70.2% as of May 12, 2010. We also note that Italy has a risk contribution that is more proportionate to its weight than the other GPISI countries. Nevertheless, its risk contribution has increased as it has for the other GPISI countries, whereas the relative risk contributions of countries outside of the GPISI block decreased significantly. This suggests that the risk contribution of the GPISI block could increase further if the debt crisis spreads to Italy.

Table 3: Risk Contributions by Country for the Citigroup Salomon Europe Government Bond Index (using BIM Daily)

		Percent Contribution to Total Risk	
Country	Weight (%)	12-May-10	1-Oct-09
Greece	3.8%	27.8%	3.7%
Portugal	1.9%	6.0%	1.8%
Ireland	1.7%	3.6%	1.2%
Spain	8.0%	10.6%	7.9%
Italy	18.4%	22.3%	17.0%
GPISI	33.7%	70.2%	31.6%
UK	12.7%	12.6%	16.0%
France	16.7%	5.4%	17.5%
Germany	17.4%	1.3%	17.9%
Other countries	19.4%	10.4%	17.0%
Rest of Europe	66.3%	29.8%	68.4%
Total Europe	100.0%	100.0%	100.0%

An Historical Perspective — Is There a Next Domino?

The concern of contagion from the current turmoil seems to have escalated and is high on the agenda of institutional investors. This is evidenced by the fact that more than 50 articles mentioning contagion from Greece debt have appeared in the *Financial Times* since the beginning of May. These market fears are reflected in the rising volatilities and risk contributions from parts of the European government bond market illustrated in Tables 1 and 3. While the intervention of the European Union and the IMF may have assuaged some investor concerns for now, the implied probabilities of default as measured by CDS spreads and the volatilities of government bond indices remain at elevated levels.

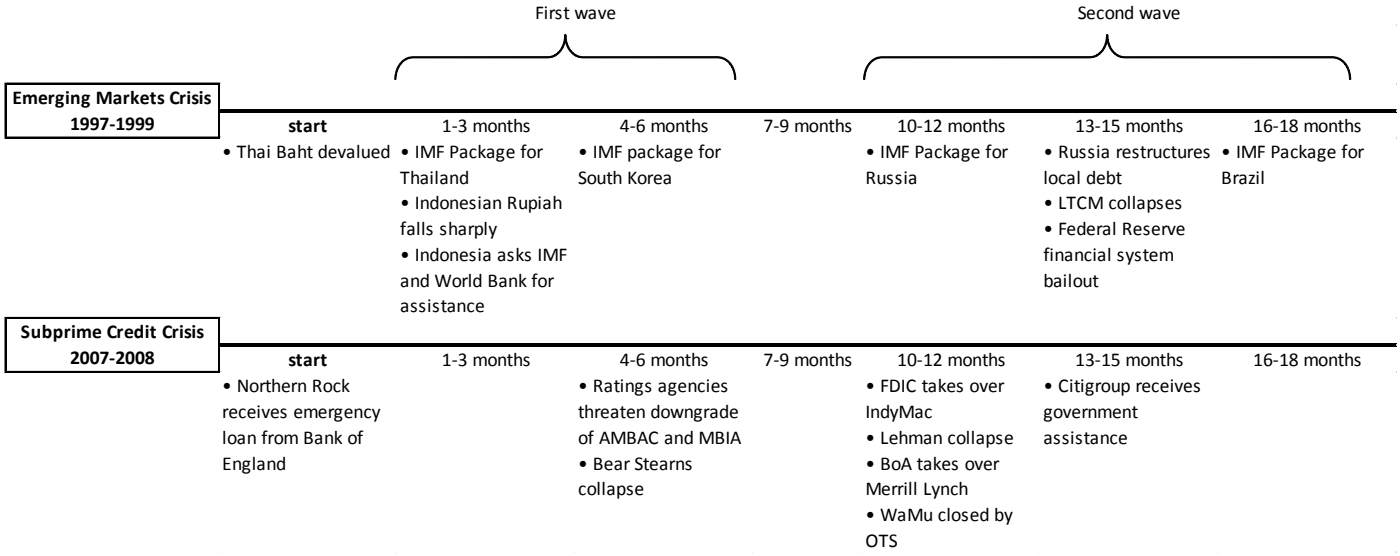
In this section, we draw on studies of contagion and histories of previous crises. Figure 9 shows a timeline of two major debt crises that occurred since the 1990s: the recent subprime turmoil and the emerging markets crisis of 1997-1999. Both of these events illustrate how contagion can develop, where the initial credit event is often followed by much larger episodes, despite the introduction of rescue packages.

Readers may recall that during the subprime crisis, when Bear Stearns got in dire straits, some of the optimistic prognosticators thought that the sale to JP Morgan would resolve the crisis. This optimism did not pan out, and the crisis spread further, consuming Lehman Brothers and leading to the forced sale of Merrill Lynch.

As noted by Adams (1999), contagion effects can be due to investor sentiment or fundamental causes. In asset pricing, valuations depend on expectations of future cash flows and the way in which those expected cash flows are discounted, which reflects perceptions about the level and price of risk. [8] Therefore, according to financial theory, if expected cashflows and risk assessments are correlated, then asset prices and returns will also be correlated, which might lead to contagion.

[8] See, for example, Cochrane (2001).

Figure 9: Timeline of Previous Crises



Sovereign debt can be analyzed as a derivative security on the macroeconomic strength of the country (see Ruban, Poon, and Vonatsos, 2008). The value of this security depends on the macroeconomic fundamentals of the country, as well as investor sentiment or risk aversion.[9] Moreover, since macroeconomic fundamentals are less volatile than financial prices, a large proportion of the time variation of debt prices is due to changes in investor perceptions. In other words, credit is a gauge of confidence. Degradation in confidence can lead to a collateral crisis, which should not be confused with a liquidity crisis. A collateral crisis that is triggered by a loss of confidence cannot be solved solely by the injection of liquidity, and it can easily spread.

Contagion may spread through several channels. The "wake-up call" channel of contagion has been examined by Goldstein (1998) in relation to the Asian crisis. The thinking behind this channel implies that if one country experiences difficulties, then such an event can lead investors to reassess their views of other countries. If investors find similar economic or political weaknesses in other countries, then the costs of borrowing increase and the crisis spreads. As seen in Figures 1 and 2, a number of countries in the eurozone share fundamental fiscal weaknesses with those that are observed in Greece.

Heavy borrowing is caused by large budget deficits used to finance spending in excess of government revenue. The current situation in Greece is akin to "Athenian spending with Spartan taxation." Barro (1990, 1991) finds that an increase in resources devoted to "non-productive" government services is associated with lower per-capita growth. As fiscal situations are typically assessed in relation to economic growth, countries that borrow heavily to fund substantial and economically unproductive investments are potentially the most vulnerable to changes in sentiment. In 2004 for example, according to some reports[10] Greece spent almost USD 9 billion on the Olympic Games in a country of 11 million people when the country had a debt-to-GDP ratio of close to 100%.[11]

The Greece experience is characterised by a large budget deficit, high debt-to-GDP, inadequate domestic savings, and soaring international borrowing[12] used to undertake substantial and

[9] For a recent examination of the determinants of the variation in sovereign spreads, see Caceres, Guzzo, and Segoviano (2010).
[10] http://news.bbc.co.uk/2/hi/business/3649268.stm.
[11] Note, however, that such events could contribute to significant infrastructure development in the host cities. This could be classed as productive spending if it leads to economic growth and tax revenue in order to provide a return on the investment.
[12] We already noted that foreign participation in domestic currency debt markets can contribute to volatility. A more well-known risk in sovereign borrowing is the ability to generate foreign currency to service any external debt. Note that the risks of Greece EUR-denominated

unproductive spending. Historically this kind of fiscal situation combined with the degradation of investor confidence increased the probability of contagion seen in previous crises, during which the first domino was not the last to fall. Experience indicates that when the cost of rescuing the first domino is too high, the following dominos tend not to fare well. The first domino may have already consumed a significant portion of available rescue capital, leaving very little for the following dominos. The lesson to be learned from this historical experience is significant, hence the saying, "History never repeats itself, but often rhymes."

The title of this Research Insight, "The Curse of Olympian Spending with International Borrowing," is designed to illustrate that when countries, companies, or individuals borrow heavily to fund substantial and economically unproductive investments, trouble tends to follow. This is true particularly when a significant portion of the borrowed funds is short-term and non-domestic.

Finally, note that there are successful precedents in implementing large fiscal adjustments. IMF (2010) notes the importance of political flexibility to address mounting debt concerns in market perceptions. Historical evidence supports this: South Korea successfully implemented austerity measures following its IMF rescue and has recovered strongly as a result. On the other hand, the experience of Argentina illustrates how a lack of political willingness to tackle debt problems can exacerbate those problems. It remains to be seen which course will be undertaken by Greece and other countries with debt vulnerabilities: the South Korea model or the Argentina model? Could the current crisis turn into contagion and enlarge from Greece into other countries in the European backyard?

Conclusion

In this Research Insight, we illustrated the insights that can be gained by looking through the lens of the Barra Integrated Model to examine events unfolding during the sovereign debt crisis in Europe. First, we looked at the fundamental vulnerabilities in a range of government bond markets by examining their fiscal positions and short-term refinancing risks. We then studied recent developments in the forecast volatilities of government bond markets in Greece, other Southern European countries, as well as the more stable European nations. For a European government bond portfolio, we showed a growing risk concentration coming from the individual countries in the GPISI block.

We see from Table 1 that the bond market volatilities of the GPISI countries consistently rose, on both a short- and long-term basis, since October 2009. The implied default probabilities in Figure 6, and the 95% one-day shortfall forecasts in Table 2, are consistent with these observations. However, it appears that the sovereign debt market is more concerned with rising default risk than with risk implied by the equity markets, as shown in Figures 7 and 8. Finally, in Table 3 we showed growing risk concentration coming from the GPISI countries.

As a final point, we attempted to provide an historical and qualitative perspective of the possibility of this crisis morphing into a contagion. Depending upon the courses that the countries involved choose to pursue, the risk profile of this event can change considerably.

debt lie somewhere between those of domestic currency debt and foreign currency debt. Greece does not control its own monetary policy. If Greece were to exit the eurozone, it would likely have trouble converting its EUR debt into its new domestic currency. In such an event, the EUR-denominated debt could become external currency debt. In such an eventuality, a measure such as the ratio of short-term external debt to reserves (as per the Guidotti-Greenspan rule) would be a useful measure of vulnerability.

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