Contents lists available at SciVerse ScienceDirect

Journal of Financial Stability

journal homepage: www.elsevier.com/locate/jfstabil

Sovereign default risk, overconfident investors and diverse beliefs: Theory and evidence from a new dataset on outstanding credit default swaps☆

Thorsten Janus[a], Yothin Jinjarak[b,*], Manachaya Uruyos[c]

[a] Department of Economics and Finance, University of Wyoming, Laramie, WY 82071 United States
[b] DeFiMS, SOAS, University of London, WC1H 0XG, United Kingdom
[c] Faculty of Economics, Chulalongkorn University, Bangkok 10330, Thailand

ARTICLE INFO

Article history:
Received 31 October 2011
Received in revised form 13 August 2012
Accepted 28 November 2012
Available online 10 December 2012

JEL classification:
E6
F4
H6
O1

Keywords:
Public debt
Fiscal capacity
Sovereign default
Market expectation

ABSTRACT

In standard public finance theory a government's cost of borrowing depends on the common beliefs held by rational investors regarding default risk. We advance understanding of the effects of diverse beliefs and overconfidence among investors in their ability to assess the sovereign's creditworthiness. Theoretically, we find that demand for insurance against default is positively related to the absolute difference between the market price of sovereign risk and the risk forecasted by the economy's fundamentals. We find preliminary support for this prediction in a newly available dataset on sovereign credit default swaps (CDSs): after controlling for the size of the public debt, the absolute size of the gap between the actual and forecasted spreads is positively related to the value of outstanding CDSs.

1. Introduction

In this paper we present a theory and evidence of heterogeneous investor expectations and excessive trade in the market for insurance against sovereign default. The motivation for the study is the diversity of default risk pricing faced by developed countries and emerging markets after the 2008–2009 financial crisis. For instance, the cost of insuring against default by the Euro area's peripheral members remains higher than the insurance cost for several fiscally comparable emerging markets (Aizenman et al., forthcoming). To explain how economies with similar fundamentals can lead to different prices for default risk we present a model where agents are overconfident in their ability to beat the market. As a result, agents with a favorable signal ("optimists") regarding default risk supply insurance to the remaining agents ("pessimists"). The model predicts that agents trade more insurance when the market-assessed default risk is either higher or lower than the forecasted risk. We find evidence consistent with these predictions using a new dataset on sovereign credit default swaps (CDSs): after controlling for the size of the public debt, the absolute value of the market-forecasted spread difference is positively related to the stock of outstanding CDSs. Due to the limited number of observations and variables in the dataset, however, we prefer to interpret the findings as tentative and leave more thorough empirical testing to future work.

The paper's key theoretical assumption that investors are overconfident in their ability to beat the market follows the literature in behavioral finance linking psychological factors to irrational investment behavior and inefficient financial markets (Barberis et al., 1998; Chui et al., 2010; De Bondt and Thaler, 1995). According to Odean (1998, p. 1889), who also provides an overview of the literature in both psychology and economics, "A review of the psychology literature on inference finds that people systematically underweight abstract, statistical, and highly relevant information, and overweight salient, anecdotal, and extreme information." For the purpose of formal modeling, Odean (1998) follows Kyle and Wang (1997), Daniel et al. (1998) and Wang (1998) in assuming that overconfidence implies investors overestimate the precision

☆ We would like to thank two anonymous referees for useful comments and suggestions.

* Corresponding author.
E-mail addresses: tjanus@uwyo.edu (T. Janus), yj5@soas.ac.uk, yothin.jinjarak@gmail.com (Y. Jinjarak), manachaya.u@chula.ac.th (M. Uruyos).

1572-3089/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.jfs.2012.11.007

of their information. More precisely, in all four papers investors overestimate the precision of their private signals concerning an asset value.[1] In Benos and Alexandros (1998) they overestimate the precision of *every* market participant's signal. We instead assume investors underestimate the precision of signals received by others and therefore believe that the market price they observe may be misleading. Equivalently, they might know the precision of the signals of others, but underestimate others' ability to interpret and act appropriately on the signals. In other words, we assume investors underweight statistical information (the precision of the market price), whereas previous work assumes they overweight anecdotal information (the precision of private signals).[2] Investors in this paper believe they are rational, but that the other investors and the market may be irrational.

The paper also relates to the finance literature on CDSs. The pricing of CDSs and their effects on borrowing costs have attracted significant attention since the global crisis of 2008–2009. A complicating factor is that most CDS contracts are traded over the counter (OTC) and various trading motives tend to intertwine (e.g., counter-party risk, hedging, and speculation). Ang and Longstaff (2011) find that systemic risk components in CDS spreads are less correlated across states in the US than across the US and the Euro countries. The difference in correlations is strongly associated with the systemic effects of global financial market variables. Che and Sethi (2011) show that naked CDS trading can divert a CDS seller's capital into collateral for a speculative position, and away from potential borrowers, thereby increasing borrowing costs and the likelihood of default. In both Che and Sethi (2011) and this paper the reason agents contract on CDSs is their heterogeneous beliefs regarding sovereign default risk. The papers differ since Che and Sethi endogenize the level of sovereign borrowing but do not explain why investors hold heterogeneous beliefs. In contrast, we take the sovereign debt stock as a given and derive investor beliefs from an underlying information environment. In particular, we show that investor beliefs can remain diverse even when the market price is fully revealing, that is, it summarizes investors' joint information. Another difference to Che and Sethi (2011) is that we are able to test our model in a new dataset on sovereign CDSs. Geanakoplos (2009) shows that heterogeneous beliefs can interact with leverage to increase the volatility of asset prices. The reason is that assets are bought by the most optimistic investors, and therefore increasing leverage increases the optimism of the marginal investor. Leveraging thus increases asset demand before the asset's true value becomes revealed and demand systematically drops. Like Che and Sethi (2011), Geanakoplos (2009) focuses on the consequences rather than causes of heterogeneous beliefs. Finally, Bruneau et al. (2012) link CDS mispricing to investor sentiments in a multiple-equilibrium model of the European sovereign debt crisis. Their paper may suggest that the interaction between diverse investor beliefs and multiple equilibriums, or between mispricing in related asset markets, is an important avenue for future research.

Both the model and the evidence in the paper contrast with models of sovereign risk based on common rather than heterogeneous investor beliefs. In fundamentals-based models of default risk (Acharya et al., 2011; Aizenman et al., forthcoming) the riskiness of debt should increase insurance demand when agents are risk-averse. However, insurance demand then depends on the risk of default, and not on the difference between the market and forecasted default risks emphasized in the present paper. In multiple equilibrium-based models of default risk (Calvo, 1988; Cole and Kehoe, 2000) the market-assessed risk generally differs from the forecasted risk, since investors may not choose the equilibrium the forecaster expected.[3] However, again insurance demand should depend on the actual default risk and not the forecasting error for that risk. It is true that if the market chooses a high-rather than low risk equilibrium the market risk may exceed the forecasted risk in that case the market-forecasted spread difference may be correlated with high actual risk. However, in that case the converse should also hold: economies where investors choose a low-risk equilibrium, and therefore the market risk is below the forecasted risk, should have safer sovereign debt and occasion less insurance demand. We find the opposite in the data: even economies where the market-assessed risk is *below* the fundamentals-forecasted spread have higher insurance demand than economies where the market and forecasted risks are similar.

In the remainder of the paper, Section 2 presents the model. Section 3 presents evidence linking the gap between market-assessed and forecasted sovereign default risk to demand for insurance using a novel dataset on credit default swaps. The conclusion is in Section 4.

2. Theoretical model

We assume a government with a stock of outstanding debt B and a continuum of symmetric risk-neutral investors with finite liquidity. These investors can potentially trade insurance against default in the form of credit default swaps (CDSs). Because a CDS trader need not be a debt holder the model allows for naked swaps. The debtor's fundamentals are either good (g) or bad (b) with probability 0.5 of each. Good fundamentals imply default risk d^g and bad fundamentals imply default risk $d^b > d^g$. For simplicity there is zero repayment in the default state. The timing is that each investor receives an i.i.d. private signal regarding the country's fundamentals. Subsequently they can contract on CDSs. The signal is correct with probability $p > 0.5$, that is, $pr(g|G) = pr(b|B) = p > 0.5$, where $G(B)$ denotes a good (bad) signal. Due to the law of large numbers, the proportion of agents receiving a correct signal is also p. We denote the market price of insurance against default – the CDS spread – when fundamentals are good μ^g and the spread when fundamentals are bad μ^b. We solve for these prices below. Finally, we assume that agents are overconfident in their ability to beat the market. Specifically when the market price of insurance is μ^g (μ^b), suggesting fundamentals are good (bad), agents believe the market is wrong about the sovereign risk with probability $0 < 1 - \phi < 0.5$. For example, they may believe that a stochastic fraction of other investors $q \in (0, 1)$ will irrationally interpret a good signal as a bad signal or vice versa because of behavioral biases, or because they are busy and do not have time to process the information adequately. In that case, while the actual fraction receiving the correct signal is p, the fraction assessing the risk correctly is only $pq + (1 - p)(1 - q)$:

[1] Nikolic (2011) finds evidence consistent with the predictions of Daniel et al. (1998).

[2] Odean (1998, pp. 1894–1895) briefly discusses our modeling approach as an alternative to his own. Although mathematically underweighting the information of others or overweighting one's own information may yield similar results, at least in the simplest models, they are conceptually different sources of inefficiency. Addressing underweighting of statistical information may require convincing agents to "trust the statistics". Addressing overweighting of private information may require them to be skeptical of what they hear from friends and colleagues, etc.

[3] For example, if investors believe the default risk is high they will charge a high risk-adjusted interest rate. The high interest rate may increase the government's debt burden and therefore default risk enough to justify investors' initial expectations. Conversely, if investors do not expect default they will charge a zero risk premium. If the low interest rate brings the actual risk to zero then against investor expectations are justified.

the fraction whose signal and interpretation are both correct, pq, plus the fraction who fail on both accounts, $(1-p)(1-q)$. In turn, the chance that most market participants will act based on the signal most of them received is $prob(pq+(1-p)(1-q)>5)=\phi<1$. Since the market price depends on how the majority acts, as we show below, each investor believes the market is wrong, and she can potentially beat it, with probability $(1-\phi)$.

2.1. Outcome with rational investors

With rational investors the law of large numbers implies that the market price of insurance is perfectly informative: a market price of μ^g (μ^b) implies that a proportion $p>0.5$ of the agents received the good signal. Therefore the fundamentals are good with probability one. Since the market is always right any rational agent ignores her private signal. Thus, with good fundamentals the CDS spread must be $\mu^g=d^g$ and with bad fundamentals $\mu^b=d^b>d^g$. Since the insurance price is fair and agents are symmetric and risk-neutral they perceive no gain to CDS trading.

2.2. Outcome with overconfident investors

When investors are overconfident they think that the market is only right with probability $\phi<1$. Thus, when the fundamentals are good (the argument is symmetric when fundamentals are bad) an agent's belief in good fundamentals depends on her signal:

$$pr(g|\mu^g,G,\phi)=\frac{\phi p}{\phi p+(1-\phi)(1-p)}\equiv q(\mu^g,G,\phi) \tag{1}$$

$$pr(g|\mu^g,B,\phi)=\frac{\phi(1-p)}{\phi(1-p)+(1-\phi)p}\equiv q(\mu^g,B,\phi)<q(\mu^g,G,\phi), \tag{2}$$

where (1) is the perceived probability that fundamentals are good given a good signal and a market price reflecting most other investors got the good signal. Similarly, (2) is the perceived probability fundamentals are bad given a bad signal and the market price reflecting most other investors got the good signal. The inequality in (2) follows from $p>0.5$ and implies that a worse private signal makes investors more pessimistic. Investors with bad and good signals – henceforth denoted *pessimists* with superscript p and *optimists* with superscript o – will value insurance against default as follows:

$$\mu^o(g)=q(\mu^g,G,\phi)d^g+(1-q(\mu^g,G,\phi))d^b, \tag{3}$$

$$\mu^p(g)=q(\mu^g,B,\phi)d^g+(1-q(\mu^g,B,\phi))d^b>\mu^o(g), \tag{4}$$

where (3) is the subjective likelihood of default given the bad signal and therefore the perceived likelihood of good fundamentals in Eq. (1). Similarly, (4) is the likelihood of default with perceived likelihood of good fundamentals (2). The last inequality uses $d^g<d^b$ and $q(\mu^g,B,\phi)<q(\mu^g,G,\phi)$ from (2).

Since optimists value insurance less, they are willing to sell it to the pessimists. The perceived gain to insurance trade is

$$\mu^p(g)-\mu^o(g)=\left(\frac{\phi(1-p)}{\phi(1-p)+(1-\phi)p}d^g+\left(1-\frac{\phi(1-p)}{\phi(1-p)+(1-\phi)p}\right)d^b\right)-\left(\frac{\phi p}{\phi p+(1-\phi)(1-p)}d^g+\left(1-\frac{\phi p}{\phi p+(1-\phi)(1-p)}\right)d^b\right)>0 \tag{5}$$

where the inequality uses $d^g<d^b$ and that the weight on the first term is less in the first compared to the second brackets since $p>0.5$. The perceived gain to trade only vanishes if investors stop believing they can beat the market ($\phi=1$).

Proceeding symmetrically shows that in the bad-fundamentals state pessimists and optimists value insurance at

$$\mu^o(b)=(q(\mu^b,G,\phi)d^g+(1-q(\mu^b,G,\phi))d^b. \tag{6}$$

$$\mu^p(b)=q(\mu^b,B,\phi)d^b+(1-q(\mu^b,B,\phi))d^g>\mu^o(b) \tag{7}$$

The inequality in (7) implies that there is again a perceived gain from optimists selling insurance to pessimists.

The price of insurance, the public information-based forecast error, and insurance trade

Due to $p>0.5$, in the good-fundamentals state optimistic insurance sellers compete for pessimistic insurance buyers. The clearing price is therefore the optimists' reservation price or $\mu^g=\mu^o(g)$. Conversely, in the bad-fundamentals state the price is the pessimists' reservation price or $\mu^b=\mu^p(b)>\mu^g$. On the other hand, the best price prediction an econometrician – or other agents with access only to public information – can make is the average $(\mu^g+\mu^p)/2=(\mu^o(g)+\mu^p(b))/2$. The gap between the market and forecasted CDS spreads – the forecast error – is therefore

$$\mu^o(g)-\frac{\mu^o(g)+\mu^p(b)}{2}=\frac{\mu^o(g)-\mu^b(b)}{2}=\frac{(d^g-d^b)(\phi+p-1)/2}{\phi p+(1-\phi)(1-p)}<0 \tag{8}$$

in the good state and

$$\mu^b(b)-\frac{\mu^o(g)+\mu^p(b)}{2}=\frac{\mu^p(b)-\mu^o(g)}{2}=\frac{(d^b-d^g)(\phi+p-1)/2}{\phi p+(1-\phi)(1-p)}>0 \tag{9}$$

in the bad state. As investors become more realistic about their ability to outsmart the market (so ϕ increases) two things happen. First, the absolute size of the forecast errors (8) and (9) decrease: $(\partial/\partial\phi)((d^b-d^g)(\phi+p-1)/(\phi p+(1-\phi)(1-p)))<0\Leftrightarrow 0<2p(1-p)$. Second, the gain to insurance trade on the left hand side of (5) (and the symmetric expression for the bad state) decreases: we have $d^g<d^b$ and the weight on d^g increases in the first brackets and decreases in the second, that is $(\partial/\partial\phi)(\phi(1-p)/(\phi(1-p)+(1-\phi)p))<0<(\partial/\partial\phi)(\phi p/(\phi p+(1-\phi)(1-p)))$. In the limiting case of rational investors ($\phi\to 1$) the forecast errors are minimized at $(d^g+d^b)/2$ and there is no gain to insurance trade.

In sum, the model predicts that the forecast error of agents with access only to public information should be positively correlated with gains to trade in insurance against default. We now proceed to test this prediction in a new dataset on sovereign credit default swaps.

3. Empirical evidence

Table 1 reports statistics for sovereign debt, bond yields, and outstanding sovereign CDS contracts for fifty countries with available data for 2010–2011. We report several proxies for the riskiness of the debt in the following columns. Column (3) provides the market spread of sovereign credit default swap (CDS) contracts as of December 2010.[4] The CDS spread indicates the quarterly payments

[4] The CDS prices are based on London closing values of five-year tenor contracts as of 31st December 2010. CMA Datavision compiles the CDS values from a consortium of thirty-five major buy-side participants in the swap markets. The sovereign CDS spreads are priced in basis points, with a basis point equal to $1000 to insure $10 million of debt.

Table 1

Statistics of government debt, sovereign interest rate, and market outstanding sovereign credit default swap contracts. This table provides data and statistics for main variables in the theoretical model of Section 2. The total government debt data are from the latest International Monetary Fund's World Economic Outlook statistics on gross government debt as of December 2010. Debt/tax is the average ratio of 2008–2010 total government debt relative to average previous tax base in the previous 5 years. Market CDS spreads are based on the London closing values of 5-year tenor sovereign CDS contracts, in basis points. Like CDS, a market probability of sovereign default is from CMA Datavision. Forecasted CDS spreads are based on the dynamic panel regression of market CDS spreads on fundamental variables, including lagged CDS, TED spread, trade openness, inflation, fiscal space; see Aizenman et al. (forthcoming) for detailed estimation. Sovereign bond yields are based on JP Morgan series (EMBI Global Diversified and Government Bond Index (GBI)) for the middle-income countries and emerging markets; from OECD statistics (10-year bonds; stats.oecd.org/index.aspx?queryid=86) for non-Euro OECD; and from Eurostat for the Euro-area countries (ecb.europa.eu/stats/money/long/html/index.en.html). The CDS turnover and notional amounts of CDS outstanding are based on the Depository Trust & Clearing Corporation (DTCC).

Income group	Country	ISO	Govt. debt (bil US$)	Debt tax	Sovereign interest rate: December 2010				CDS turnover January–March 2011		Notional CDS outstanding as of March 2011		
					Market CDS	Forecasted CDS	Pr (default)	Bond yld	Trades (US$)/day	#/day	Gross (US$)	Net (US$)	Contracts
Middle income	Argentina	ARG	177	2.481	602.4	466.4	35.4	35.4	175,000,000	17	56,559,512,794	2,166,184,627	5975
	Brazil	BRA	1381	1.989	110.8	181.3	7.6	9.7	575,000,000	36	171,195,085,796	15,670,582,457	11,708
	Bulgaria	BGR	9	0.521	247.2	170.8	16.2	8.2	50,000,000	5	18,715,005,688	982,213,505	1844
	China	CHN	1041	1.075	67.8	106.1	6.0	6.7	27,500,000	2	36,618,649,311	5,839,903,940	3862
	Colombia	COL	104	1.865	113.0	160.5	7.8	11.4	100,000,000	7	34,201,146,025	2,365,600,280	3255
	Indonesia	IDN	190	2.384	128.4	301.3	8.9	13.6	125,000,000	16	33,055,277,733	2,675,182,171	4140
	Kazakhstan	KAZ	16	0.369	178.0	310.6	12.0	13.6	15,000,000	3	19,898,273,350	993,046,717	1783
	Lebanon	LBN	54	9.909	298.1	361.2	19.2	11.6	5,000,000	1	2,144,011,400	473,950,000	352
	Lithuania	LTU	14	1.381	251.2	211.8	16.4	15.9	5,000,000	1	5,778,279,058	633,848,170	648
	Malaysia	MYS	129	3.342	72.7	99.2	6.4	8.8	50,000,000	4	16,959,086,298	1,315,738,355	2168
	Morocco	MAR	52	2.104	125.2	40.3	8.5	–	–	–	–	–	–
	Panama	PAN	11	3.864	99.5	206.8	6.9	11.1	10,000,000	1	7,588,469,965	861,912,924	1014
	Peru	PER	37	1.759	113.0	97.9	7.8	11.6	100,000,000	7	24,653,526,203	2,118,735,718	2444
	Philippines	PHL	89	3.587	125.6	212.8	8.7	13.4	125,000,000	12	54,288,178,757	2,948,701,507	6102
	Romania	ROM	57	1.034	290.2	220.2	18.7	7.1	12,500,000	1	17,020,407,858	1,086,564,853	1779
	Russia	RUS	145	0.274	145.5	333.2	10.0	8.6	225,000,000	20	98,198,976,333	4,498,633,687	6841
	South Africa	ZAF	128	1.164	124.3	227.8	8.6	9.6	100,000,000	8	41,041,447,526	2,510,683,086	4353
	Thailand	THA	141	2.576	98.5	33.5	8.5	17.4	50,000,000	5	15,902,511,915	1,212,544,143	2359
	Tunisia	TUN	18	2.043	119.7	282.5	8.2	5.5	7,500,000	1	2,140,341,965	334,251,796	337
	Ukraine	UKR	55	0.889	509.5	742.4	30.6	34.3	50,000,000	6	42,616,048,244	1,288,841,677	3343
	Venezuela	VEN	112	2.479	1009.6	1118.2	51.4	16.1	150,000,000	15	57,040,384,893	2,397,460,608	5586
	Vietnam	VNM	55	2.433	299.6	432.5	19.4	9.8	50,000,000	5	8,576,331,708	805,605,600	1256
High (non-OECD)	Croatia	HRV	24	1.705	256.0	97.4	16.8	3.2	20,000,000	3	7,629,252,673	754,808,228	1051
	Qatar	QAT	23	1.009	88.5	155.1	6.1	.	50,000,000	8	7,967,769,213	1,163,199,848	1137
Euro Zone Periphery	Greece	GRC	434	3.983	1026.5	266.8	58.8	12.0	225,000,000	20	86,824,391,218	5,613,859,753	5003
	Ireland	IRL	196	2.280	619.2	188.3	41.2	8.5	175,000,000	16	51,415,185,361	4,275,225,085	3087
	Italy	ITA	2446	2.695	238.0	66.5	19.3	4.6	900,000,000	45	304,508,105,319	26,481,392,307	9216
	Portugal	PRT	191	2.183	497.3	58.4	35.9	6.5	400,000,000	27	81,151,810,190	7,331,017,950	4325
	Spain	ESP	848	1.448	347.7	48.9	26.7	5.4	1,000,000,000	70	171,126,342,971	18,792,383,373	8290
OECD (non-OECD)	Australia	AUS	276	0.588	50.1	55.7	4.4	5.3	125,000,000	10	14,512,576,400	2,699,942,020	1284
	Chile	CHL	18	0.307	84.1	84.2	5.9	6.1	7,500,000	1	4,636,609,439	619,970,114	471
	Czech	CZE	76	0.947	91.1	44.5	6.3	3.9	12,500,000	1	10,407,634,239	866,617,684	838
	Denmark	DNK	138	0.866	45.9	48.0	4.0	3.0	17,500,000	2	11,839,635,026	2,271,170,649	640
	Hungary	HUN	104	2.011	378.0	169.7	23.6	7.9	175,000,000	21	63,722,175,341	3,821,105,227	5204
	Iceland	ISL	12	2.193	265.0	558.4	19.2	3.8	7,500,000	1	7,449,823,082	908,084,379	1118
	Israel	ISR	166	2.226	114.7	99.7	7.9	4.5	50,000,000	7	9,534,350,984	1,359,370,660	1150
	Japan	JPN	12,025	7.630	72.3	32.4	6.4	1.1	275,000,000	38	51,040,495,200	7,497,438,938	5664
	Korea	KOR	311	1.231	93.9	101.1	8.1	4.4	200,000,000	22	51,504,469,955	4,282,794,091	5716
	Mexico	MEX	444	2.381	112.8	170.8	7.8	10.5	375,000,000	26	122,392,303,866	8,434,776,927	9544
	Norway	NOR	225	1.273	23.2	39.0	2.1	3.4	10,000,000	1	7,176,059,400	957,236,900	325
	Poland	POL	261	1.525	143.9	87.0	9.8	6.0	100,000,000	8	33,479,817,897	2,277,739,929	2918
	Sweden	SWE	181	0.832	34.3	14.1	3.0	3.2	50,000,000	3	17,313,354,975	2,968,217,192	963
	Turkey	TUR	309	1.725	140.0	283.2	9.6	12.0	400,000,000	29	141,725,714,710	7,077,418,209	8516
Euro (Excl. Periphery)	Austria	AUT	263	1.567	100.6	47.4	8.6	3.4	150,000,000	8	44,919,565,100	6,164,085,006	1903
	Belgium	BEL	452	2.137	219.8	88.1	17.9	4.0	225,000,000	18	40,919,444,224	6,804,384,759	2126
	France	FRA	2,176	1.746	107.3	33.3	9.2	3.3	575,000,000	34	88,696,858,059	18,857,132,131	4545
	Germany	DEU	2,652	2.055	59.1	22.0	5.2	2.9	325,000,000	13	84,617,150,287	16,535,428,329	2678
	Netherlands	NLD	499	1.583	62.8	60.1	5.5	3.2	75,000,000	4	19,967,140,882	2,849,100,115	1003
	Slovakia	SVK	37	1.158	82.3	9.7	7.1	4.1	10,000,000	1	10,082,517,579	814,328,286	744
	Slovenia	SVN	18	0.833	76.9	30.2	6.7	4.1	7,500,000	1	4,463,195,056	765,865,011	359

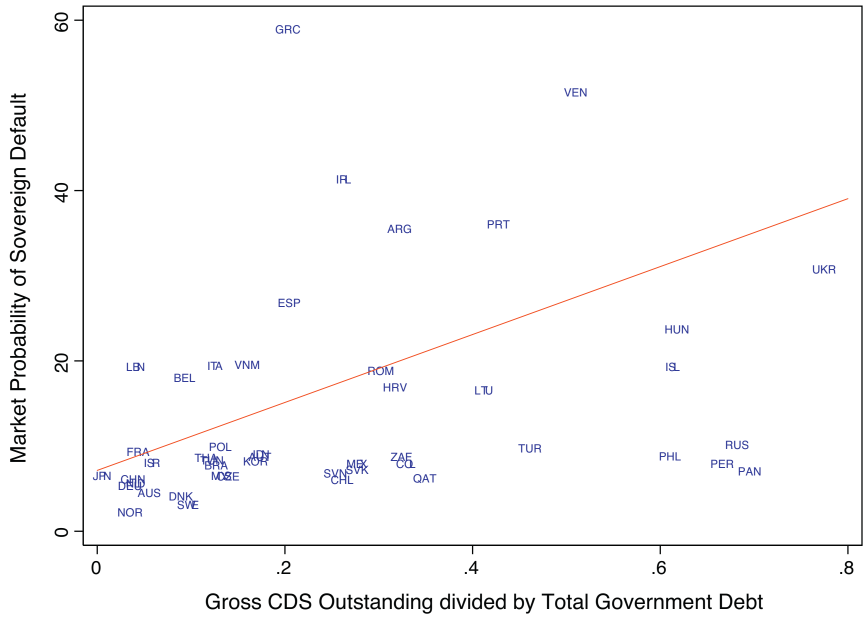

Fig. 1. Sovereign default and market insurance. This figure provides a scatter-plot of the market-estimated probability of sovereign default (%) against the size of notional gross CDS outstanding relative to the size of total government outstanding debt at the end of December 2010. The fitted line is weighted by the total government debt (in billion of US$). Table 1 provides the statistics and detailed descriptions of data sources.

that must be paid by the buyer of a CDS to the seller for the contingent claim in the case of a credit event (i.e. non-payment, forced restructuring) of sovereign debt. It is therefore a good proxy for the market price of insurance. Emerging markets and the peripheral Euro-area countries of Greece, Ireland, Italy, Portugal, and Spain, are at the high end of the risk spectrum.

In column (4) we provide forecasted CDS spreads based on macroeconomic fundamentals, including the lagged CDS spread, the TED spread, trade openness, inflation, and the debt/tax base ratio. These forecasts are drawn from Aizenman et al. (forthcoming), to whom we refer for further details. Comparing columns (3) and (4) shows that the gap between the market and forecasted spreads (the forecast error) can be large and varies significantly across countries. Default risk for the peripheral Euro-area countries appears to be over-priced given their fundamentals. Conversely, the risk for several emerging markets, such as Brazil, Peru, Russia, the Philippines, and South Africa, is under-priced. Column (5) reports the market-assessed default probability (including the probability of debt restructuring) based on the CDS spread.[5] As expected, this default probability is positively correlated with the market CDS spread, the forecasted spread, and the sovereign bond yield (column 6). Although the correlation between the yield and the market CDS spread is only .46, the literature suggests that the bond-yield CDS spread correlation varies significantly across time and countries (Favero and Giavazzi, 2005; Calice et al., forthcoming).[6]

The main contribution of our paper is to link the price and quantity of sovereign default insurance to the forecast error on the price of insurance. The theoretical model predicts that insurance demand should be positively related to the absolute gap between the market-assessed and forecasted risks. Newly published data, which are presented in columns 7–11 of Table 1, enable us to test the model. The average daily turnover of CDSs and the number of trades per day from January–March 2011 are in columns 7–8. The data shows that market activity for sovereign CDS contracts differs markedly across countries and is positively associated with the size of government debt. It is also correlated with the value of the stock of outstanding CDS contracts measured by gross claims, net claims, and the number of contracts in columns 9–11.[7] Fig. 1 plots the relationship between the market-assessed default probability in column 5 and gross CDSs outstanding relative to government debt. Although risk and insurance in Fig. 1 are positively correlated,[8] it is not a tight relationship.

Table 2 summarizes the results of cross-country regressions of market CDS activity on the size of public debt and the forecast errors.[9] Since the model makes predictions for total trade in CDSs our main dependent variable is the stock of gross outstanding CDSs. We begin by documenting a positive association between CDS holdings and government debt in column (1). In column (2) we add the forecasting errors. In columns (3)–(5) we control for measures of the riskiness of the debt, including the bond yield, the forecasted risk and the default probability. Columns (6)–(8) add region dummies and replace the dependent variable with two turnover measures: the value and the number of CDS contracts traded per day. Column (9) employs net rather than gross CDS outstanding as the dependent variable.

The results show that total government debt is significant at the 1 percent level in all specifications. Increasing government debt by 1 percent is estimated to increase the daily CDS turnover by 0.67 percent (column iv) and the notional gross and net CDS

[5] CMA reports the cumulative default probability for the five-year period, calculated using a proprietary credit valuation model and sovereign CDS data.

[6] We also note that markets can quickly adjust their risk perceptions: the market-assessed default probability for Greece increased from 58% in December 2010 to 91% in September 2011; for Portugal, the default probability increased from 36% to 61% in just three months.

[7] The net claims are the value of outstanding CDSs after offsetting claims have been netted out across issuing entities. See also The Economist (2010).

[8] The slope of the regression line in Fig. 1 is significant at the one percent level and yields an R^2 of .24.

[9] Apart from the region dummies, default probability and number of CDS contracts traded per day; all variables discussed below are measured in logs.

Table 2
CDS demand and the forecast error on the CDS spread.

CDS measure	(1)Gross	(2)Gross	(3)Gross	(4)Gross	(5)Gross	(6)Gross	(7) Net	(8)Turnover	(9)No/day
Debt	0.512^{**}	0.504^{**}	0.581^{**}	0.557^{**}	0.515^{**}	0.488^{**}	0.559^{**}	0.673^{**}	5.640^{**}
	(0.086)	(0.084)	(0.065)	(0.079)	(0.079)	(0.088)	(0.066)	(0.104)	(0.975)
Mkt < Frc spread		0.242^{**}	0.137^{+}	0.126	0.178^{*}	0.191^{*}	0.1029^{*}	0.239^{**}	2.338^{+}
		(0.083)	(0.072)	(0.075)	(0.077)	(0.085)	(0.048)	(0.081)	(1.266)
Mkt > Frc spread		0.241^{**}	0.184^{**}	0.200^{**}	0.149^{+}	0.179^{*}	0.1278^{**}	0.257^{**}	2.880^{*}
		(0.071)	(0.057)	(0.057)	(0.076)	(0.085)	(0.047)	(0.083)	(1.369)
Non Euro OECD						−0.628			
						(0.456)			
High income NonOECD						-0.976^{*}			
						(0.408)			
Middle income						−0.473			
						(0.391)			
Core Euro area						-0.759^{**}			
						(0.269)			
Bond Yld			0.606^{**}						
			(0.175)						
Forc. spread				0.324^{**}					
				(0.095)					
Pr (default)					0.0183^{*}				
					(0.008)				
Constant	21.46^{**}	20.51^{**}	19.28^{**}	19.01^{**}	20.52^{**}	21.35^{**}	18.39^{**}	13.71^{**}	-25.96^{**}
	(0.426)	(0.524)	(0.489)	(0.538)	(0.453)	(0.822)	(0.360)	(0.601)	(8.097)
Observations	49	49	48	49	49	49	49	49	49
R-squared	0.491	0.599	0.679	0.641	0.623	0.628	0.756	0.623	0.539

Robust standard errors in parentheses. The omitted region is the peripheral euro area economies of Greece, Ireland, Italy, Portugal and Spain. Mkt < Frc spread is the absolute value of the market-assessed minus the forecasted CDS spread when negative. Mkt > Frc in the market-assessed minus the forecasted CDS spread when positive.
* $p < 0.05$.
** $p < 0.01$.
$^{+}$ $p < 0.1$.

outstanding by about 0.5 percent.[10] The remaining columns show that both positive forecast errors (when the market-assessed risk exceeds the forecasted risk) and negative errors (the opposite) are positively and significantly related to outstanding CDSs. Adding the controls for risk in columns (3)–(5) decreases the coefficients on the forecast errors, but both remain significant. Compared to column (1) adding the forecast errors in column (2) increases R^2 from 0.49 to 0.6. As noted, while the positive signs and significance of both forecast errors is consistent with the model of overconfident investors, it appears inconsistent with models of sovereign risk under common investor beliefs. Additional robustness checks (available on request from the authors) also remain consistent with the model. Nonetheless, given the small size of the dataset we prefer to interpret the evidence as supportive of the model but tentative. We therefore hope to test the model in a larger dataset in the future.

4. Conclusion

We use a combination of a public debt model and new market data to understand the price and volume of international purchases of insurance against sovereign default. The model assumes that investors are overconfident in their ability to beat the market. It predicts a positive correlation between the error in forecasting default risk based on public information – the absolute difference between the market and forecasted CDS spreads – and trade in default insurance. We find preliminary support for this prediction in a newly available dataset on sovereign credit default swaps (CDSs): after controlling for the size of the public debt, the absolute size of the gap between the actual and forecasted spreads is positively related to the value of outstanding CDSs. We conclude that heterogeneous investor beliefs and overconfidence may be important in driving trade in CDSs.

[10] Since gross CDS outstanding are on average 12 times greater than net outstanding, the absolute effect is much larger for gross CDSs. While we considered using net positions as the dependent variable throughout, large gross positions may precisely reflect that parties offset their previous positions due to the kind of heterogeneous beliefs our theoretical model is trying to capture. Changing the dependent variable to the net position leads to smaller and somewhat less significant, but still positive coefficients on the forecast errors.

References

Acharya, V.V., Drechsler, I., Schnabl, P., 2011. A pyrrhic victory? Bank bailouts and sovereign credit risk. CEPR Discussion Paper No. 8679.

Aizenman, J., Hutchison, M.M., Jinjarak, Y. What is the risk of European Sovereign debt defaults? Fiscal space, CDS spreads and market pricing of risk, Journal of International Money and Finance, forthcoming.

Ang, A., Longstaff, F.A., 2011. Systemic sovereign credit risk: lessons from the U.S. and Europe. NBER Working Paper No. 16982, April.

Barberis, N., Andrei, S., Robert, V., 1998. A model of investor sentiment. Journal of Financial Economics 49, 307–343.

Benos, Alexandros, V., 1998. Aggressiveness and survival of overconfident traders. Journal of Financial Markets 1 (3–4), 353–383.

Bruneau, C., Anne-Laure, D., Julien, F., 2012. Is the European sovereign crisis self-fulfilling? Empirical evidence about the drivers of market sentiments. Working Paper. Université Paris X Nanterre.

Calice, G., Chen, J., Williams, J. Liquidity spillovers in sovereign bond and CDS markets: an analysis of the Eurozone sovereign debt crisis, Journal of Economic Behavior and Organization, forthcoming.

Calvo, G.A., 1988. Servicing the public debt: the role of expectations. American Economic Review 78 (4), 647–661.

Che, Y.-K., Sethi, R., 2011 April. Credit derivatives and the cost of capital. Columbia University Working Paper.

Chui, A.C., Titman, S., Wei, K.J., 2010. Individualism and momentum around the world. Journal of Finance 65, 361–392.

Cole, H.L., Kehoe, T., 2000. Self-fulfilling debt crises. Review of Economic Studies 67 (1), 91–116.

Daniel, K., Hirshleifer, D., Subrahmanyam, A., 1998. Investor psychology and security market under- and overreactions. Journal of Finance 53, 1839–1885.

De Bondt, W.F.M., Thaler, R.H., 1995. Financial decision-making in markets and firms: a behavioral perspective. In: Jarrow, R.A., Maksimovic, V., Ziemba, W.T. (Eds.), Handbook in Operations Research and Management Science, vol. 9, pp. 385–410 (Chapter 13).

Favero, C.A., Giavazzi, F., 2005. Inflation targeting and debt: lessons from Brazil, in inflation targeting, debt, and the Brazilian experience, 1999 to 2003. In: Giavazzi, Francesco (Ed.), Ilan Goldfajn and Santiago Herrera. MIT Press, Cambridge, pp. 85–108.

Geanakoplos, J., 2009. The leverage cycle. NBER Macroeconomics Annual 24 (1), 1–66.
Kyle, A.S., Wang, F.A., 1997. Speculation duopoly with agreement to disagree: can overconfidence survive the market test? Journal of Finance 52 (5), 2073–2090.
Nikolic, B., 2011. Momentum, reversal, and investor overconfidence: an empirical investigation of mutual fund managers. University of Missouri, Unpublished Dissertation Chapter.
Odean, T., 1998. Volume, volatility, price, and profit when all traders are above average. Journal of Finance, 1887–1934.
The Economist, 2010. Biggest Sovereign CDS Positions, October 14th. Available online at: http://www.economist.com/node/17251924
Wang, F.A., 1998. Strategic trading, asymmetric information and heterogeneous prior beliefs. Journal of Financial Markets 1 (3-4), 321–352.