

The Impact of Pensions and Insurance on Global Yield Curves

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October 2019

The impact of asset prices on pension funds and insurance (P&I) companies is well understood:

- Falling **asset prices** erode solvency
- Falling **interest rates** erode solvency by increasing the PV of liabilities (given imperfect duration matching)
- **Global financial crisis, European debt crisis.**

But what about the impact of the P&I sector on asset prices?

- We document large effects of this sector on **long end of yield curve.**
- Well-identified evidence from six **regulatory reforms** in northern Europe in 2008-2013.
- **Cross-country** evidence from 26 countries.

Why is this interesting?

1. Informative about the effects of regulation in times of stress:

Regulators wanted to limit P&I sector from feeling forced to buy or sell particular assets, thereby **locking in undesirable prices** for P&I investors and contributing to **self-reinforcing spirals** (“pro-cyclicality”). All reforms involve **less strict regulations**.

Did it work?

2. Provides well-identified evidence for the importance of intermediary behavior on asset prices:

P&I sector important for the shape of the yield curve.

It has **preferred habitat demand** for **long-maturity assets** due to long-maturity liabilities.

3. Emerging evidence that the P&I asset demand affects long yields, consistent with a preferred habitat theory of the yield curve:

- Greenwood and Vayanos (2010):

Demand from pension funds may have driven yield spreads on long bonds in the UK negative in 2005 and 2006.

- Guibaud, Nosbusch, and Vayanos (2013):

Countries with older populations have lower term premiums.

- Domanski, Shin and Sushko (2015):

European pension & insurance companies may have amplified the impact of quantitative easing policies by the European Central Bank.

- Klingler and Sundaresan (2018):

US pension fund demand for long-dated interest-rate swaps explain swap rates < Treasury yields during the 2008-2015 period.

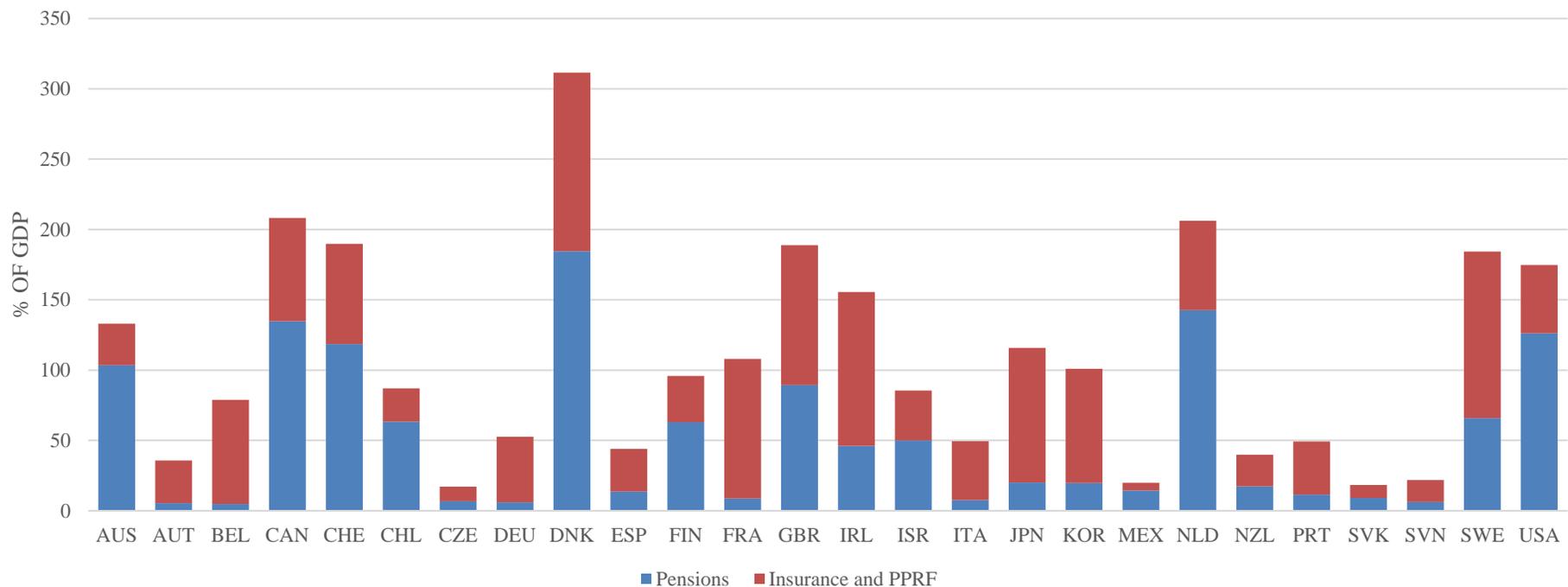
Cross-country evidence

OECD Global Pension Statistics, OECD Public Pension Reserve Funds' Statistics, OECD Insurance Statistics

- Private pension assets: Assets held by pension funds (defined benefit and defined contribution) and pension insurance contracts.
- Public pension reserve fund assets
- Insurance assets: Life insurance assets and “composite” insurance assets (about 70% is life insurance when split is available).

Exclude country-years in which 5-year government CDS spread exceeds 200 basis points.

Figure I. Pension and Insurance Assets
Panel A. (P&I Assets)/GDP (%), mean 2009-2016



Lots of variation:

- Partly driven by public pension replacement rate (Scharfstein 2018).
- Also driven by e.g. age of the private pension system, regulations on mandatory contributions, and demographics.
- PPRF has a minor contribution (largest in Japan, Sweden, Korea, Lux, where it is between 20 and 30 pct points of GDP).

Appendix Table I. P&I Sector in Europe and Elsewhere, 2011

Country	Private pension assets (€B)	Life insurance assets (€B)	Life+non-life insurance assets (€B)	Private pension+ insurance assets (€B)	Fraction of total private pension assets	Fraction of total pension + insurance assets
Eurozone or pegged to Euro						
Netherlands	1,056	462	545	1,518	0.399	0.177
Denmark	581	357	388	939	0.220	0.109
France	224	519	2,370	2,316	0.085	0.270
Germany	193	1,098	1,578	1,290	0.073	0.150
Spain	173	104	331	471	0.065	0.055
Finland	129	50	66	179	0.049	0.021
Italy	120	189	758	853	0.045	0.099
Ireland	94	199	244	293	0.035	0.034
Belgium	20	12	331	337	0.008	0.039
Austria	20	6	119	128	0.007	0.015
Portugal	19	33	67	80	0.007	0.009
Slovak	8	1	8	16	0.003	0.002
Slovenia	3	1	7	10	0.001	0.001
Latvia	2	0	0	2	0.001	0.000
Estonia	2	1	2	3	0.001	0.000
Luxembourg	1	132	144	133	0.000	0.016
Greece	0	8	19	16	0.000	0.002
Sum:	2,643	3,173	6,978	8,584		
Other European Union countries						
Sweden	322	361	434	683		
Poland	68	26	43	94		
Czech	12	2	22	33		
Hungary	4	3	10	14		

P&I sector fixed income investments are longer duration than those of other investors (due to long liabilities):

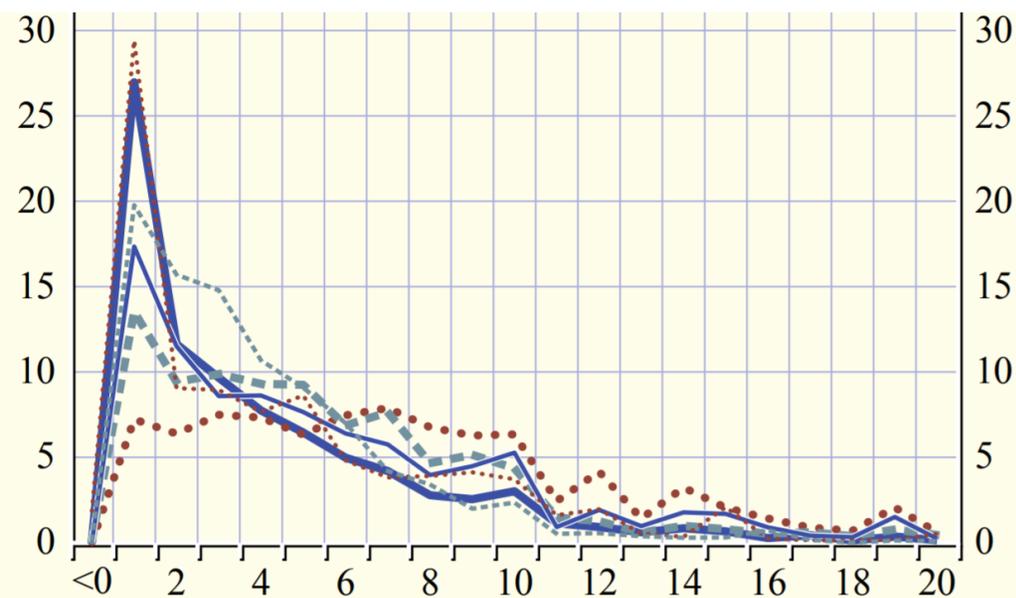
- Holdings of euro area investors (2014):

Chart 2 Maturity profile of holdings of debt securities by euro area sector

(percentage of total holdings at the end of the second quarter of 2014)

x-axis: residual maturity in years

- monetary financial institutions
- insurance corporations and pension funds
- - - other financial institutions
- general government
- non-financial corporations
- - - households and NPISH



Sources: ECB (SHS Sector) and ECB calculations.

- Liability durations:

	INSURERS				PENSION FUNDS			
	2010	2012	2014	2016	2010	2012	2014	2016
US				11.3				
BE			10.2	9.4				
DE			14.7					
ES	9.3	9.8	10.0	9.6				
FR				12.5				
LU	7.0	7.9	8.2	8.3	11.6	12.1	12.2	12.5
NL	14.9	16.3	21.4		16.8	17.7	18.8	19.4
SE				16.6				
JP	14.7	14.5	14.2	13.8				

Source: BIS CGFS Paper No 61 (2018)

Hypotheses for cross-country analysis:

- **Demand:** In countries with larger P&I systems, there is greater demand for long-term assets, depressing long yields.
- **Supply:** This effect should be attenuated in countries with large stocks of government debt to help satisfy P&I demand.

Relate 30-10 spread to *supply* and *demand* for long duration assets.

$$y_{30} - y_{10} = a + b * P\&I \text{ Assets}/GDP + c * GovtDebt/GDP + d * z + u_{it} \quad (1)$$

$$y_{30} - y_{10} = a + b * NETDEMAND/GDP + d * z + u_{it}, \quad (2)$$

- Use total P&I assets rather than long P&I assets.
Use total govt debt to GDP rather than long govt debt.
Maturity choice is endogenous (to yields).
- *NETDEMAND* is P&I assets minus government debt.

Sample:

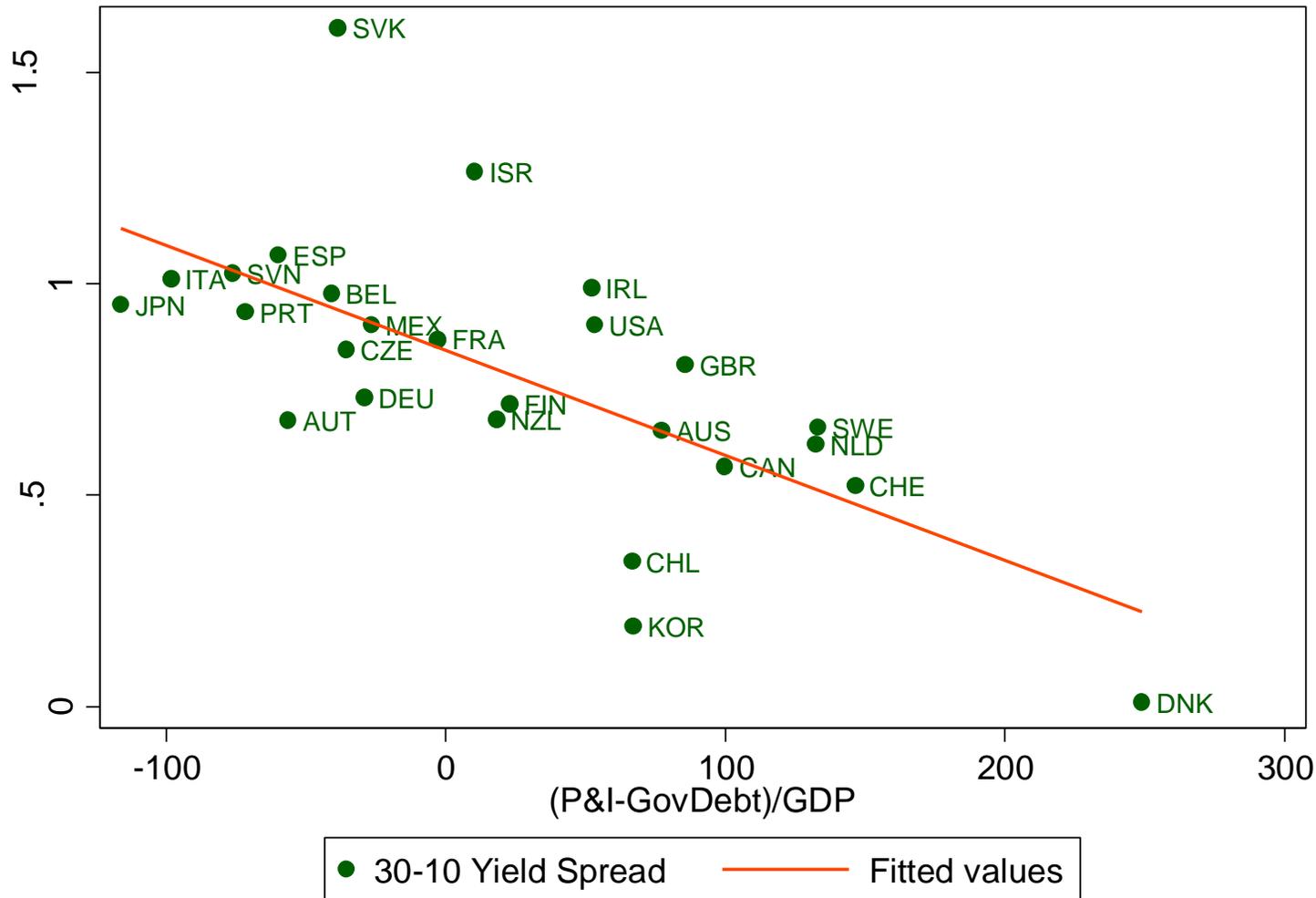
- 2009-2016: 26 OECD countries (pension & insurance)
Prior to 2009: 16 OECD countries (pension only)
- Primary source of variation is *between countries*.
Left and right side variables are country-averages.
- Time-series relations may be driven by business cycle and thus spurious. Alternative: Panel regressions with year fixed-effects.

Controls (z):

- 5-year government CDS (in bps)
- Yield spread between the 10- and 2-year government bond (may be over-controlling).
- Median population age (to see if we're saying something beyond Guibaud et al).

Yield spreads on government debt obtained from Bloomberg and supplemented by Datastream and Global Financial Data.

Figure 2. Pensions and Global Yield Curves



Countries with high net demand for long assets from private pensions and insurance have low 30-10 yield spreads. **Correlation=-67%**.

Table 2. Pensions and Global Yield Curves

Panel A. Baseline Estimation

	Baseline Results 2009-2016			Exclude Insurance & PPRF		
	(1)	(2)	(3)	(4)	(5)	(6)
(P&I Assets)/GDP	-0.0024*** [-3.61]	-0.0024*** [-3.80]		-0.0032*** [-3.16]	-0.0029** [-2.73]	
GovDebt/GDP		0.0027** [2.44]			0.0021 [1.60]	
(P&I Assets- GovDebt)/GDP			-0.0030*** [-5.04]			-0.0030*** [-3.86]
CDS			-0.0028* [-2.04]			-0.0015 [-1.01]
10-2 Yield Spread			0.2585*** [3.04]			0.2494** [2.46]
Age			-0.0202* [-1.92]			-0.0249** [-2.21]
Constant	1.0501*** [10.60]	0.8159*** [5.05]	1.4515*** [3.26]	0.9563*** [11.74]	0.7578*** [4.22]	1.3972*** [3.07]
Year FE?	No	No	No	No	No	No
Observations	26	26	26	26	26	26
R-squared	0.320	0.455	0.620	0.280	0.360	0.549

Both demand and supply hypotheses are confirmed. Magnitudes are large:

- Increasing (P&I Assets)/GDP by 150 pct points of GDP (about two std. dev. in cross-section) reduces yield spreads by 36 bps.
- An important offset to this effect is the supply of government debt. Enters with a nearly identical coefficient of the opposite sign.
- NETDEMAND has *t*-stat of 5 (and similar coefficient with or without controls).

The impact of P&I sector on long end of the yield curve appears to be a broad global phenomenon.

- Consistent with large preferred-habitat allocation of P&I sector to long maturity bonds, but one worries about potentially omitted variables.

Further robustness:

- Collapsing by currency:
Combine Euro countries into a single observation, weighting by GDP.
- Panel regressions using year fixed effects.
- Omitting ZLB period: Results from 1999-2008 (pensions only).

Panel B. Additional robustness

	Collapse Euro area		Panel Estimation		Pre-2009	
	(1)	(2)	(3)	(4)	(5)	(6)
(P&I Assets- GovDebt) /GDP	-0.0025*** [-3.54]	-0.0033*** [-5.53]	-0.0022*** [-9.14]	-0.0025*** [-8.28]	-0.0020** [-2.65]	-0.0017** [-2.58]
CDS		-0.0037 [-1.73]		-0.0027*** [-3.84]		
10-2 Yield Spread		0.3385*** [3.27]		0.2486*** [5.40]		0.4505*** [3.29]
Age		-0.0113 [-0.76]		-0.0119* [-1.79]		-0.0182 [-0.69]
Constant	0.8125*** [11.26]	1.0609 [1.46]	0.8091*** [33.77]	1.0944*** [3.86]	0.3012*** [6.07]	0.6237 [0.67]
Year FE?	No	No	Yes	Yes	No	No
Observations	15	15	128	121	16	15
R-squared	0.491	0.810	0.420	0.570	0.367	0.718

Event studies

Study changes in **the statutory discount curve** by which P&I sector values their liabilities for regulatory purposes.

- When regulators change the P&I sector's demand for a given asset by changing the regulatory discount curve methodology, this affects yields and yield spreads.

Provides better identified evidence that pension and insurance demand *causes* lower yields on long-term bonds.

- Also documents a **role for regulation** in shaping P&I asset demand.

Simplified framework for role of regulatory discount rate for liabilities:

Statutory (regulatory) funding position of a pension fund at time t :

$$F_t = A_t - L_{Tt} / (1+R_t)^T \quad (3)$$

A_t : Value of the assets

L_{Tt} : Face value of time- T liabilities known as of t

R_t : Regulatory discount rate.

Various methods used for regulatory discounting (Langejan et al, 2013).

- Denmark, Netherlands, Sweden use **market-based discounting** (as advocated by Novy-Marx and Rauh).
- Pre-2008: Discount curves were based on swap or govt bond yields.

	Austria	Belgium	Germany	Germany	Denmark	Spain	Finland	France	Greece	Ireland	Italy	Lithuania	Luxembourg	Malta	Netherlands	Norway	Portugal	Sweden	United Kingdom	number
Fixed discount rate (max.)																				4
Current risk-free market rate																				5
Expected returns on investments																				8
Life directive																				3

Source: Langejan, T. W., T.E. Nijman, A. A. J. Pelsser, O.C.H.M. Sleijpen, O.W. Steenbeek, and C. van Ewijk, "Advisory Report of the UFR Committee," 2013.

Incentive generated by regulatory discount curve:

- Hold *as assets* what's in the regulatory discount curve *for liabilities!*
- Analogous to trying to minimize tracking error.

Then, when yields on securities used in discount curve move:

- The (regulatory) value of liabilities changes
- The value of assets changes in the same direction
- Thus, (regulatory) solvency is stable.

Events: Changes in what securities go into regulatory curve, R_t to R_t^*

1. **Effect on funding position:** If $R_t^* > R_t$, funding position is improved.
2. **Effect on future volatility of funding position** and therefore on **asset/derivatives demand.**

$$F_t = A_t - L_{Tt} / (1 + R_t)^T$$

Example:

- Moving statutory discount rate to R_t^* opens up pension to tracking error ($Var(F_t)$).
- This can be undone only by shifting the asset portfolio towards assets that deliver returns of R_t^* . Or use derivatives. Either way, regulation induces demand for asset that delivers reference return.

We exploit changes in P&I demand via the second effect.

Testable prediction:

- If market yield (or spread) of a particular asset is included in regulatory discount rate, this will induce demand for asset tied to the new reference rate.
- Conversely if a given market yield is removed from the regulatory discount curve, this will reduce demand.

Press coverage of events broadly consistent with this framework.

- Following a change to the regulatory discount rate in Denmark in 2011, the main Danish financial newspaper Børsen quotes a pension company executive:
``Danish government bonds are no longer linked to the method for calculating liabilities and therefore become risky to hold. From being gold-plated they become risky. We have sold everything we could get rid of' [our translation].

Table 3. Overview of regulatory reforms studied

Reform	Change to regulatory discount curve	Date announced	Upward shift in regulatory discount curve	Using day t-1 data	Using day t+1 data
Danish 2008 reform	Including half of OAS in curve	October 31, 2008	Maturities 7 years or longer: None for maturities 0 to 2 years. Linear interpolation from 2 to 7 years.	52 bps	34 bps
Danish 2011 reform	Floor and averaging for Danish-German 10-year spread	December 2, 2011	Maturities 7 years or longer: None for maturities 0 to 2 years. Linear interpolation from 2 to 7 years.	40 bps	24 bps
Swedish 2012 reform	Floor introduced. Rates bounded below at May 31, 2012 values	June 7, 2012	At 20 year maturity: At 10 year maturity: At 2 year maturity:	12 bps 13 bps 5 bps	-17 bps -15 bps -9 bps
Danish 2012 reform	UFR introduced, LLP=20y, convergence of forward rate to 4.2% at 30y	June 12, 2012	Maturity 50 years Maturity 30 years Maturity 25 years None for maturities 0-20 years.	103 bps 56 bps 28 bps	88 bps 47 bps 24 bps
Dutch 2012 reform	UFR introduced, LLP=20y, convergence of forward rate to 4.2% at 60y	July 2, 2012	Maturity 50 years Maturity 30 years Maturity 25 years None for maturities 0-20 years.	78 bps 32 bps 12 bps	72 bps 32 bps 15 bps
Swedish 2013 reform	UFR introduced, LLP=10y, convergence of forward rate to 4.2% at 20y	February 18, 2013	Maturity 50 years Maturity 30 years Maturity 25 years None for maturities 0-20 years.	TBD	TBD

Denmark, October 31, 2008: Change to “2008 curve”

P&I solvency issues.

- Falling stock markets.
- Widening spreads on MBS relative to govt. bonds (value of MBS assets falls relative to value of liabilities).

Concerns about further spread widening.

Increased P&I incentive to align assets with regulatory discount curve:

- Sell MBS for govt. bonds
- Risk of self-reinforcing spiral.

Change in discount curve:

$$R_{PRE}(\tau) = \text{Euro swap}(\tau) + [\text{Danish govt.}(\tau) - \text{German govt.}(\tau)] \quad (\tau: \text{maturity})$$

For all maturities (except that $[\text{Danish govt.}(10) - \text{German govt.}(10)]$ was used for all maturities 10 years and longer)

$R_{POST} =$

0-2 years:	Weighted average of rates on variable-rate Danish mortgage bonds
7 years and longer:	$\text{Euro swap}(\tau) + (\text{Danish govt.}(10) - \text{German govt.}(10)) + 0.5 * \max(0, [\text{OAS} + \text{DK swap}(10)] - [\text{Euro swap}(10) + (\text{Danish govt.}(10) - \text{German govt.}(10))])$
2-7 years:	Short and long segments are linked by linear interpolation.

OAS is between Danish mortgage bonds and the Danish Kroner interest rate swap rate.

Prediction:

Increased P&I demand for Danish MBS relative to Danish Kroner interest rate swaps.

⇒ We expect OAS on Danish MBS relative to Danish Kroner interest rate to fall.

Figure 3. OAS on Danish MBS over Danish interest rate swaps

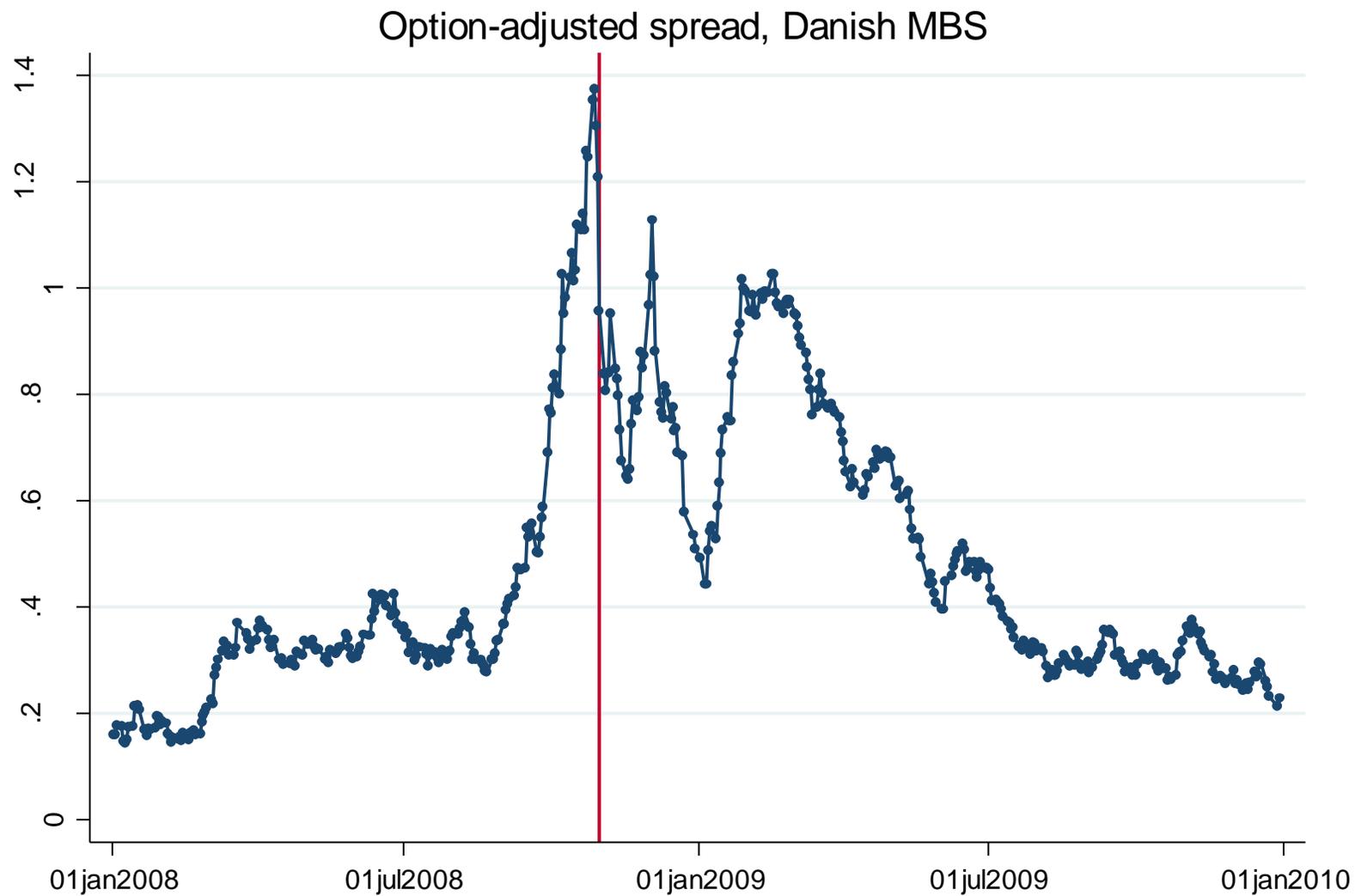


Table 4. Effects of Danish 2008 reform

	(1)	(2)
	OAS on Danish MBS	Yield on Danish MBS
Dummy for 2008 change to Danish discount curve (including half of OAS in curve)	-0.369*** [-11.68]	-0.302*** [-7.93]
Constant	0.000316 [0.53]	-0.00138* [-1.96]
N	1435	1460

- Dependent variable: Daily change in the variable stated.
- Dummy variable: Turned on for the day of the announcement and the following day. The dummy is divided by two so the coefficient has the interpretation of the abnormal 2-day change in the dependent variable.
- Data are for 2008-2013. ***/**/* indicate sign. at 1%/5%/10% level.

Robust to controlling for changes in US MBS option-adjusted spread.

Denmark, December 2, 2011: Change to “2011 curve”

European sovereign debt crisis intensified in the second half of 2011.

P&I solvency issues.

- Falling stock markets.
- Falling bond yields in the north.
- Narrowing spreads on Danish govt. (10) relative to German govt (10)

Concerns about further spread narrowing.

Increased P&I incentive to align assets with regulatory discount curve:

- Sell German for Danish govt. bonds
- Risk of **self-reinforcing spiral** in spread and strengthening of Kroner.

July 1 to Dec 1, 2011:

- MSCI EMU stock market index fell by 19%
- Danish 10-year government bond yield fell by 139 bps.

Change in discount curve from 7 years and out:

$$\begin{aligned} R_{PRE}(T) &= \text{Euro swap}(T) \\ &\quad + (\text{Danish govt.}(10) - \text{German govt.}(10)) \\ &\quad + 0.5 * \max(0, [\text{OAS} + \text{DK swap}(10)]) \\ &\quad - [\text{Euro swap}(10) + (\text{Danish govt.}(10) - \text{German govt.}(10))] \end{aligned}$$

$$\begin{aligned} R_{POST}(T) &= \text{Euro swap}(T) \\ &\quad + \max(0, 250\text{-day MA of } (\text{Danish govt.}(10) - \text{German govt.}(10))) \\ &\quad + 0.5 * \max(0, [\text{OAS} + \text{DK swap}(10)]) \\ &\quad - [\text{Euro swap}(10) + (\text{Danish govt.}(10) - \text{German govt.}(10))]. \end{aligned}$$

Prediction:

- a. **Direct:** Decreased P&I demand for Danish government bonds relative to German government bonds.
 - ⇒ We expect yield spread between Danish government bonds and German government bonds to increase.
- b. **Indirect, via spillovers to closely related markets:**
 - ⇒ We expect yield spread between Danish interest rate swaps and German government bonds to increase.

Figure 4. Spread between Danish and German 10-year govt bond yields

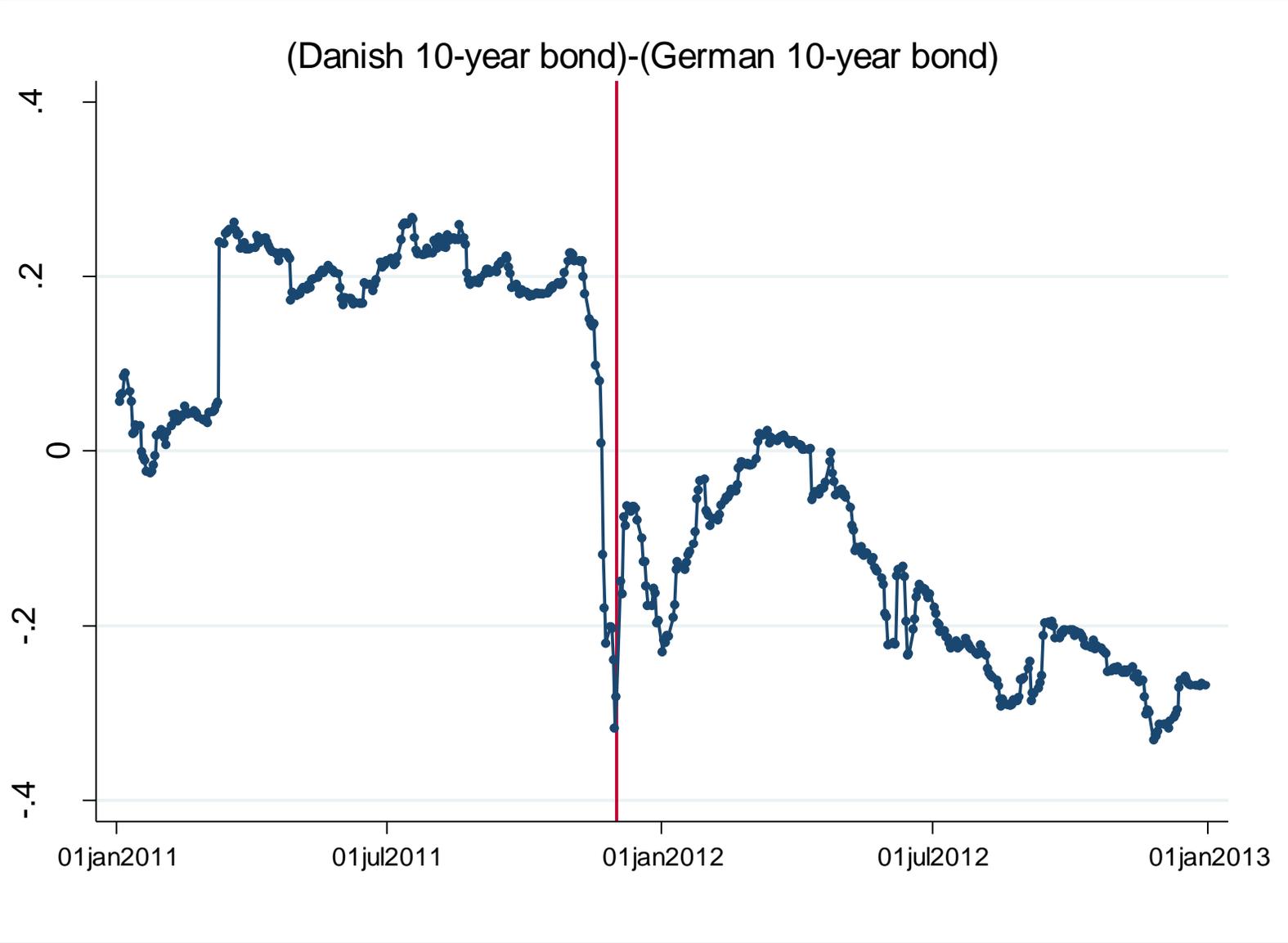


Table 5. Effects of Danish 2011 reform

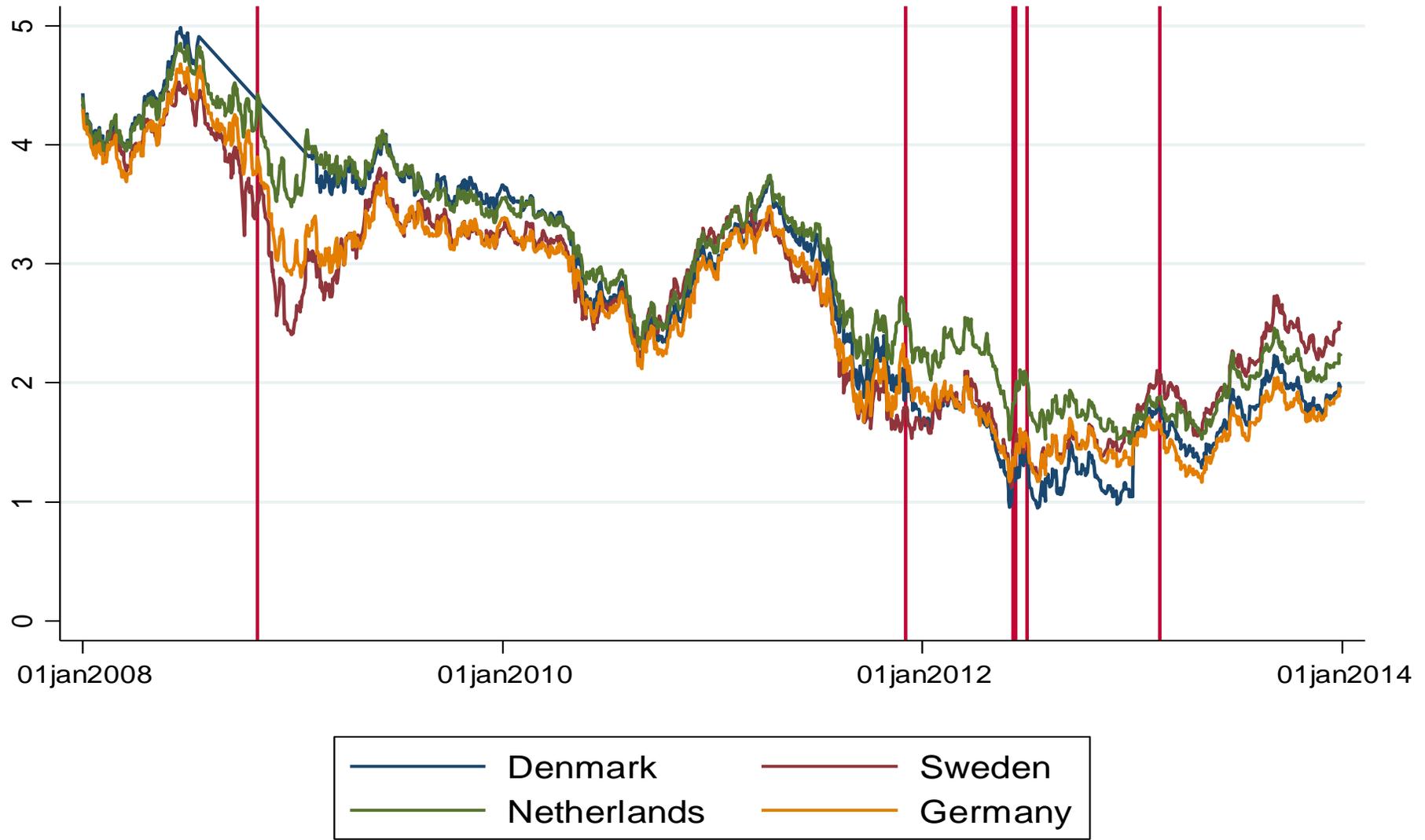
	(1)	(2)	(3)	(4)	(5)
	A.	B.	C.		
	Danish 10-year govt bond yield	Danish Krone 10- year interest rate swap yield	German 10-year govt bond yield	A-C	B-C
Dummy for 2011 change to Danish discount curve (floor and avg for Danish- German 10-year spread)	0.195*** [2.72]	0.211*** [3.12]	0.0281 [0.38]	0.169*** [6.75]	0.183*** [4.05]
Constant	-0.00117 [-0.87]	-0.00169 [-1.40]	-0.00154 [-1.16]	-0.000444 [-0.95]	-0.000152 [-0.19]
N	1428	1566	1566	1428	1566

Declining interest rates in spring of 2012 as the European sovereign debt crisis intensified

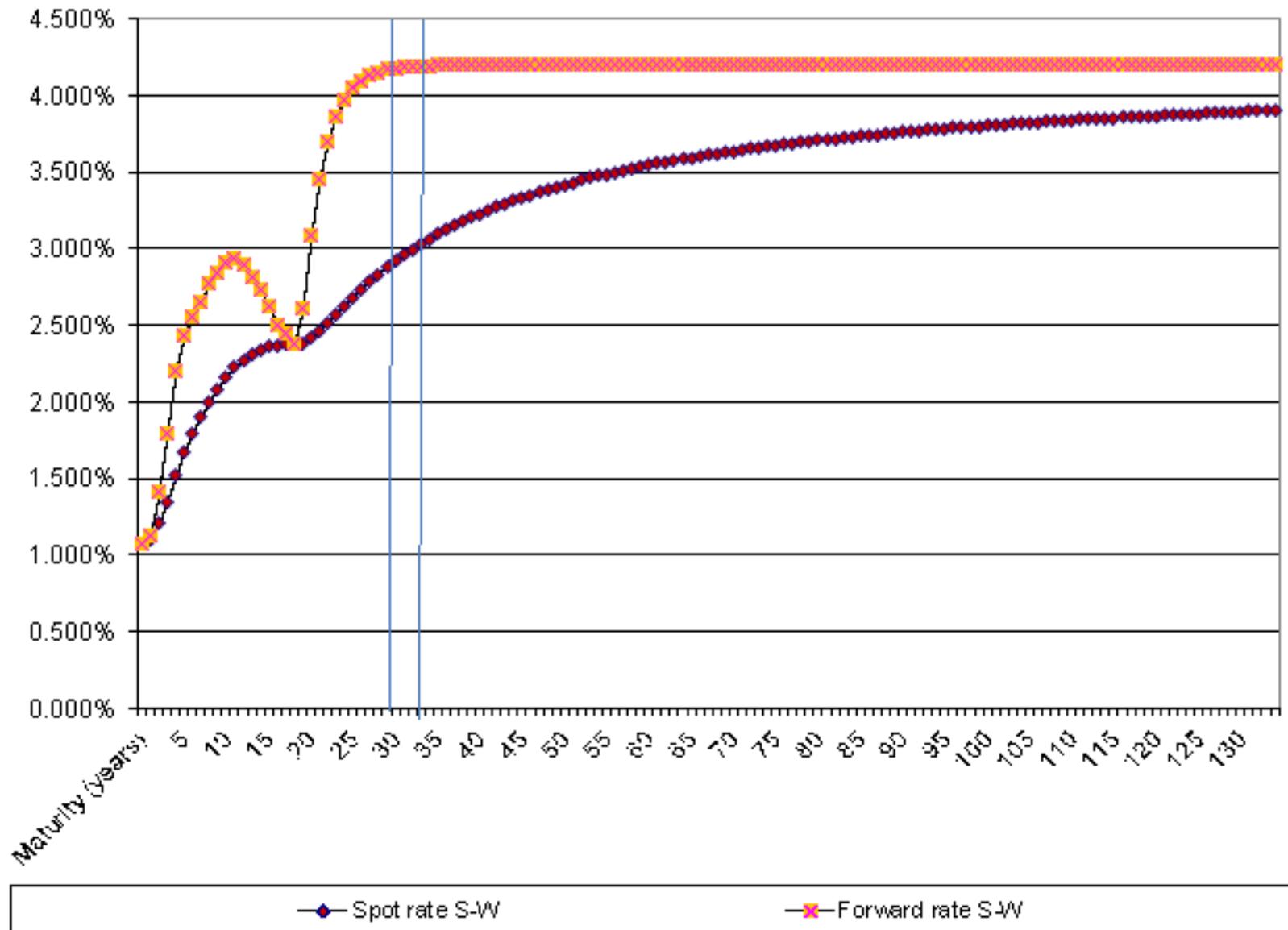
- Lowered solvency of P&I sector (if not fully hedged)
- Lengthened duration of liabilities (duration is higher for lower rates) → need to lengthen asset duration.
- Risk of self-reinforcing spiral in long yields.

Lead to regulatory reforms in Sweden, Denmark and Netherlands.

Yields on 10-year government bonds in northern Europe:



Danish regulatory curve (spot and forward), June 13, 2012:



Conclusion: P&I demand is an important driver of yields on long bonds.

26 countries:

- Yield spread between 30-year and 10-year govt bond yields is negatively related to (Pension and insurance assets)/GDP.

6 event studies to obtain unexpected changes in P&I demand:

- Causal impact of P&I demand on asset prices.
- Demand is partly driven by the regulatory discount curve.

Regulators face a trade-off:

- Stopping spirals – “pro-cyclicality” – is good for P&I solvency
- But leniency may increase the risk that pensions will not be ultimately be able to meet their obligations.