Building a stress-testing framework for the household sector

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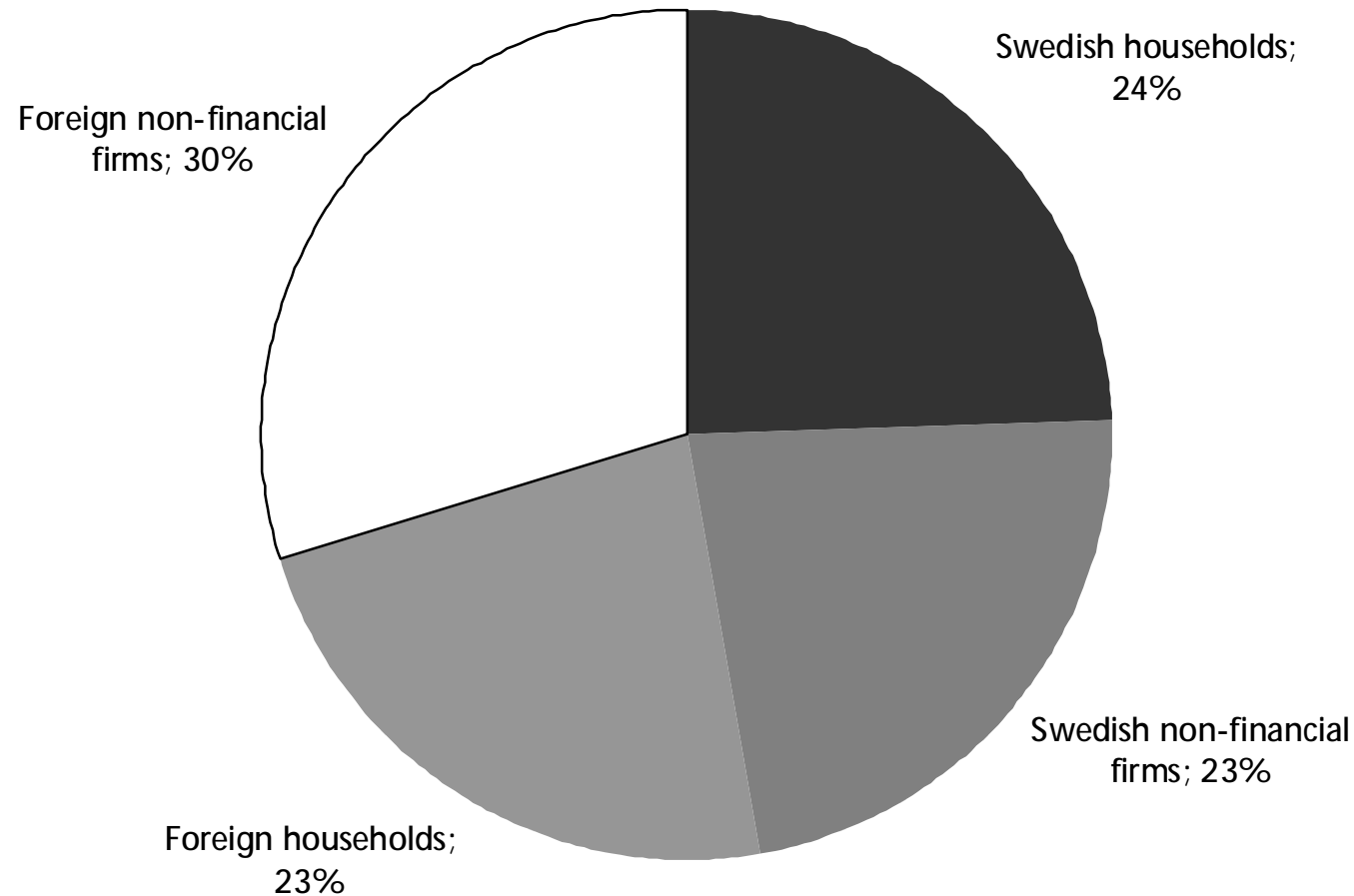
The Riksbank

- **Founded in 1668**
  - Operates an inflation target (±2 % p.a.)
  - Non-regulatory central bank
- **Financial Stability Report (FSR) issued twice a year** (first issue: 1997)
- **Financial Stability Department has 40 employees**

The Swedish banks' lending

Swedish households; 24%

Foreign non-financial firms; 30%

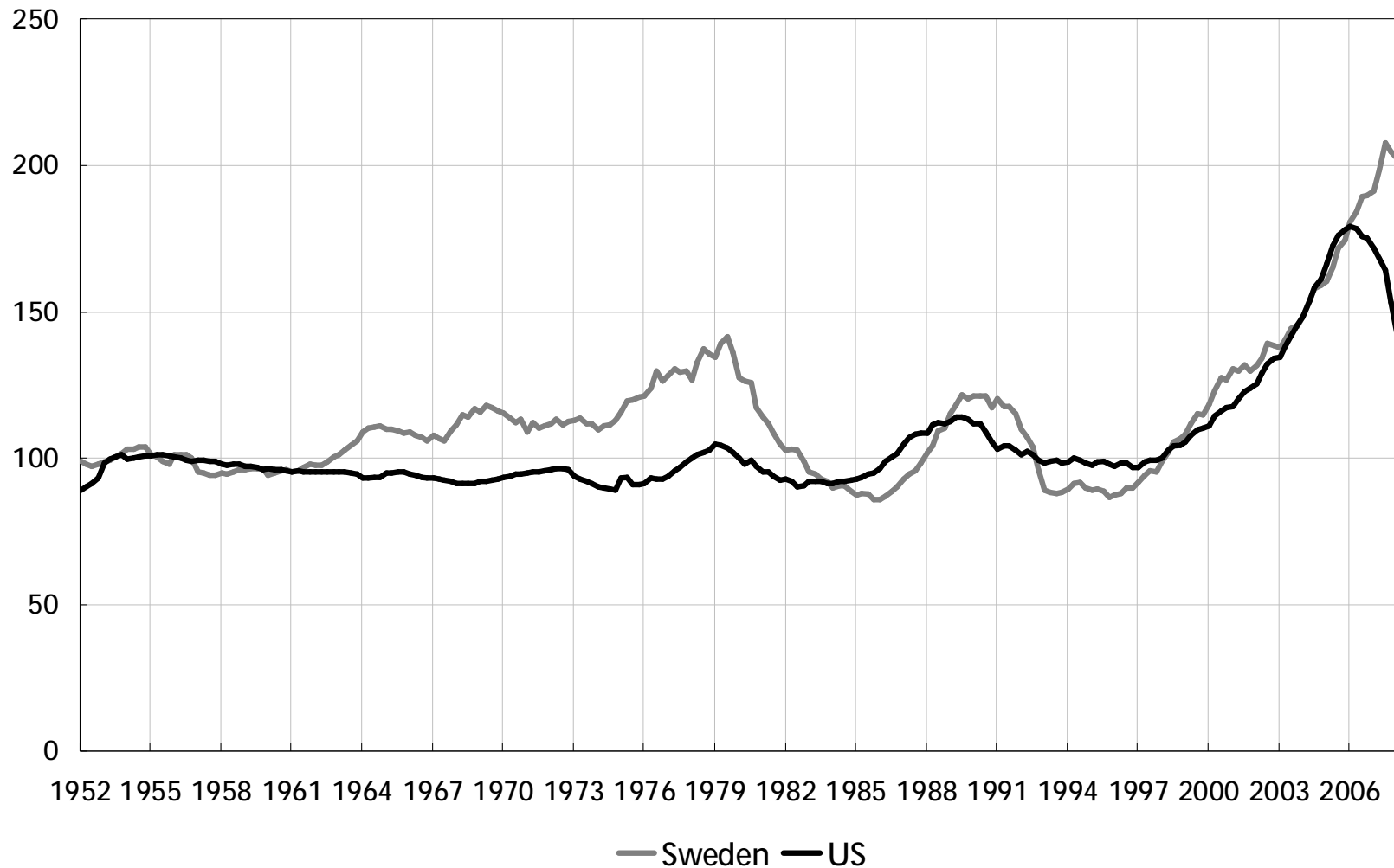Swedish non-financial firms; 23%

Foreign households; 23%

Outline of presentation

- A bird's eye view of the Swedish household sector

- Micro data

  - The data sets

  - Constructing metrics for household vulnerabilities
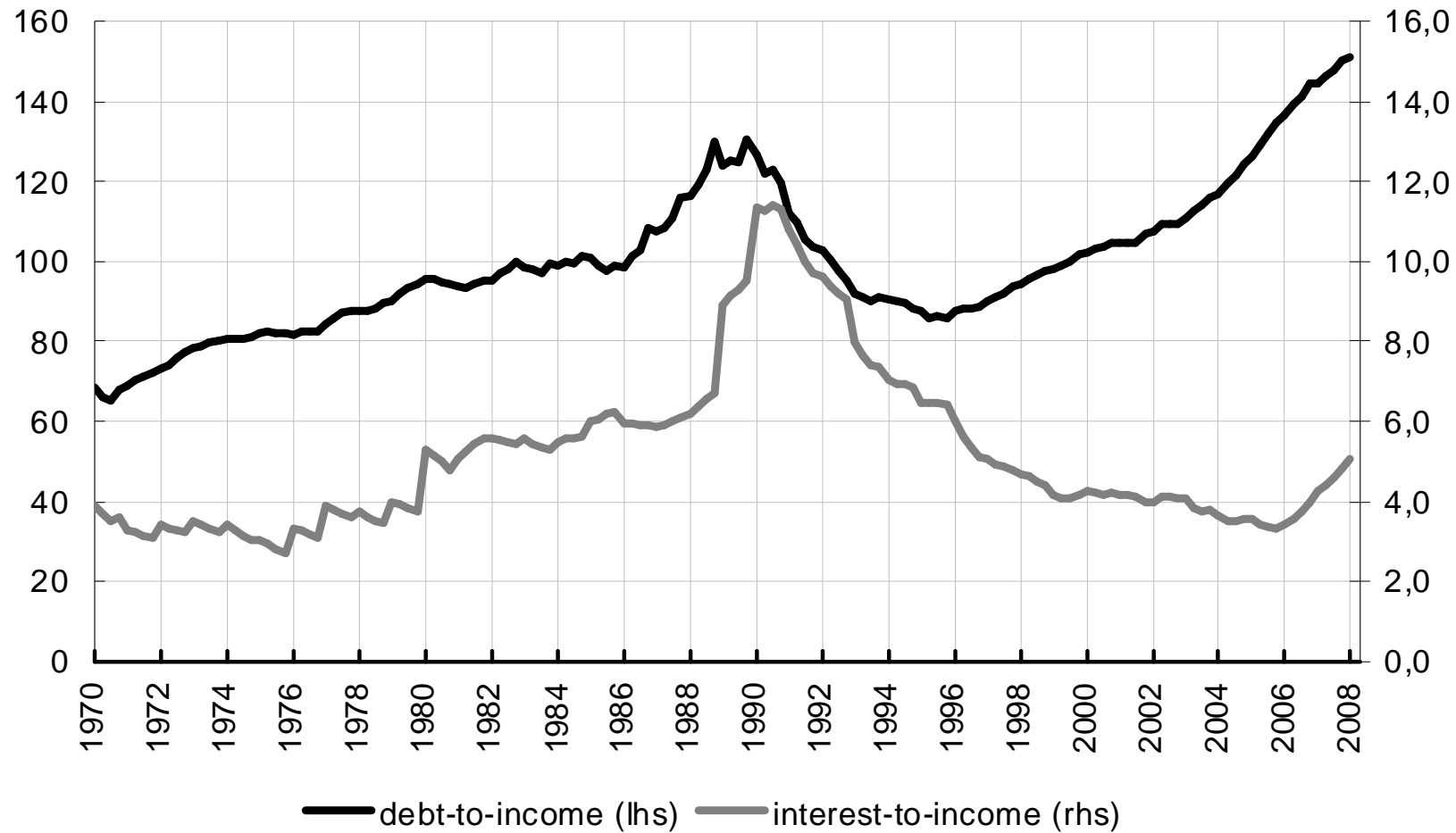
  - Stress-testing

- Conclusions

Real house prices
index 1953=100

Sources: Robert Shiller, OFHEO, Reuters EcoWin, Statistics Sweden and the Riksbank
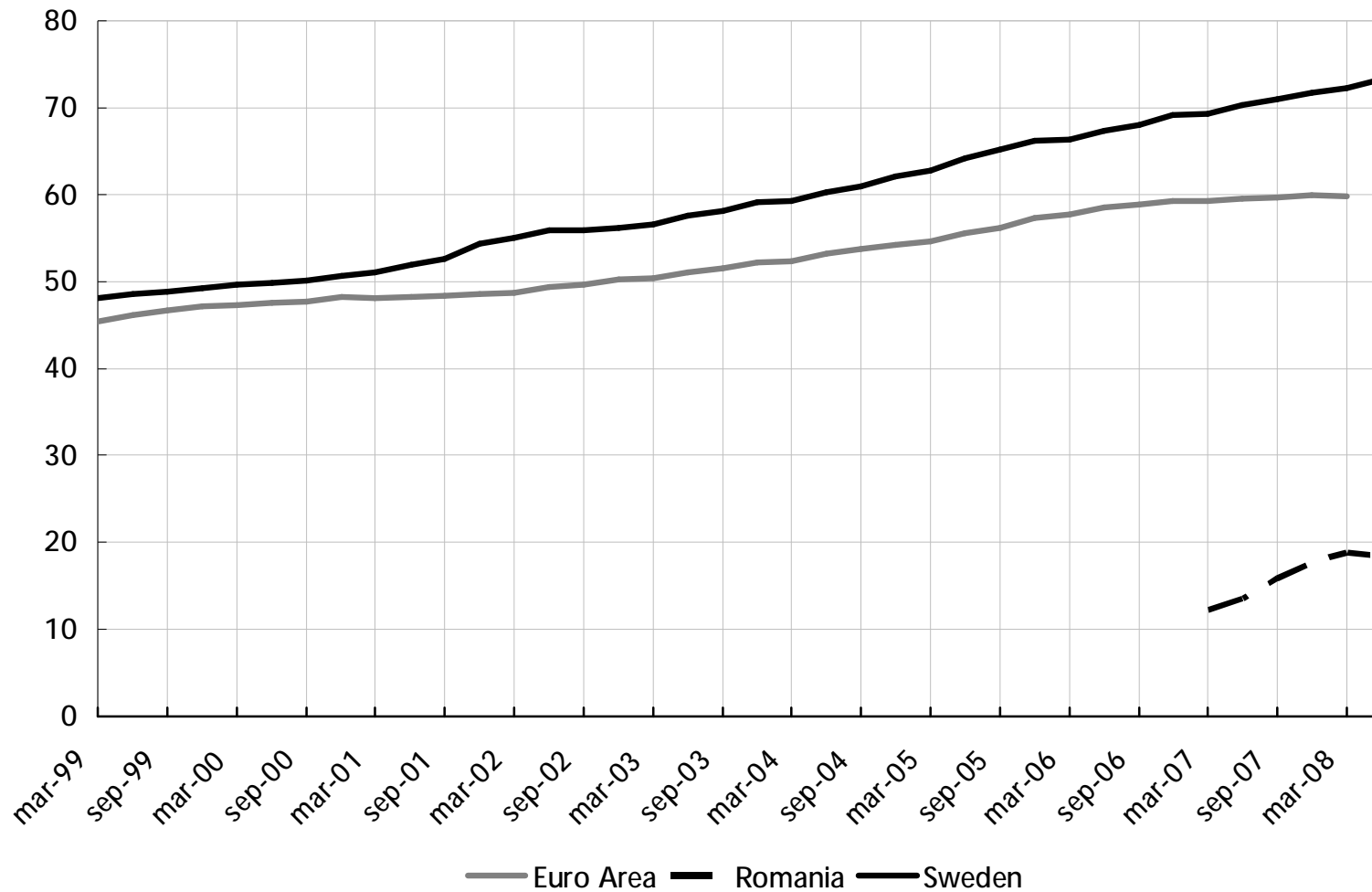
Household indebtedness and interest expenditures
per cent of disposable income

debt-to-income (lhs)   interest-to-income (rhs)

Household indebtedness
per cent of GDP

Sources: Statistics Sweden, Eurostat and Reuters EcoWin

Possible threat to financial stability (and macroeconomic stability)

- Household debt has increased sharply in the last few years. What happens to the ability to pay if…
    - Unemployment rise?
    - Interest rates go up?
- How many households will end up with negative equity if house prices fall by 20 per cent?

Possible avenues

- Time-series analysis
  - Example: Running a univariate regression or VAR on non performing loans, Profit/Loss, GDP, interest rates, inflation etc
  - See e.g. Norges Bank (2007): " An analysis of banks' problem loans", Economic Bulletin 2007:2
    - http://www.norges-bank.no/Upload/62923/ec_bull2_07_problem_loans.pdf

Time-series analysis

n **Pros**

   n Timely data

   n Lots of useful tools (e.g. impulse-response functions, variance decomposition and R^2)

   n Relatively easy to incorporate with models used in monetary policy (e.g. Bayesian VAR:s)

n **Cons**

   n Disregards the distribution of income, assets and liabilities within the household sector

   n Often little (useful) variation in data

Micro data

- **Micro data**
  - Pros
    - Possible to take into household heterogeneity.
    - Lots of variables which offers to answer wide range of questions.
    - PR value
  - Cons
    - Substantial time-lags
    - Confidentiality issues

Household Finance survey

- **n** Dataset compiled the national statistical agency (Statistics Sweden), *not* the Riksbank

- **n** Annual data set (consistently constructed since 2000)
    - n Preliminary data release 11 months after year's end
    - n Final data release 15 months after year's end

- **n** Dataset originally complied to facilitate socioeconomic studies. *Not* financial stability analysis. (we were just lucky)

Household Finance survey, cont

- Data on individuals is mainly based on information acquired by the tax authorities (submitted by employers, not reported by the individuals themselves)

- Still, of course, problems with measurement errors and omissions

- The survey covers 40 000 individuals, comprising 20 000 or 13 000 households depending on how a household is defined

Household Finance survey, cont

- Included variables
    - Income and its various components
        - Labor income
        - Capital income
        - Transfers
        - Interest expenditures
    - Debts
        - Student loans
        - Other loans (mainly mortgages)
    - Assets
        - Financial assets (stocks, bonds and deposits)
        - Residential property (assessed values)
- All in all 1000 variables

Household Finance survey, cont

n Since 2003 half of the households in the survey answer an add-on questionnaire related to housing

n Example:

    n Have you borrowed money that you have spent on non-housing items? If yes, how much?
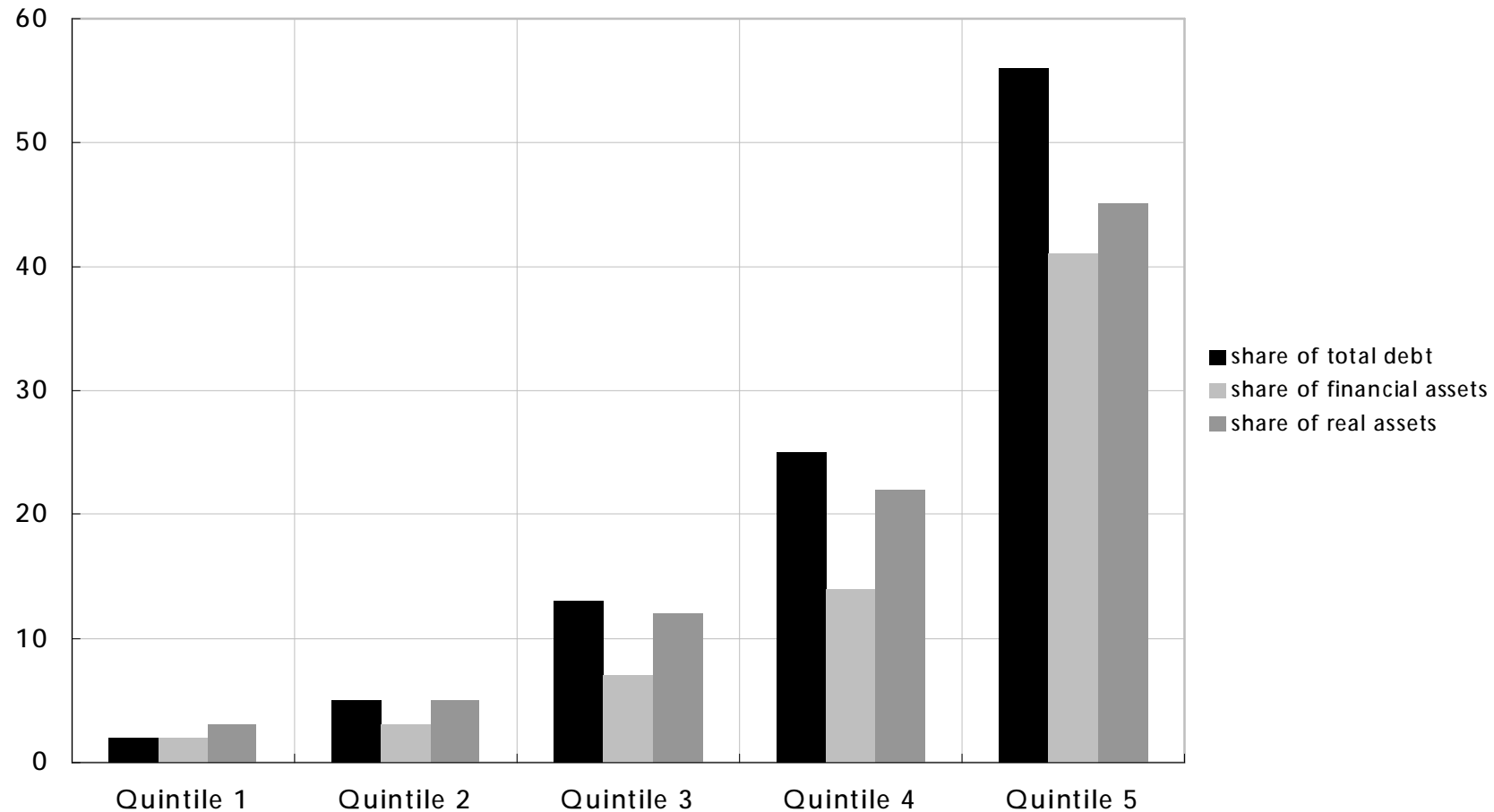
Preparing the data set for analysis

- n Divide the data into five income groups containing an equal number of households.

- n Remove households with…

  - n Zero debt (no credit risk)

  - n Negative disposable income (obvious measurement errors/omission)

- n The remaining households make up the sample used for analysis. *N.B. each income category now holds an unequal number of households.*

Distribution of debt and assets across income categories
per cent of total

Legend:
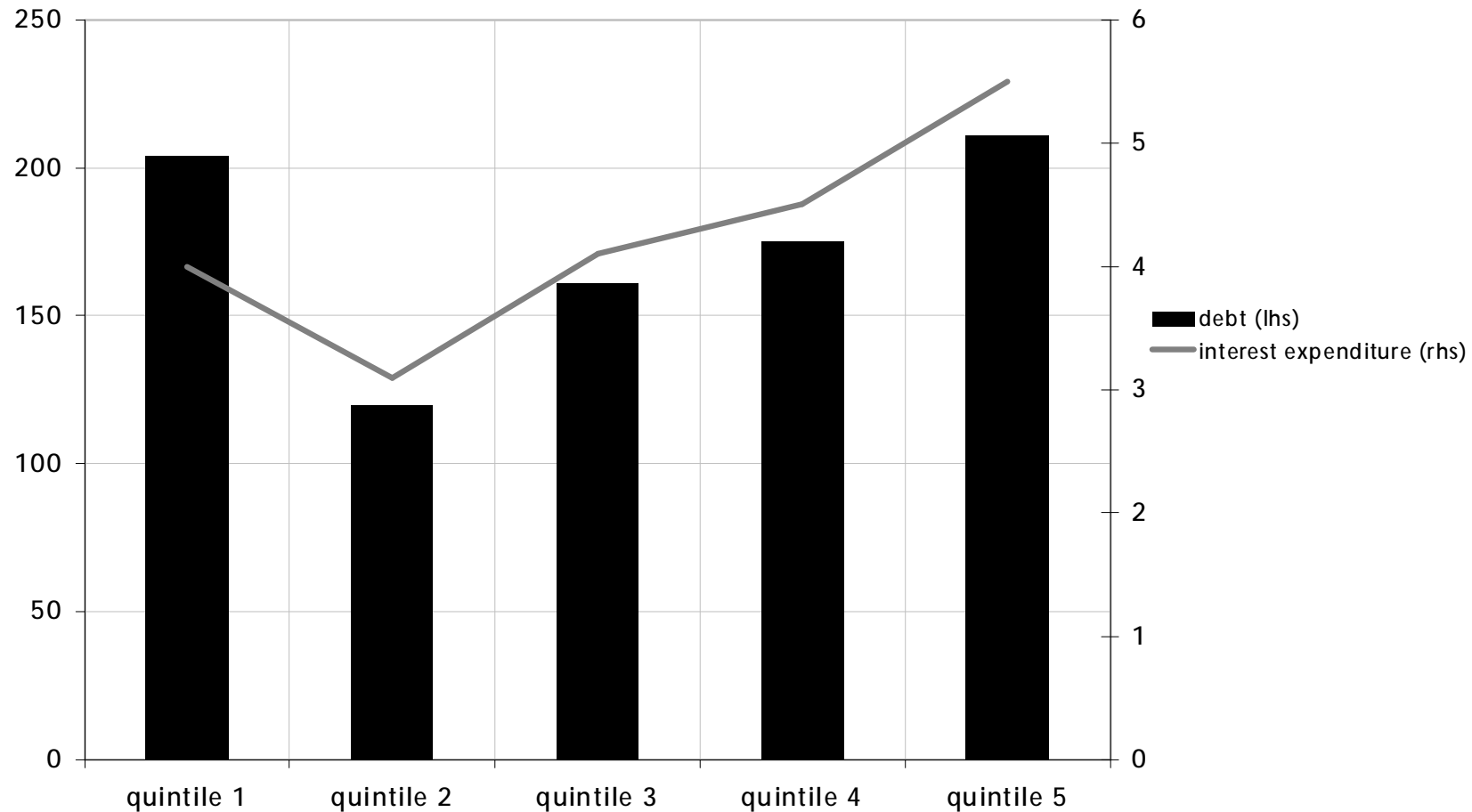- ■ share of total debt
- ▨ share of financial assets
- ▨ share of real assets

X-axis: Quintile 1, Quintile 2, Quintile 3, Quintile 4, Quintile 5

Y-axis: 0, 10, 20, 30, 40, 50, 60

Debt and interest expenditures
per cent of disposable income

Some useful metrics

- Household margins

  - The amount of income left for a household after minimum expenditures needed for food and clothing, interest rates and non-interest related housing expenditures have been paid.

  - Margin for household k: M_k =Disposable income$_k$ –(base amount)*(household size$_k$) –(interest expenditures$_k$) –(other housing expenditures of the income decile)

  - In 2006 the base amount was 39 700 SEK.

  - 1 SEK $\approx$ 0.1 EUR $\approx$ 0.35 RON

Some useful metrics, cont

n Example: household # 15877…

   n Disposable income: 386 986 SEK

   n Size: 1.92 (two adult, no children)

   n Interest expenditures: 2 132 SEK

   n Debt: 56 025 SEK

   n Value of real assets: 3 284 560 SEK

   n The household resides in income decile 9 where average non-interest housing expenditures amount to 61 110 SEK.

n M_k = (386 986 – 1.92*39 700 – 2 132 – 61 110) SEK= 247 520 SEK.

n If a household has a margin less than zero, it is termed "vulnerable"

Some useful metrics, cont

- **Exposure at default (EAD):**
  - The share of total debt held by vulnerable households

- **Loss given default (LGD):**
  - The share of total debt, held by vulnerable debts, that is not covered by assets

A simple example

- The entire household sector consists of 5 households with total debts 10 000 SEK

- Only household i and household j have margins less than zero. This means that the proportion of vulnerable households is 2/5=40%

- Suppose household i has 800 SEK in debts and assets worth 1300 SEK. Household j has 900 SEK in debts and 600 SEK worth of assets. The EAD is (800+900)/10000= 17 %

- However, the LGD for household i is zero as its net wealth is positive. The LGD for household j is –(600-900)=300 SEK à LGD=300/10 000= 3 %

Descriptive statistics from 2006
thousands of SEK and per cent

Income quintile à	1	2	3	4	5
Disposable income	79	139	204	307	515
Debt	161	168	328	536	1087
Assets	630	662	1038	1672	3407
Debt-to-income	204%	120%	161%	175%	211%
Interest-to-income	4.0%	3.1%	4.1%	4.4%	5.1%
Assets-to-debt	392%	395%	316%	312%	314%
Vulnerable households	62%	6.3%	2.2%	0.6%	0.02%
Share of total debt	2%	5%	13%	25%	56%

Sources: The Riksbank and Statistics Sweden

Proportion of vulnerable households EAD:s and LGD:s in 2006

	EAD (as share of total debts)	LGD (as share of total debts)
Income quintile 1	1.8 %	0.5 %
Income quintile 2	1.3 %	0.06 %
Income quintile 3	1.0 %	0.08 %
Income quintile 4	0.3 %	0.004 %
Income quintile 5	0.08 %	0.00 %
Σ quintiles	4.03 %	0.64 %

Source: Statistics Sweden and the Riksbank

Stress testing

- Parameters:
  - *Interest rate* changes
  - Swings in *asset prices*
  - Changes in *unemployment*
- Variables:
  - The proportion of households with a margin less than zero ("vulnerable households")
  - The debt held by vulnerable households as a proportion of total household debt ("exposure-at-default", EAD)
  - The debt held by vulnerable households that is *not* covered by assets as a proportion of total household debt (LGD)

Stress testing the interest rate

1. An implicit interest rate is calculated for each and every household by dividing interest rate expenditures with debt

2. Calculate stressed levels of interest rate expenditures by multiplying the debts of each household by a stressed level of interest rate

3. Recalculate the EAD and LGD

Stress testing the interest rate

- **E.g. Household no 15877**
    - Implicit interest rate, $i = 2132/56025 = 3{,}81\%$
- **Assume interest rates rise by 2 percentage points**
- **New interest rate expenditure:** $56025*(2+3{,}81)\% = 3252$ SEK
- **New Margin:** $(386\ 986 - 1.92*39\ 700 - 3\ 252 - 61\ 110)$ SEK $= \underline{246\ 410}$ SEK

Effects of a 2-4 p.p. increase in the interest rate

per cent

Note: numbers in parentheses denote the long-term effect of changes in interest rates.

Increase in interest rate à	0	2	3	4
Proportion of vulnerable households	6.5	6.9 (7.4)	7.1 (7.9)	7.2 (8.6)
EAD	4.0	5.3 (7.0)	5.9 (7.9)	6.6 (10.0)
LGD	0.6	0.9 (1.2)	1.0 (1.3)	1.2 (1.6)
Interest ratio (iD/Y)	4.6	5.3 (6.4)	5.7 (7.4)	6.1 (8.3)

Source: Statistics Sweden and the Riksbank

Stress testing asset prices

n   Easy!

1. Write down the value of the real- and/or financial assets of each household by a stressed percentage

2. Recalculate the EAD and LGD

LGD:s from falling asset prices and a 4 p.p. increase in the interest rate
(per cent)

Remaining real wealth à	100 %	90 %	80 %	70 %
	1.2 (1.6)	1.2 (1.7)	1.3(1.8)	1.5 (2.0)

Stress testing the unemployment rate

- **n** A lot trickier!

1. Randomly pick an employed individual and recalculate that individual's income if he/she were to be unemployed

2. Do (1) until the aggregate level of unemployment reaches the stressed level

3. Form the households from the individuals

4. Recalculate the EAD and LGD

5. Repeat (1)-(4) 500 times and calculate the average EAD and LGD

Effects of a 2-4 p.p. rise in unemployment
per cent

Increase in unempl. rate à	0	2	3	4
Proportion of vulnerable households	6.5	6.8	6.9	7.0
EAD	4.0	4.5	4.7	4.9
LGD	0.6	0.7	0.7	0.7
Interest ratio (iD/Y)	4.6	4.7	4.7	4.7

Source: Statistics Sweden and the Riksbank

How to forecast the metrics?

- Data is at least 11-15 months old. What does things look like today?
  - Disposable income for all households is assumed to grow in line with data from the national accounts
  - Prices and interest rates are also assumed to change in line with the national averages
- Stress tests can then be performed on "updated" data

Conclusions

- Credit losses are more vulnerable to interest rate hikes than to rising unemployment
- Question: How bad are the stressed EAD:s and LGD:s?
- Our conclusion: An adverse macroeconomic outcome would increase credit losses in the banking sector, although it seems unlikely it would pose a threat to the stability of the financial system
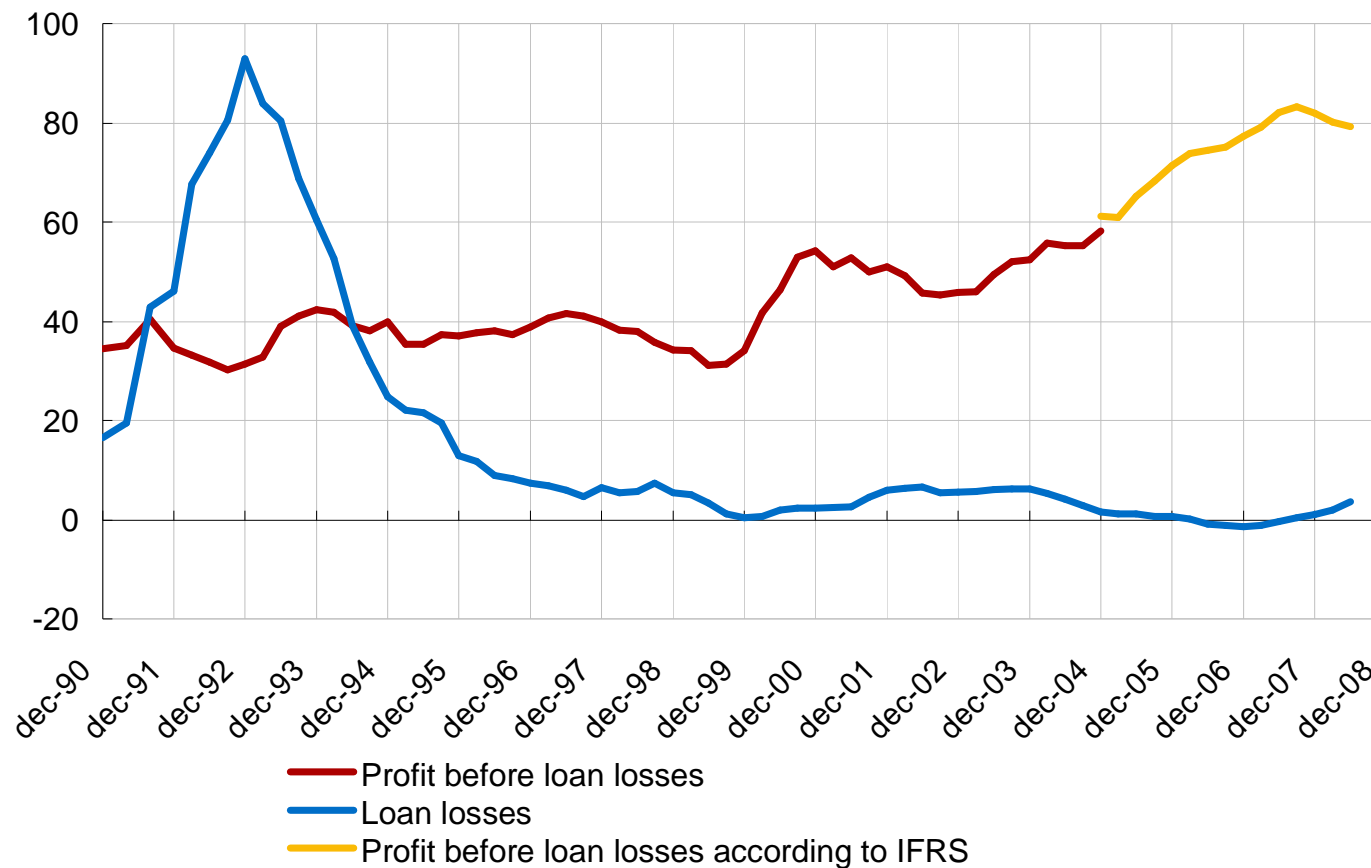- Challenge: Roughly half of the lending of the Swedish banks is abroad.

Thank you!

Bonus slides

Profit before loan losses and net loan losses in the major banks

Four-quarter totals. SEK billion. 2008 prices

Profit before loan losses
Loan losses
Profit before loan losses according to IFRS