QUANTIFYING CONTAGION CHANNELS

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INTRODUCTION

The financial crisis has shown that financial contagion can cause massive disturbances of financial stability. Contagion is typically measured as losses on interbank exposures, which may cascade through the system. However, several studies found that the effects from such loss cascades are limited (Glassermann and Young 2014,...), raising questions about whether this channel alone can explain the extent of the crisis. The aim of this work is thus to create a model that includes other contagion channels besides interbank exposures and to quantify their importance.

METHODOLOGY & DATA

The following contagion channels are considered:

- **Direct contagion** (figure 1)
  Computes losses resulting from direct bilateral exposures.
- **Asset Fire Sales** (figure 2)
  Liquidation losses increase the losses for creditors of defaulted banks.
- **Asset Fire Sales** (figure 3)
  Lower prices through fire sales have to be recognised as losses by all banks, regardless of their interbank exposures.

Impact Measurement
Impact of is measured by Jaccard-Index (share of defaulting banks) $\eta(e, p)$. This measure is evaluated for various combinations of active and inactive contagion channels, the impact of a channel is then the η-delta when the channel is activated:

$$\zeta(\gamma) = \eta(\cdot_{11}, \cdot_{12}) - \eta(\cdot_{21}, \cdot_{22}) \qquad (1)$$

The impact is aggregated across shock levels in two different ways (average and maximum):

$$\zeta^* = \max_{0 \le \gamma \le 1} \zeta(\gamma) \qquad \bar{\zeta} = \int_0^1 \zeta(\gamma)\,\mathrm{d}\gamma$$

Data
Complete network of interbank loans for Austrian banks. Quarterly data from 2008 Q1 to 2014 Q4, average number of banks: 814.

OVERVIEW OF CONTAGION CHANNELS

Figure 1: Direct Contagion

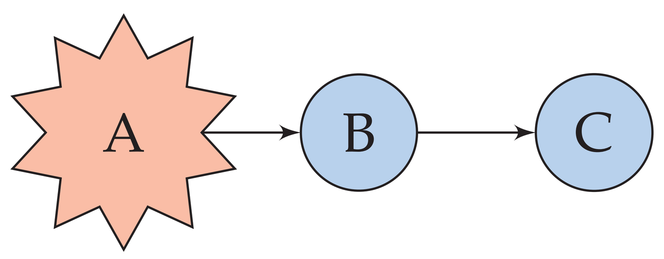


Figure 2: Asset Fire Sales

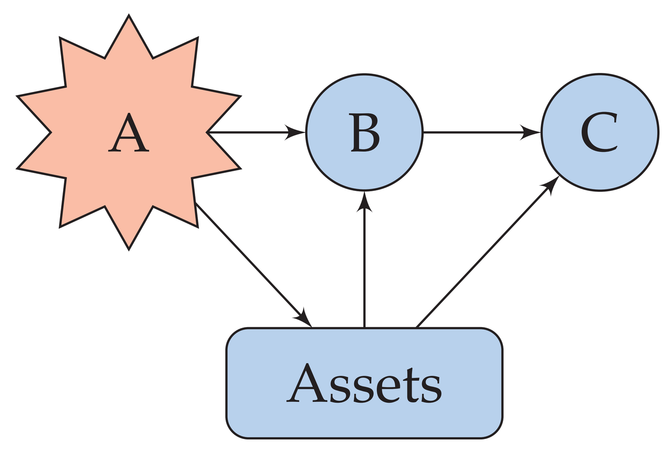
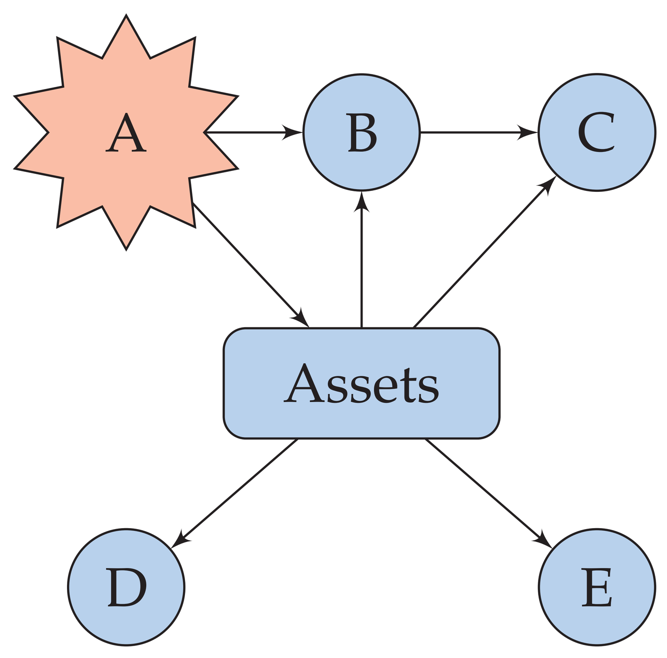


Figure 3: Mark-to-market effects



DIRECT CONTAGION MODEL

Value of interbank claims depends on payments vector p:

Figure 4: Balance sheet of firm i

Interbank Assets $(\Pi' p)_i$	Equity $e_i + (\Pi' p)_i - \bar{p}_i$
Other assets e_i	Liabilities $\bar{p}_i$

General as well as idiosyncratic shocks are captured in a shock matrix $\Gamma(\gamma)$, which depends on a general shock γ (fraction of value remaining).

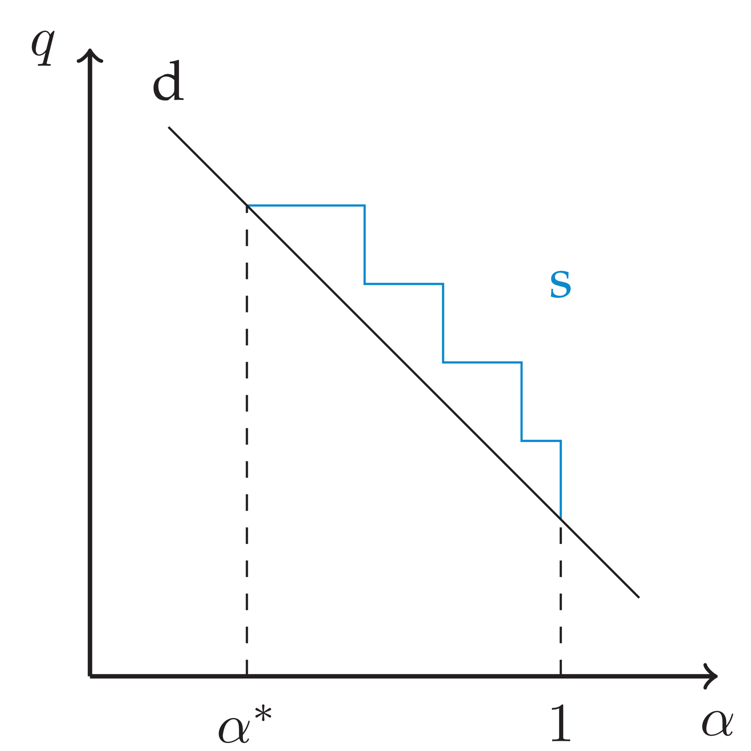
Clearing payment vector $p^{*,1}(\alpha, \Gamma)$ (fixed point):

$$\Phi_1(p)_i = \begin{cases} \bar{p}_i & \text{if } \bar{p}_i \le e_i\Gamma_{ii} + (\Pi' p)_i \\ \alpha e_i \Gamma_{ii} + (\Pi' p)_i & \text{otherwise} \end{cases}$$

- Solvent banks repay their obligations $\bar{p}_i$ in full.
- Defaulted banks: liquidation losses $(1-\alpha)$ on non-interbank assets.
- Defaulted banks repay the recovery value of non-interbank $\alpha e_i \Gamma_{ii}$ plus equilibrium value of interbank assets $(\Pi' \bar{p})_i$.

ASSET FIRE SALE MODEL

Figure 5: Tâtonnement process



Supply of firesold assets:

$$s(p, \Gamma) = \sum_{\{i \in \mathcal{N} \,:\, \Gamma_{ii} e_i + (\Pi' p)_i < \bar{p}_i\}} e_i$$

Inverse demand function ($\alpha =$ price):

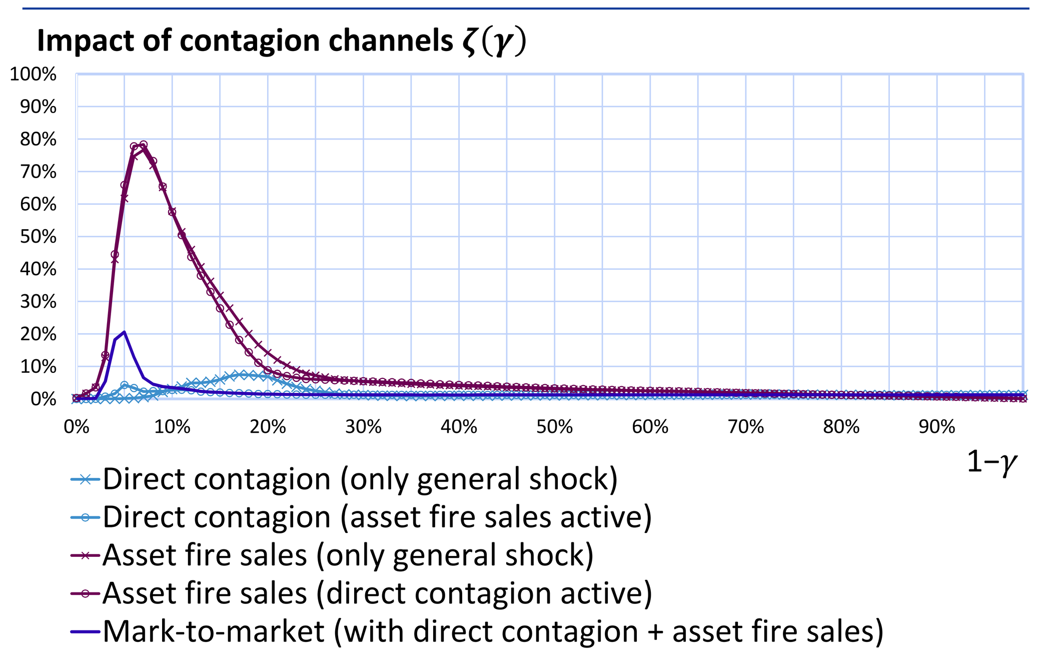
$$\alpha(s) = 1 - \kappa * \frac{s}{\sum_{i=1}^{n} e_i} \qquad d^{-1}(p, \Gamma) = \alpha(s(p, \Gamma))$$

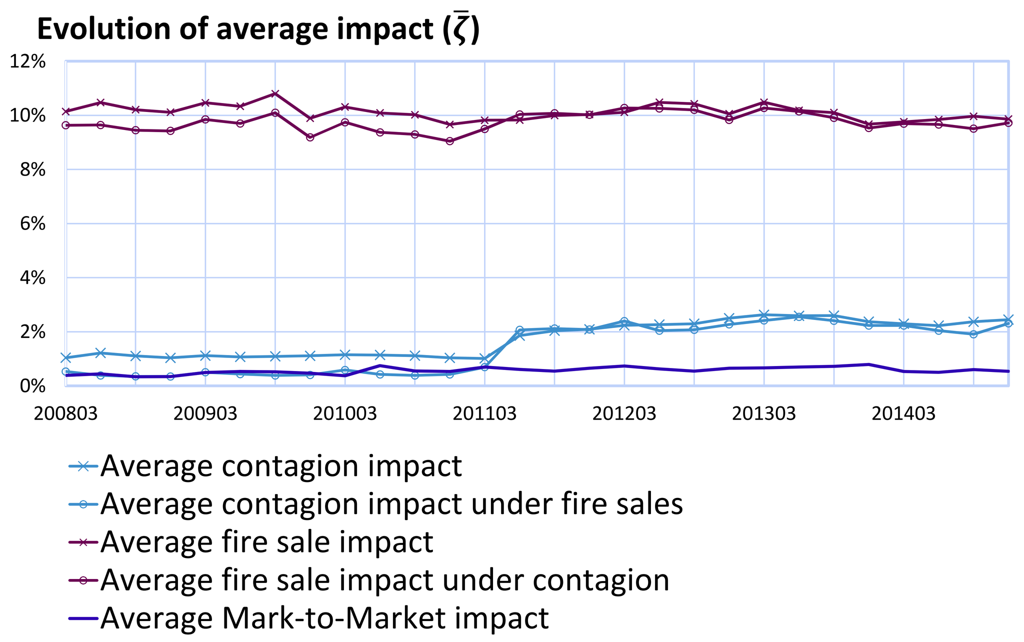
Equilibrium price $\alpha^{*,1}(\Gamma)$ fixed point of the map:

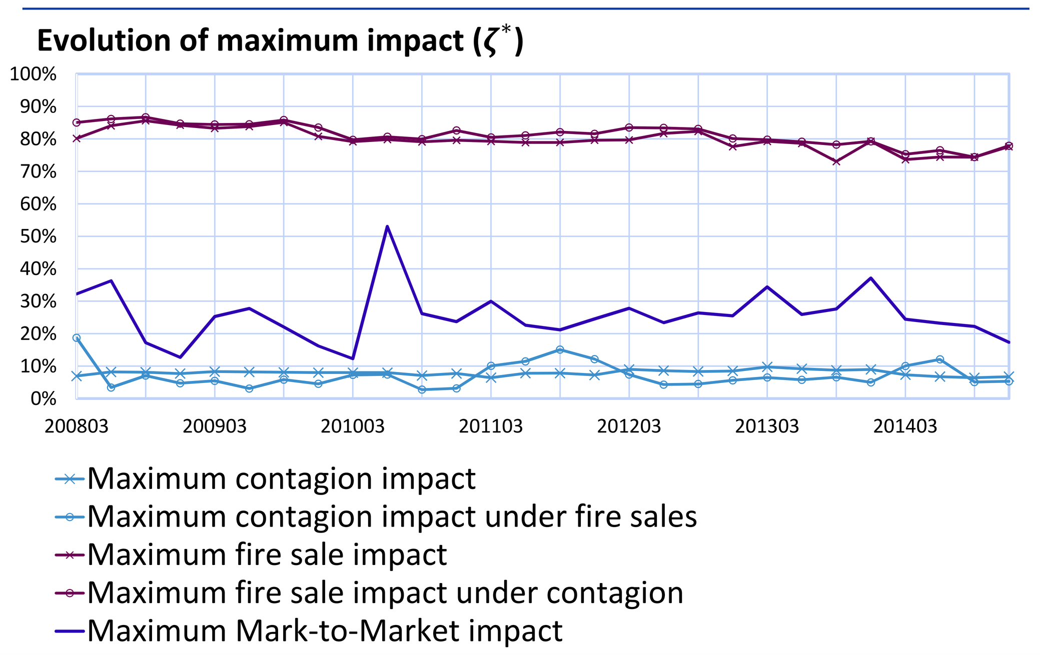
$$\Theta_1(\alpha) = d^{-1}(p^{*,1}(\alpha, \Gamma), \Gamma)$$

Where: $p^{*,1}(\alpha, \Gamma) = \Phi_1(p^{*,1}(\alpha, \Gamma))$. $\kappa \in [0, 1]$ is the share of banks in the system among all buyers

RESULTS







CONCLUSION

Methodological contributions

- A common framework for assessing multiple contagion channels was developed.
- Impact of a contagion channel can be measured in isolation or jointly with others.
- The framework allows accounting for general shocks and correlated exposures.

Empirical results

- Asset fire sales were found to be the most important channel by far.
- Contribution of different channels is rather stable over time.