This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 740322

Simulating the effects of cyber-attacks on critical sectors: the Case of finance

November 6, 2018

The growing importance of cyber-security in knowledge-based economies has generated concerns about the risks of data integrity, data confidentiality and data accessibility. Moreover, cyber-security is also related to the well-functioning of the infrastructure which is integrated to the Internet.

Statistics on cyberattacks show their increasing numbers. In addition, cyberattacks become more and more sophisticated, which makes it difficult to assess the damages at the firm level and identify the perpetrator. Their high sophistication level also increases complexity in the global costs estimation of such attacks. In this study, we have mainly used two databases: Advisen for cyberattacks and Compustat for financial data of attacked firms.

Figure 1 below shows the evolution of the number of cyberattacks of the used data based for the period 2000-2015.

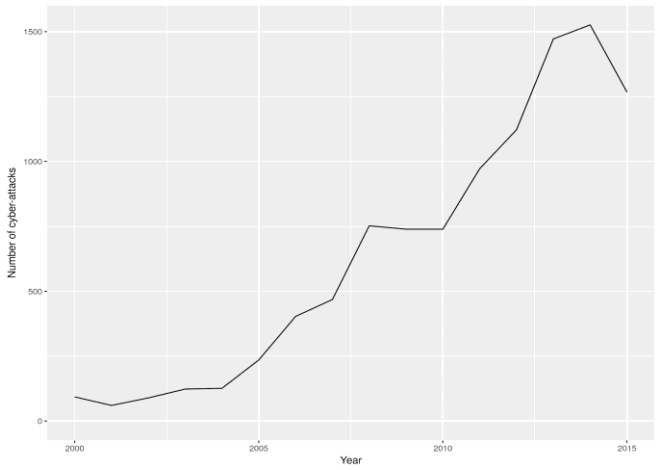

Figure 1: Number of cyberattacks evaluated in this study (2000-2015).

Dynamic Input/Output Model

The methodology used in the first part of this research concentrates on input-output based models. The macroeconomic approach used in this study is based on the Dynamic input-Output Model (DIIM) that uses sectors' interdependencies model based on the Leontief input-output matrix. One of the main assumptions is this model is that the cyberattacks perpetrated in a given sector result in a certain level of *inoperability* that cascades over other sectors through their input-output relationships. *Inoperability*, which varies from 0 to 1, is an indicator of production dysfunction. An economic sector is said inoperable up to a certain level if, in the post-disruption state, it does not function as it was originally forecast. An inoperability level of 1 means that the whole economic sector is not functioning at all and 0.5 means that the production level of this sector is decreased by 50%. Figure 2 pictures the cascading effect of a cyber-attack on a firm from the sector 1to other industries based on their input-output interdependencies. In this study we used the World Input Output Database that contains the input and output coefficients of 56 sectors in 43 countries and a model for the Rest of the World. We carried out several simulations with different scenario-based inoperability levels. Global estimates of the costs of cyber-attacks are thus provided by combining the direct losses that are associated both inoperability levels and the intangible losses that also may partly depend on inoperability. In this blog post we are only presenting our results obtained with 40% of inoperability starting from finance and ICT sectors in the US.

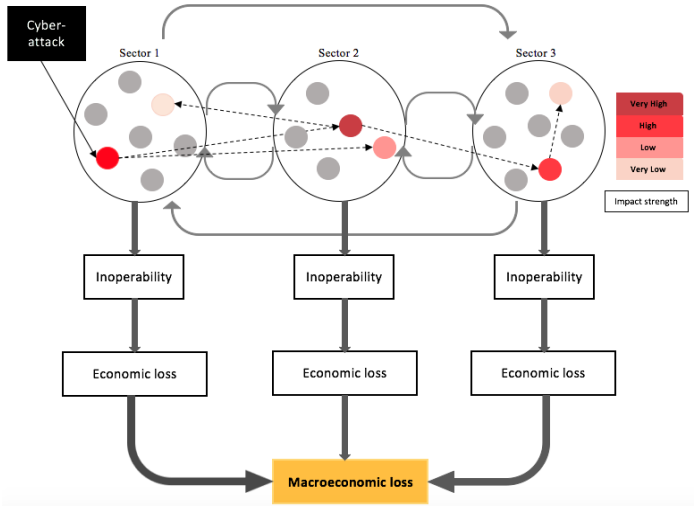

Figure 2: Modelling cyber-attacks with cascading effects.

Simulating the impact of 40% inoperability in finance and ICT

The macroeconomic results reported here are concentrating on two sectors from which cyber-attacks originate: the finance sector and the ICT sector. Given data constraints, such losses are mainly estimated on the US and the UK. As expected and based on scenario-specific parameters, there are cascading effects of cyberattacks resulting from sector inoperability. In the US in 2013, the most (top five) critical sectors affected by cyberattacks that hits the ICT sector, the most affected sectors in terms of economic losses are the ICT, the motion picture, video and television program production and followed by the legal and accounting activities sector.

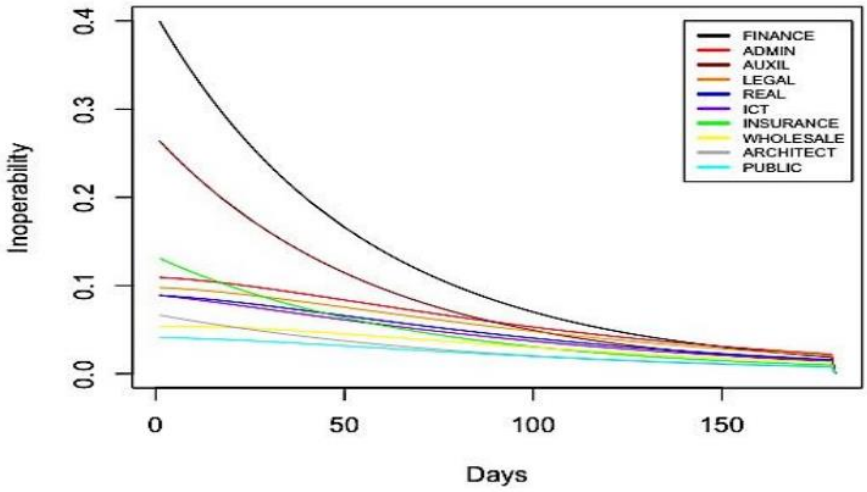

Figure 3: Evolution of inoperability for the top-ten affected sectors, initialinoperability = 0.4 (US, Finance, 2013)

The inoperability of 40% in the finance sector which starts by a cyberattack also affects other sectors, the resulting inoperability is shown in Figure 3. The order in the legend is the descending order of the other touched sectors. Figure 4 shows the evolution of the economic loss (US $ in millions) across ten affected sectors due to an initial inoperability of 40% in the finance sector in the US.

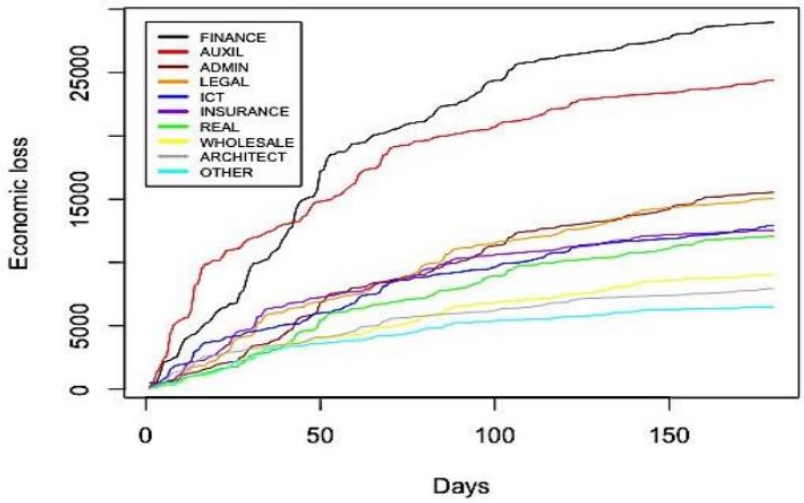

Figure 4: Evolution of economic loss for the top-ten affected sectors, initial inoperability = 0.4 (US, Finance, 2013) - USD $ in millions

Acknowledgement: This is the first of a set of blog posts which summarize the main findings of the work led by Professor Ahmed Bounfour, European Chair on Intangibles, Université Paris Sud, on the evaluation of the impact of cyberattacks on intangibles both at the firm and macro levels. This scientific work is conducted within the EU H2020 Project HERMENEUT (Enterprises intangible Risks Management via Economic models based on simulatioN of modErn cyber-aTtacks) : www.hermeneut.eu

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