The effects of cyberattacks on intangibles of firms

November 6 2018

Firms' intangibles represent on average 80% of their assets. In case of a cyberattack, such intangibles have a high probability of being harmed, hence of inducing financial losses to the firm. In this third blog post on the economic evaluation of the impact of cyberattacks, we summarize our studies on the impact of cyber-security events on firms' intangible assets. To this end, we value intangible assets using a residual method. This study consists of three steps as follows:

1. Construct a counterfactual panel of not attacked firms to assess the losses on intangibles that occur after a cyber-breach;
2. Use the event study methodology to assess the damages on the financial market;
3. Use a Natural Language Processing (NLP) analysis on press releases right after the data breach to assess the percentage of loss suffered by each category of intangible.

Firms' intangibles

The HERMENEUT taxonomy of intangibles shown in Table 1 is developed with experts in cybersecurity and in intangible assets. Accordingly, in the last step we estimated by splitting the economic loss with respect to different intangible assets.

Intangible	Description
IPR	Firms' existing copyrights, patents, IP in progress internally etc.
Innovation	Firms' trade and business secrets, industrial process, on-going R&D, new product and services, business models
Key competence and human capital	Firms' personnel key technical and business competences, firms' personnel soft skills, organizational knowledge, learning capabilities, etc.
Organizational capital	Firms' digital supported process, non-digitised functional and interfunctional processes, firms' strategic capabilities, royalty, coperation and commercial agreements
Reputation	Organizatin reputation with clients, stakeholders and firms' ecossytems. Reputation of managers and employees. Cyber-thrustworthiness.
Brand	Brand value with customers, stakeholders and firm/organisations' ecosystem, brand reputation.
Data	Data on clients, on personnel, on business ecosystem etc.

Table 1: HERMENEUT taxonomy of intangible assets.

Results

Intangibles are valued for all firms in our sample from 2000 to 2014. In general, the value of intangible capital of firms grows each year. For example, Pfizer Inc. has a value of intangibles that has grown from 2002 to 2014 and that amounts up to US $600 billion in 2014.

We created for a counterfactual analysis a panel of firms that are not attacked. This approach seeks to estimate the impact of a cyberattack on intangibles by obtaining the difference of attacked vs. non-attacked firms intangible evaluation. Sector loss results are reported on and split by a year from 2009 to 2012. We conclude about the high level of losses that are observed in our sample. For example, losses on the healthcare sector are high in 2011 and amount almost US $50 billion for firms in our sample. The last figure shows the losses on intangibles per sector in 2009 (top-left), 2010 (top-right), 2011 (bottom-left) and 2012 (bottom-right).
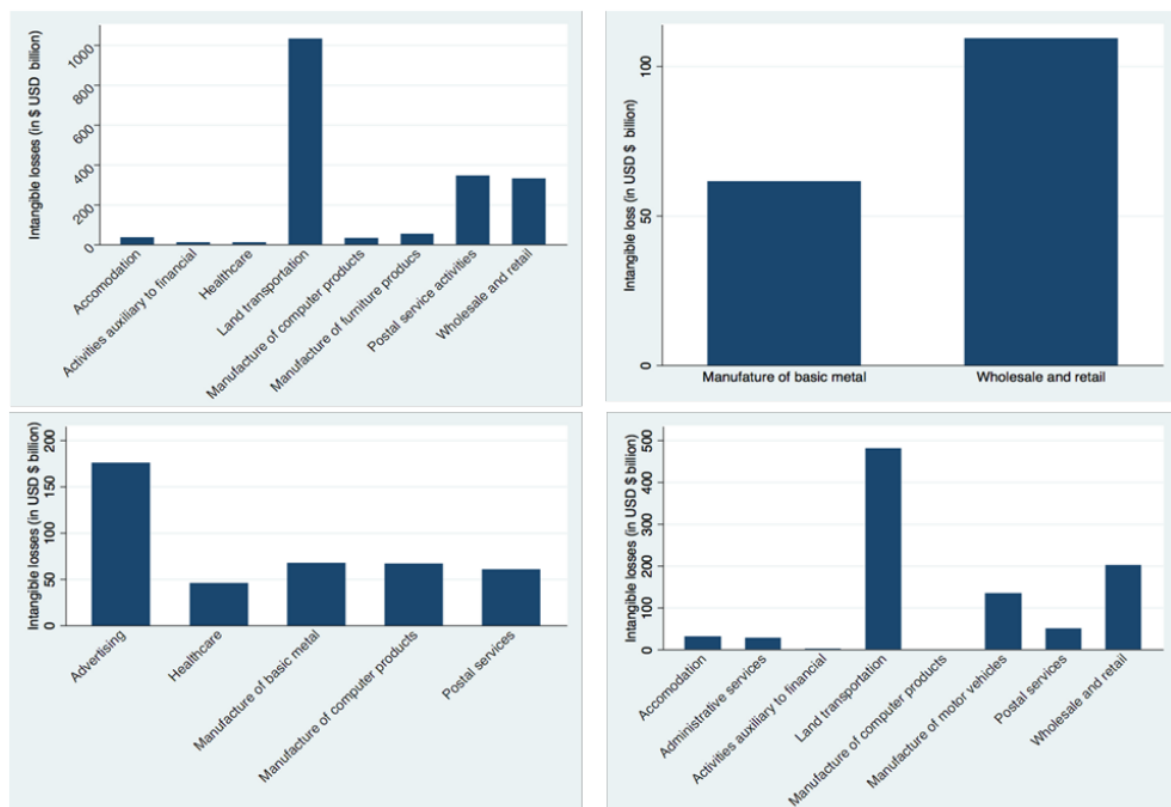

Figure 1 : Intangible asset losses for different sectors, 2009 (top-left), 2010 (top-right), 2011 (bottom-left) and 2012 (bottom-right).

In the last step we have split the loss with respect to different intangible assets in order to understand how firms' intangible assets are affected in different sectors. This aims to refine cyber insurance policies regarding firms' intangible assets. In order to estimate the impacts of cyberattacks for different intangible assets in different sectors we use natural language processing (NLP) approach that uses a lexicon developed by Bounfour et al. (2017). This lexicon categorizes words by types of intangibles and we process press releases like it is made for sentiment analysis. In this approach, it is common to use a specific lexicon which categorizes words and count the words thus categories to understand the content of a text automatically. In this study we have used press releases which are provided by the VERIS database. Our final sample comprises articles, which are treating 133 cyberattacks published in the press. The category of intangibles affected by cyberattacks varies from one sector to another. The result of the splitting the effects of a cyberattack according to the firms' intangible assets are shown in Table 2. Results are aggregated into four different sectors. In this last part we used a concise HERMENEUT taxonomy of intangibles, we have combined the IPR and Innovatoin in IP and included Reputation and Brand in Organizational Capital.

	IP	Key Competence	Organization Capital
Finance and Insurance	13.6 %	45.3 %	41.1 %
Healthcare and Social Assistance	14.7%	63.3 %	22.0 %
Information	27.5 %	27.8 %	44.7 %
Professional Scientific and Technical Services	6.1 %	53.7 %	40.2 %

Table 2: Splitting the loss into three distinct intangible assets in four different economic sectors.

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