

# Impact of Covid-19 Outbreak on Performance of Indian Banking Sector

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## Abstract

The COVID-19 pandemic adversely impacted various industrial sectors of India as well as other countries across globe. In India, impact is resulting to a negative growth rate in economy. Many sectors were performing good before the pandemic but now they have been pulled down by this pandemic. So, it is very much required to analyze and cater the data about those sectors which are badly impacted by pandemic, these sectors play vital role in Indian economy. One of the most important sector of Indian economy is banking sector which is responsible for all the financial activities going on in the country and working as a supporting hand to all of the industries in term of financing, credit, transactions, collection and payment and so on. There are so many reports containing numerous data are in public domain stating the effects of this virus pandemic. The data is not only in physical form but also it is scattered in various format over the internet. Though the data amount is enormous, the major problem is to get the appropriate data according to the user needs. The databases available online are being regularly updated but these databases are not able to provide inference over the knowledge already stored. By using inference capability, we can fetch latent and indirect information out of the knowledge base. Various ontologies for Covid-19 are available online but they do not focus on the performance of banking sector of India during Covid-19. So, many times users do not get appropriate information according to the imposed query. This article attempts to highlight the repercussions of the Covid-19 in the performance of the Indian banking sector by creating and evaluating the largest comprehensive knowledge base called ontology (Covid19-IBO) in order to get semantic information, in continuation of the same we address few important research questions with respect to Indian economy.

## Keywords

Large data, Ontology, Indian Banking, Covid-19, Sectors, Evaluation

## 1. Introduction

Indian economy basically depends on the three sectors namely primary sector, secondary sector and tertiary sector and all the three sectors are being majorly supported by banking sector. Banking sector is providing the financial support to all these sectors by disbursing loans, advances, short term credits, issuing letter of credit, bank guarantees etc as its traditional

work. Apart from it the new phase of Indian Banking resembles in work like providing forex support, digital banking, e-commerce, telebanking, e-kiosk and many more. You cannot imagine rapid growing economy without banking support. If banking sector get impacted by any obstacle its consequences will definitely be borne by all these three sectors which are pillar of the Indian economy.

This pandemic appeared as “black swan event” that needs immediate action from government to help resume economic stability through banking channel [1]. Based on approximation about recovery time from this global pandemic various economic tools are pointing out towards global economic depression of different dimensions. Covid-19 has affected the economy of India at that time when the growth rate of the country was at lowest in last 10 year. In the recent past, Indian

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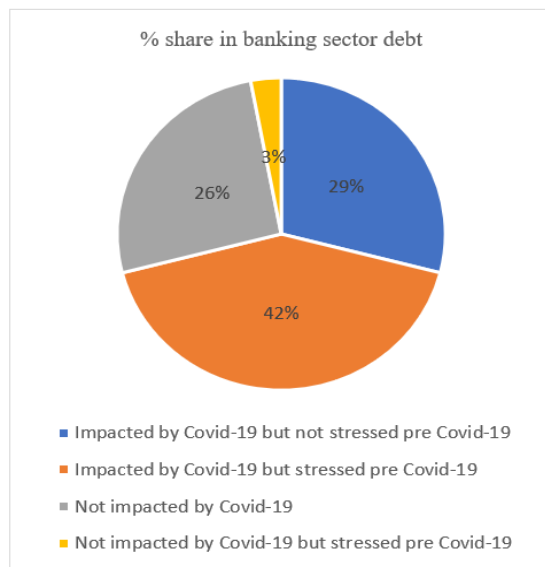
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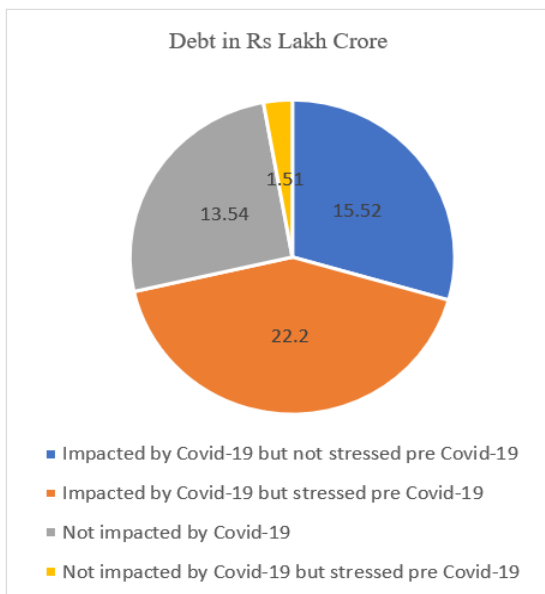


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economy was trying to get on the track by recovering with a slow rate. However, due to this pandemic the recovery process is severely impacted. As in last two quarters India has facing negative growth in GDP. The Indian economy was already suffering even before the Covid-19 outbreak, but Covid-19 outbreak resulting it worsen more. In a recent report published by the RBI (India's central bank) states that this virus has impacted better companies, organizations and businesses that were performing well before this pandemic.



(a)



(b)

**Figure 1:** (a) % share in banking sector debt  
(b) debt in Rs lakh crore (Source: data taken from [2])

Now, Banks have to minimize the risk and use the high risk-averse strategy to restructure loans, provisioning bad debts due to less risk appetite, Indian banks have already suffered severe losses in past restructuring attempts. The same report indicates that 19 sectors are been adversely impacted by this pandemic resulting the stress of debt having value Rs 15.5 lakh crore which were not under the stress before this virus outbreak [2]. Fig 1 (a) and (b) shows the adverse impact on % share in banking sector debt and debt in Rs lakh crore respectively.

Therefore, investigation of the impact of Covid-19 from the large amount of distributed data is very vital to prevent the downfall of the economy and the minimize the pandemic effect. It is also essential because this study will be used as a touch bearer in future if any of the pandemic impacts like Covid-19. This paper offers the Covid19 impact on Banking ontology (Covid19-IBO) that provides semantic information about the impact of the Covid-19 on the banking sector of India. The major contributions of the paper are listed below:

- Development of Covid19 Impact on Banking ontology (Covid19-IBO)
- Evaluation of the Covid19-IBO by different evaluation approaches

The rest of the paper is divided into six sections. Section 2 describes existing work. Section 3 discusses some research questions that is handled by developed ontology. Section 4 shows the development and evaluation of the Covid19-IBO. Section 5 emphasizes the result and discussion of the proposed work. Section 6 shows the results of subjective testing and last section concludes the paper.

## 2. Literature

Covid-19 pandemic adverse impact the Indian economy. To control the flow of the virus, GoI announced a nationwide lock down and various policies to help the people. Dev and Sengupta [3] have analyzed the economic condition of the India before the Covid-19 along with policies that has been declared so far and potential effect of the shock on several part of the Indian economy. Rakshit and Basistha [4] have wrote an article about economic effect of the outbreak in India by considering outbreak as a man-made disaster i.e. human tragedy. They addressed three important research questions: the effect of Covid-19 on the Indian economy along with the detailed analysis of the different sectors that suffered from Covid-19, the effect of Covid-19

on the bilateral trade relationship between China and India, the performance of health system during this pandemic. Kanitkar [5] demonstrated the economic loss of India during Covid-19 by using a linear I/O model and results shows that the loss is about 10-30% of its GDP. The author has also focused on the emission of CO<sub>2</sub> from the power sector and electricity supply, demand. Demircuc-Kunt et al. [6] have analyzed the effect of the Covid-19 outbreak on the banking sector by discussing the bank stock prices all over the world along with examine the role of financial policy by using global databases for the performance of bank stocks.

The Covid-19 data is available on the internet in various format. WHO provides multilingual Covid-19 database that updates regularly and contains all the information about Covid-19 [7-8]. Kousha and Thelwall [9] provided the access of the coverage of scholarly databases and impact indicators from the period of 21.03.2020 to 18.04.2020 so that people can identify the important new studies quickly from Covid-19 publications like news, tweets, citations, facebook, databases and many more places. To respond effectively to emergencies like public health, we need to share the information across various disciplines and IT systems [10]. This is the place where ontologies offer excellent services and overcome the problem of interoperability. Along with the databases, various ontologies also have been developed in order to exact the hidden and semantic information. Dutta and DeBellis [11] have published the ontology as a data model namely COviD-19 ontology for case and patient information (called CODO) on the web as a knowledge graph that provides the information about the Covid-19 pandemic. The primary focus of the CODO ontology is to describe the Covid-19 cases and Covid-19 patient data. Infectious Disease Ontology (called IDO) is an interoperable ontology that contains the domain information about infectious disease where entities are related to the clinical and biomedical aspects of the disease [12]. The extension of the IDO and Virus Infectious Disease ontology (VIDO) is called COVID-19 Infectious Disease Ontology (known as IDO-COVID-19) and contains the information about the Covid19 disease and SARS-CoV-2 virus [13].

The available different format of data (text documents, video, audio, databases and ontologies) contains the detailed information about the Covid-19 disease. After studying the

literature, we claim that the available databases and ontologies that provide information according to the user queries do not have the complete information about the impact of Covid-19 on Indian banking sector that play vigorous role in the growth of Indian economy.

### 3. Research Questions

By the current article, three important research question are addressed that are listed below:

**RQ1.** What are the necessary steps to minimize the loss to banking sector by Covid-19 pandemic?

In current situation by the cause of outbreak of this virus pandemic, Indian banks need to review the portfolio in asset and liability side, for all the discussed cases to easily grasping the negative effect. This present economic situation warns more stress evaluation that might show straight implications for settlement that are make by Indian Banks for current time. Finding the high-risk sectors/areas/corporates/individuals and re-evaluating the credit risk provisions related with loan for various economical cases is inevitable.

**RQ2.** What are the major challenges for Indian banking sector during Covid-19?

During the virus pandemic, major production units were closed or partially working. Entertainment, Aviation, Tourism industries are badly impacted. Due to the same liquidity in market needs to increase with keeping an eye to lowering down the NPA. This is major challenge for banking industry. For the same, RBI has infused liquidity of about 3.2 % of GDP in the system. Now banks can lend to reconstruct / support badly impacted industries but taking a lighter risk. Right now, many SMEs and MSMEs are bound to shut down their operations, surely it is indicating towards increasing of loan default cases. Though as a cushion RBI has allowed moratorium period, it is not enough to meet the requirement of industries. Hence RBI has to make all efforts to meet the challenges and take the banking industry in right direction.

**RQ3.** How much Indian banking sector prepared for effects of Covid-19 on economy?

Preparation of Indian banking sector lies on sustainability of this virus in a long-time span, it also depends on nature as well as intensity of the

shocks given to economy. In current pandemic time, future of banking sector depends mainly on designing the policy and their implementation now. RBI's proactive approach and stabilizing role is need of hour. However, RBI mainly tried to reduce the repo rates and increase the liquidity in economy. By pumping fund in the banking system without proactive assessment fiscal measures for fulfilling the demands will surely contribute in increasing the NPAs. The latest report of CRISIL indicates that banking industry will suffer with an increase of 11.5% in bad loans by March next year. This may cause uncertainty in banking industry resulting "discouragement in consumption as well as the invested corpus required for pushing quick recovery in economy." We may have a huge surplus of money due to supply of funds to maintain the liquidity and this large corpus may remain underutilized by the households organizations and industries due the pandemic effect. How long we face the same situation in future? Only time knows, but it is astonishing whether, without demand being assessed, these policies will ever be enough, though they have some relaxing effects in short run.

## 4. Development of Ontology

This section focuses on the ontology development and its evaluation followed by key information about data collection.

### 4.1. Creation of ontology

Ontology is a knowledge representation scheme that encode knowledge in the form of classes, relationships, properties or features or attributes, instances or individual and axioms [14]. Ontology helps to infer the implicit domain knowledge as like human does, which cannot be achieved using conventional Database, using domain specified rules. In case of database, we will define all the relations manually for every instance. Therefore, Database does not provide hidden information automatically until it is not defined. Although rules are also available in the database but it is limited whereas redundancy in RDBS can be reduced using normalization process but cannot be removed and ontology provides 0% redundancy due to its hierarchical nature. Therefore, ontology is used in various applications to structured real-life data [15]. Covid19 Impact on Banking Ontology

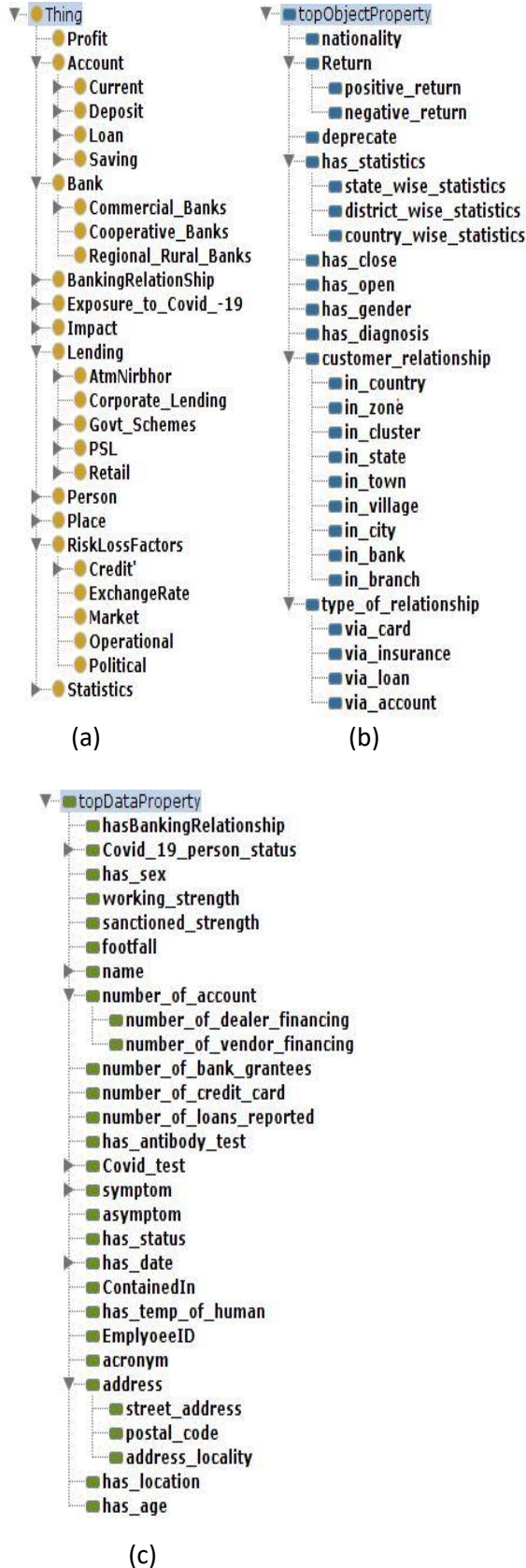
(Covid19-IBO) represents the accurate knowledge in the domain of banking sector of India and the knowledge storage is complete, continuous, easily accessible and readable. Covid19-IBO contains a structured knowledge of Indian banking sector. This knowledge is reusable according the need of user.

Collection of data in a structured manner is an integral phase of the ontology development process. For the development of the Covid19-IBO ontology, we collect the data from different sources (as mentioned below) according to the need of the domain.

- Research articles of conferences, journals and book chapters
- Existing ontology repositories/portals like Bio portal, EMBL-EBI, Agro portal
- Articles on websites (As Wikipedia, blogs, different sites and so on.)
- Covid-19 Databases and ontologies
- Conducting interviews with expert person like doctor and general public.
- Covid-19 Reports, GoI

An ontology is organized in hierarchal manner where every entity is attached with other entities in a parent-child relationship. Data property and object property are the properties contained in ontology to define the relationship between the entities. Use of data property is to relate any individual to a user-defined value while use of object property is to relate the individuals belonging to any class [16]. Covid19-IBO provides light-weight scope of representations that reflects various important and required concepts about the impact of Covid-19 on Indian Banking sector and relations among them. It has knowledge such as schedule and non-schedule bank that can further classified into Indian banks and Foreign banks in the form of concepts with relationships like disjoint, operating etc. By using this information, machines become more capable in inferring much practical and relevant knowledge of past, present and future situation, that will help people by strengthening their decision-making process in a strategic and tremendous manner.

Covid19-IBO stores real-world information into RDF format (Subject-Object-Predicate) that reduce the storage space as compared to other representation scheme. Figure 2 (a), (b) and (c) shows the classification of concepts, object and data properties respectively. All object and data properties have domain and range for example: Axis Bank has\_open Saving Account (Object Property), PNB Bank has\_status NPA(Data Property).



**Figure 2:** Covid19-IBO ontology (a) Classes (b) Object Properties (c) Data Properties

## 4.2. Evaluation

Evaluation of the Covid19-IBO is very important in order to know the quality and content of the ontology. The evaluation of Covid19-IBO ontology determines that ontology is well built and comprises all essential concepts and relationships which are required for the reasoning. Evaluation approaches are categories into two group namely Verification that means Building an ontology correctly and Validation that means building the correct ontology. For the verification, we use Quantitatively (Metric based Approach) and Qualitatively (Criteria based Approach) approaches. To validate the ontology, we use competency questions. We have utilized the Pellet and Hermit reasoners (available in the protégé tool) to check the consistency of the developed Covid19-IBO.

- **Quantitatively:** We evaluate the ontology quantitatively by using OntoMetric tool [17] which is a metric-based approach. It divides the features into five metrics namely Schema, Instance, Base, Graphs, and Individual axioms. Table 1 indicates the important magnitude of some metrics of Covid19-IBO that shows the richness of the ontology. These magnitudes have been calculated with the help of OntoMetric tool.

**Table 1**

Value of Metrics of the Covid19-IBO

Metrics	Value
Axioms	313
Logical axioms count	137
Class count	105
Object property count	28
Data property count	43
Properties count	71
SubClassOf axioms count	94
SubObjectPropertyOf axioms count	18
SubDataPropertyOf axioms count:	19
Attribute richness	0.409524
Inheritance richness	0.895238
Relationship richness	0.229508
Axiom/class ratio	2.980952
Class/relation ratio	0.860656

- **Qualitatively:** We evaluate the ontology qualitatively by using Ontology Pitfalls Scanner (OOPs) tool [18] which is a criteria-based approach. OOPs shows the pitfalls or error by determining Consistency, Conciseness,



Completeness, Correctness and Clarity of the Covid19-IBO under the three categories namely minor (not very serious pitfall), important (not critical pitfall but it is important to correct it) and critical (need to remove this pitfall) pitfalls.

Results for P04: Creating unconnected ontology elements.	8 cases   Minor
Results for P08: Missing annotations.	176 cases   Minor
Results for P10: Missing disjointness.	ontology*   Important
Results for P11: Missing domain or range in properties.	68 cases   Important
Results for P13: Inverse relationships not explicitly declared.	28 cases   Minor
Results for P22: Using different naming conventions in the ontology.	ontology*   Minor
Results for P30: Equivalent classes not explicitly declared.	2 cases   Important
Results for P41: No license declared.	ontology*   Important

**Figure 3:** Pitfalls that has been removed

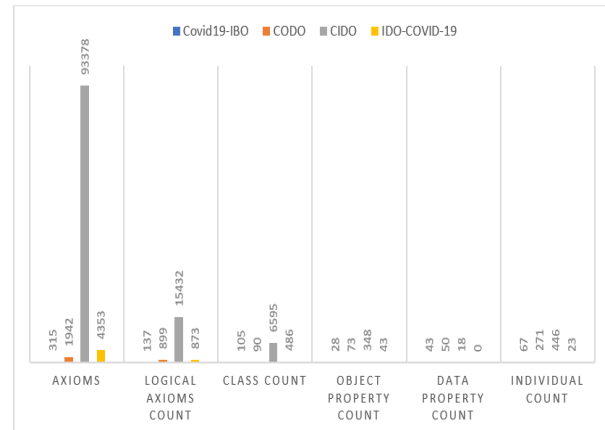
Figure 3 shows all the pitfalls that are calculated by OOPS! tool [18] and these pitfalls need to be removed from the ontology. We have removed all the minor and major pitfalls of the Covid19-IBO ontology by enhancing it. Covid19-IBO has no critical pitfalls as shown in figure 3.

- **Competency Questions:** We validate the ontology by writing competency questions that provides better understanding of the scope and objectives of the Covid19-IBO and helps to build the correct ontology according to the user's need. Some selected competency questions are mentioned below:
  - What is state wise rise in NPA during Covid-19 pandemic?
  - How many corporate accounts has been closed during Covid-19 pandemic?
  - What is sector wise depreciation rate in credit repayment during Covid-19 pandemic?
  - Which bank and sector suffered most by this pandemic?
  - How many bank employee's loss their job during pandemic?
  - How many new accounts, loans, credit cards are being issued from starting of the pandemic?

## 5. Result and Discussion

The available ontologies namely an ontology for collection and analysis of Covid-19 data (CODO), Coronavirus Infectious Disease Ontology (CIDO), and COVID-19 Infectious

Disease Ontology (IDO-COVID-19) do not contain the complete information about the impact of Covid-19 on Indian banking sector.



**Figure 4:** Matrix value of ontologies namely Covid19-IBO, CODO, CIDO and IDO-COVID-19

Figure 4 shows the value of different metrics of available ontologies as compared to Covid19-IBO. Although in some cases available ontologies have more matrix values as compared to Covid19-IBO yet our developed ontologies are sufficient in order to provide the complete and precise information about each question which are related to the impact of Covid19 on Indian banking sector. Figure 5 depicts the number of common entities of available ontologies as compared to Covid19-IBO.



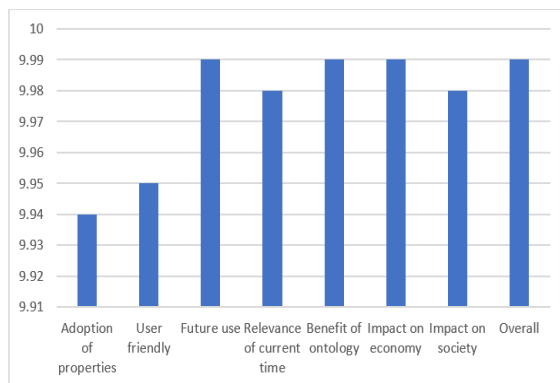
**Figure 5:** Number of common entities of Covid19-IBO of available ontologies

## 6. Subjective Testing

To test our approach, we have adopted subjective testing suggested by industry experts. Several important parameters namely Adoption of properties (as compared to existing ontologies), User friendly (How easily user can adopt), Future use (How ontology can be used in future viz vaccination process), Relevance of current time (Referring to the current situation of Covid-19

pandemic), Benefit of ontology, Impact on economy and Impact on society (How this ontology can be used by students, research scholars, professionals, Industry personnel etc) has been considered for the rating of this ontology by the users on the scale 1 to 10 where 1 stands for not at all satisfying these parameters and 10 for best possible satisfaction.

Thirty-nine users participated in the subjective testing by filling the google form. Among the thirty-nine users, the eighteen are female and twenty-one are male. The average age of the participant is 28.05 whereas minimum and maximum age of participants are 21 and 52 respectively. The participated users belong to different occupation like faculty, engineers, students and scholars etc. Users have also provided additional comments over the developed ontology like very useful, incorporate all the facts of the Indian economy, ontology is very much required in order to analyze the impact of Covid-19 on Indian banking sector and so on that shows accuracy and importance of Covid19-IBO ontology. The user's results are shown by the figure 6 on the basis of the different parameters that suggested by experts.



**Figure 6:** Ranking of Covid19-IBO

## 7. Conclusion and Future Work

The positive economic growth of any country reflects the financial soundness and increased purchasing power of that country. The Covid-19 pandemic destroyed the growth of the various economic activities in countries so India as well. Banking sector plays vital role in supporting the economy of the country by maintaining liquidity. In order to know the impact of Covid-19 on the Indian banking sector, we have presented Covid19-IBO ontology by analyzing existing data that available in different format.

The developed Covid19-IBO ontology has been evaluated by three approaches namely competency questions, OntoMetric tool and OOPs pitfall scanner that shows completeness of the Covid19-IBO. We have also compared the Covid19-IBO with other accessible and available ontologies of Covid19 and infer that the existing ontologies are not able to provide complete and concrete answer of the question about the Indian banking sector.

The future work of this paper is focus on the development of the widget that offer semantic services like visualization, annotation, mapping etc. We will also publish the Covid19-IBO on linked open data (LOD) for better accessibility and reusability.

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