Evaluating Chinese GDP Growth using the Keqiang Index

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While Chinese GDP growth has undoubtedly been impressive, there has been much skepticism with regards Chinese economic data reporting. To address this somewhat, Premier Li Keqiang created the Keqiang Index (comprising 40% of both bank loans and electricity consumption growth along with 20% of rail freight growth) in order to better proxy economic growth in China. In this paper, we use the Keqiang Index to evaluate Chinese economic growth by comparing the Keqiang Indices of other Southeast Asian countries to China's Keqiang Index. We consider the accuracy of Chinese economic figures and find that China seems to over-report its economic growth data. Additionally, we found a slowdown in Chinese economic growth in recent years.

1   Introduction

Since the establishment of the People's Republic of China, there has been much skepticism of official Chinese economic data. For example, Economist Thomas Rawski pointed out that between 1997 to 2000 official Chinese figures state that Chinese real GDP grew by 24.7%, whilst energy consumption decreased by 12.8% [7]. This seems highly unlikely as China was industrializing at that time. To further highlight this discrepancy, Rawski compares this data with other Asian countries' energy use and shows that in each case, energy usage has grown in parallel with real GDP [7]. Recently, China's National Bureau of Statistics reported that the economy grew 8.1% for all of 2021; This would be the fastest GDP growth in a decade [8]. Compared to the US's mere 3.8% GDP growth and China's 2.2% growth in 2020, the numbers do not seem to correlate [8]. This data falsification is believed to occur, according to economist Carsten A. Holz, in rural areas because leaders tend to only want good news as they are solely evaluated by the economic performance of their area of management [7]. To combat this issue, many Chinese companies or politicians create their own measures of Chinese GDP, such as skeptic and premier Li Keqiang with his Keqiang Index.

In a document released by Wikileaks back in 2010, in 2007 then-head of the Chinese Communist Party in northeastern Liaoning told then-U.S. Ambassador to China Clark Randt that he only "focused on just three data points to evaluate Liaoning's economy: electricity consumption, rail cargo volume, and bank lending." [9] "By looking at these three figures [one could] measure with relative accuracy the speed of economic growth. [Whereas all] other figures, especially GDP statistics, are for reference only," according to Li [9]. In a similar vein, the Keqiang Index, created and used by the 7th Premiere of the People's Republic of China Li Keqiang, is a measurement of Chinese economic growth which is comprised of the annual growth rate of outstanding bank loans (weighted 40%), electricity consumption (weighted 40%) and rail freight (weighted 20%) [6]. The Keqiang Index is much more volatile than China's official GDP, but that would be expected as it only includes three factors [6]. Li Keqiang claims that this index can reliably measure the speed of economic growth compared to Chinese GDP figures.

Bank loans have always been a concrete way of measuring money supply - increased money supply results in higher rates of production and manufacturing, and vice-versa. Because the Chinese economy is based on manufacturing, the country uses much electricity; Electricity consumption is a great factor in measuring economic activity as changes in output tend to correlate with changes in electricity usage and also can be easily verified by sources without relation to the Chinese government [7]. Similarly, rail freight can also easily measure economic activity. China

has the busiest railways on the road and has well-developed rail infrastructure, and slowdowns in railway freight can signal a slowdown in the economy. This index allows anyone with access to data on these factors to measure Chinese economic activity. Researchers John Fernald, Israel Malkin, and Mark Spiegel used the Keqiang Index to verify Chinese GDP figures from 2000 to 2009 and then to predict China's GDP from 2009 to 2012 [7]. They found no major discrepancy in the relationship between GDP and the Keqiang Index, including during the 2009 to 2012 global slowdown, offering some validation of the Chinese figures [7]. In this paper, we repeat such an analysis, but with regards to other Southeast Asian countries reliant on manufacturing to better understand whether skepticism of Chinese GDP figures is warranted.

As we evaluate Chinese GDP, we also note that since around 2010, China has been slowly shifting towards a service economy. Journalist Peter Cai from the Lowly Institute notes, "At the end of 2015, the services sector accounted for more than 50% of GDP. Over the same period, the manufacturing sector dropped to 41% of GDP." [2] As such, the use of the Keqiang Index is better suited for the pre-2010 period as compared to the post-2010 period. However, we will still apply such analysis to post-2010 years as a weaker proxy for GDP growth.
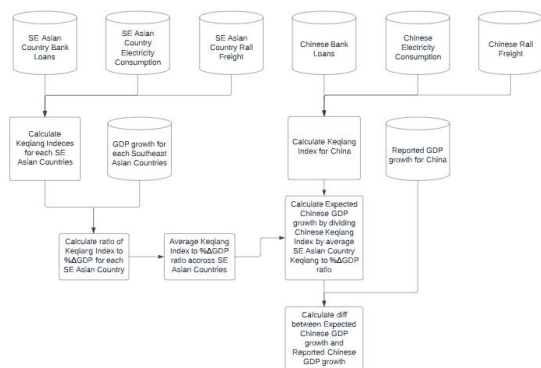
2   Methodology

Figure 1: Flowchart representing our methodology for verifying Chinese economic growth data using the Keqiang Index.

We expect that the Keqiang Index to %ΔGDP ratio between industrializing countries reliant on manufacturing and exports to be about the same. Therefore, we selected three Southeast Asian countries (Indonesia, Bangladesh, and Vietnam) with these characteristics to compare against China. For these countries, we were able to gather outstanding bank loans, electricity consumption, and annual rail freight data to construct Keqiang Indices. We then used their reported GDPs to construct the Keqiang Index

to %ΔGDP ratios for these SE Asian countries.

Table 1: Keqiang Index to %ΔGDP Ratios of SE Asian Countries.

Year	Bangladesh	Indonesia	Vietnam
1996	2.713811528	1.673240269	1.361312767
1997	1.747646689	2.247886689	1.582593906
1998	3.274421385	-0.7760026179	1.917287151
1999	2.094238606	11.88999257	2.627109854
2000	1.547608375	2.006177998	3.130086413
2001	3.92369688	2.383169581	2.757856393
2002	2.368922032	1.571493423	1.777348437
2003	1.821966097	1.535254627	2.964558181
2004	2.403207898	2.02204347	1.720076895
2005	1.478809618	2.116930712	2.23972443
2006	1.787358422	1.307608729	2.376551723
2007	0.975028462	2.178339064	2.201387243
2008	2.546983566	3.253316777	2.653339976
2009	1.624402384	1.682466417	3.878138431
2010	2.126234955	2.378207697	2.60195464
2011	1.723308144	2.5458456	1.615062026
2012	1.053985921	2.502544853	1.37021208
2013	0.5142076344	2.847487403	1.585031244
2014	2.586771923	1.350356408	2.028121663
2015	1.280738472	1.516806353	1.645300704
2016	3.276938518	1.165584266	1.105786472
2017	1.828754938	2.490893953	1.890307141
2018	1.305812071	1.624420622	1.767825233
2019	2.60477386	1.18779605	1.576504641
Avg. Error	2.025401182	2.279244205	2.098894068

At this point we validated that the Keqiang Index to %ΔGDP ratios of the SE Asian countries chosen were about the same through time. We notice that on average, the Keqiang Index to %ΔGDP ratios of the SE Asian countries was about 2.0-2.2 between the years of 1996 and 2019 inclusive. Therefore, we expect China to also follow this ratio as well, at least for years when China was industrializing and relied heavily on manufacturing for most of its economic activity.

To check this, we gathered outstanding bank loans, electricity consumption, and annual rail freight data for China in order to construct a Chinese Keqiang Index. From there, we divide the Chinese Keqiang Index by the average of SE Asian Keqiang to %ΔGDP ratios in order to generate an Expected Chinese GDP growth rate. We compare this Expected Chinese GDP growth rate to the official Reported Chinese GDP Growth rate to check whether Chinese Economic Growth data is accurate based on the Keqiang index.

2.1   Sources of Data

Data on individual countries' outstanding bank loans was found in the FRED (Federal Reserve Economic Data) database.

Data on individual countries' electricity consumption was found through DataCommons [3].

Data on individual countries' GDP growth and rail freight were found in the World Bank database [1].

Information regarding the Keqiang Index was found in an article by The Hedge Fund Journal [5]. This article

gives a quick synopsis of the Keqiang Index and directly compares the Chinese Keqiang Index to its reported GPA and a variety of other important graphs.

3   Results and Discussion

Table 2: Reported GDP growth minus expected GDP growth per year using the Keqiang Index.

Year	China	Bangladesh	Vietnam	Indonesia
1996	5.250%	-1.873%	2.693%	0.989%
1997	5.255%	-0.388%	1.221%	-0.982%
1998	3.153%	-5.256%	-1.755%	-20.006%
1999	6.098%	2.695%	2.523%	-0.918%
2000	1.702%	1.757%	-2.753%	0.488%
2001	4.884%	0.165%	0.541%	0.761%
2002	6.220%	-2.042%	0.425%	0.790%
2003	-2.465%	0.204%	-2.807%	1.303%
2004	6.586%	-2.426%	1.202%	0.064%
2005	5.821%	1.406%	-1.136%	-0.503%
2006	5.249%	-0.258%	-2.121%	1.557%
2007	6.327%	3.822%	-1.657%	-1.389%
2008	6.715%	1.481%	0.333%	-0.927%
2009	2.423%	1.202%	-3.344%	1.369%
2010	4.356%	-0.234%	-0.630%	-0.025%
2011	3.721%	0.789%	1.130%	-1.847%
2012	2.869%	2.649%	0.911%	-3.143%
2013	2.634%	4.098%	0.217%	-4.071%
2014	4.753%	-2.486%	-0.128%	1.604%
2015	4.065%	0.460%	-0.777%	-0.119%
2016	3.090%	-4.594%	2.694%	1.849%
2017	2.316%	0.151%	0.599%	-1.037%
2018	-0.386%	0.713%	-0.928%	-0.194%
2019	0.504%	2.952%	0.858%	1.682%
Avg. Error	3.797%	0.208%	-0.112%	-0.946%

In 1998, Indonesia had an error of -20%, which is significant. To address that issue, we looked at the reported GDP growth then, which was a whopping -13.1%. During 1998, there was a period of political unrest that led to the resignation of long-lasting dictator Suharto, explaining the dip in GDP growth. Therefore, we believe that 1998 in Indonesia is an anomaly in terms of the relationship between the Keqiang Index and GDP growth.

After compiling all the data, we predict that official Chinese GDP figures have over-reported their data by an average of 3.797% between 1996 to 2019 inclusive. This is significant; for reference, the U.S grew 2.3% in 2019. To verify our data, we calculated the average error of the chosen Southeast Asian countries and found that the average error of each selected country was under one percent.

Because the average errors of Bangladesh, Vietnam, and Indonesia are all under one percent, we expect that Bangladesh, Vietnam, and Indonesia have been reporting their economic growth relatively accurately. Consistent with skepticism of Chinese Economic Growth data, our analysis shows that the Chinese economic numbers are inflated.

Given our previous assertion that China has been moving towards a service-based industry, especially since 2010, we also just looked at the pre-2010 period and noticed an even bigger discrepancy. From 1996 through 2009, our analysis indicates that China has overstated its GDP growth by about 4.52% a year.

Table 3: Reported GDP growth minus expected GDP growth per year using the Keqiang Index. Truncated to only the pre-2010 period.

Year	China	Bangladesh	Vietnam	Indonesia
1996	5.250%	-1.873%	2.693%	0.989%
1997	5.255%	-0.388%	1.221%	-0.982%
1998	3.153%	-5.256%	-1.755%	-20.006%
1999	6.098%	2.695%	2.523%	-0.918%
2000	1.702%	1.757%	-2.753%	0.488%
2001	4.884%	0.165%	0.541%	0.761%
2002	6.220%	-2.042%	0.425%	0.790%
2003	-2.465%	0.204%	-2.807%	1.303%
2004	6.586%	-2.426%	1.202%	0.064%
2005	5.821%	1.406%	-1.136%	-0.503%
2006	5.249%	-0.258%	-2.121%	1.557%
2007	6.327%	3.822%	-1.657%	-1.389%
2008	6.715%	1.481%	0.333%	-0.927%
2009	2.423%	1.202%	-3.344%	1.369%
Avg. Error	4.52%	0.03%	-0.47%	-1.24%

Table 4: Ratio between Keqiang Index and reported GDP growth per year.

Year	China	Bangladesh	Vietnam	Indonesia
1996	0.90	2.71	1.36	1.67
1997	0.80	2.02	1.58	2.25
1998	0.88	2.96	1.92	-0.78
1999	1.13	2.36	2.63	11.89
2000	1.78	1.49	3.13	2.01
2001	1.25	2.92	2.76	2.38
2002	0.61	2.93	1.78	1.57
2003	2.62	2.02	2.96	1.54
2004	0.71	3.00	1.72	2.02
2005	0.95	1.52	2.24	2.12
2006	1.07	1.89	2.38	1.31
2007	0.99	0.82	2.20	2.18
2008	0.86	2.12	2.65	3.25
2009	1.78	1.82	3.88	1.68
2010	1.40	2.47	2.60	2.38
2011	1.20	1.72	1.62	2.55
2012	1.04	0.97	1.37	2.50
2013	1.09	0.52	1.59	2.85
2014	0.72	2.80	2.03	1.35
2015	0.63	1.38	1.65	1.52
2016	1.01	3.05	1.11	1.17
2017	1.38	2.02	1.89	2.49
2018	1.66	1.41	1.77	1.62
2019	1.64	1.12	1.58	1.19
Avg. Ratio	1.17	2.00	2.10	2.28

There seems to be another discrepancy; In 1999, Indonesia had a Keqiang to reported GDP growth ratio of 11.89. To explain this, we once again took a look back at the reported GDP then and saw that Indonesian data reported 0.8 growth. So when we divided the reported GDP by the Keqiang growth (9.512%), it resulted in an increased number. This means that the higher the ratio is, the less reported

GDP growth/loss there was in that year. On top of that, the opposite applies, meaning that if the average reported GDP change is high (like in the case of China with a change of 8.957%) the ratio will be smaller, further showing skepticism of reported GDP figures.

We also averaged each country's Keqiang to reported GDP growth ratio, and observed that the ratio for China is around 1.2 while the ratio for the other three countries it's around 2.1. This again shows that the Keqiang Index to reported GDP growth ratio is relatively consistent for other manufacture-reliant countries, while it diverges for China (presumably because of overstated GDP growth).

Table 5: Yearly expected GDP growth using the Keqiang Index.

Year	China	Bangladesh	Vietnam	Indonesia
1996	4.673%	6.373%	6.607%	6.811%
1997	3.982%	4.888%	6.979%	5.682%
1998	4.693%	10.456%	7.555%	6.906%
1999	1.564%	2.005%	2.277%	1.718%
2000	6.788%	3.543%	9.553%	4.412%
2001	3.452%	4.935%	5.659%	2.839%
2002	2.914%	5.842%	5.875%	3.710%
2003	12.503%	4.496%	9.707%	3.497%
2004	3.528%	7.626%	6.298%	4.936%
2005	5.574%	5.094%	8.636%	6.203%
2006	7.472%	6.958%	9.121%	3.943%
2007	7.904%	3.278%	8.757%	7.689%
2008	2.936%	4.519%	5.367%	6.927%
2009	6.976%	3.798%	8.744%	3.231%
2010	6.280%	5.834%	7.030%	6.225%
2011	5.830%	5.711%	5.270%	8.047%
2012	4.995%	3.851%	4.589%	9.143%
2013	5.132%	1.902%	5.383%	9.671%
2014	2.673%	8.586%	6.528%	3.396%
2015	2.976%	6.140%	7.777%	5.019%
2016	3.759%	11.694%	4.006%	3.151%
2017	4.631%	6.449%	6.301%	6.137%
2018	7.136%	6.587%	8.128%	5.394%
2019	5.447%	4.948%	6.342%	3.318%
Avg. Expected GDP Growth	5.159%	5.646%	6.770%	5.334%

We also averaged each country's predicted GDP growth to compare economic growth between the four countries and found that all three Southeast Asian countries averaged higher than China. This makes sense, as those three countries are heavily industrial developing economies while China is shifting more towards a service-based economy. Vietnam in particular has an especially high average growth, but that isn't odd. More and more companies have been moving production to Vietnam. David Hutt from DW notes that the reason for this is in part due to lower salaries in Vietnam than in China, and a deteriorating relationship between the EU and China [4].

4   Conclusion

We can conclude that China has most likely overreported its GDP growth numbers, and based on our calculated predicted GDP growth China is no longer industrializing at the rate it once was. This may be a sign that China is soon going to become a developed nation with a service-based economy. However, this does still beg the question: how much of Chinese growth being reported now is based on

economic activity, and how much of it is based on bureaucratic manipulation and to meet central planning targets.

Additionally, we can conclude that for countries with a heavily manufacturing-based economy, the ratio between that country's Keqiang index and reported GDP growth per year should be around 2; This ratio might be useful in the future to evaluate how close other countries, especially third-world countries, in industrializing, or becoming a developing nation, allowing for people/companies to invest in those respective countries. Further research still needs to be done, however, to verify this ratio and see whether or not it is a good way to evaluate economic activity.

4.1   Further Discussions and Implementations

After analyzing expected Chinese GDP growth, we did a little more analysis of each country's average expected GDP growth. We averaged each decade's predicted GDP growth to take a look at growth from a broader view.

Table 6: Average predicted GDP growth per decade.

-	China	Bangladesh	Vietnam	Indonesia
Average predicted GDP growth from 2000-2009	6.01%	5.01%	7.77%	4.74%
Average predicted GDP growth from 2010-2019	4.89%	6.17%	6.14%	5.95%

In the 2000s, China averaged a high 6.01% in growth, normal for a rapidly industrializing country. However, from 2010 to 2019, GDP growth in China dropped down to an average of 4.89%. This is still relatively high but shows signs of a slowdown in rapid industrialization, especially when compared to the other three countries. Bangladesh and Indonesia both have increased in economic growth over the decade, while Vietnam, although having decreased in growth, still remains at high levels of growth. China may be finally at the end of its road as a developing country and finally transitioning to a developed country, with a GDP more influenced by services rather than manufacturing.

But what will happen if China finally becomes a developed nation? From a supply chain perspective, we don't think much will change. Manufacturing will still most likely come from other Southeast Asian countries such as Bangladesh, Vietnam, and Indonesia. The significance of that is that supply chains will still remain one-directional, beginning from Southeast Asia and traveling to developed countries, meaning that global supply chains will still be too volatile, as shown by the COVID-19 pandemic. However, because of the proximity of China to these other southeast Asian countries, this slowdown in economic growth might actually benefit China, as they still retain a nearby manufacturing base while transitioning off reliance on its own manufacturing.

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5 Appendix I: Additional Resources and Process

We noted these datas for China, Vietnam, Indonesia, and Bangladesh (from 1995 - 2019) on an excel sheet

- Outstanding Bank Loans (China, Vietnam, Indonesia, Bangladesh)

- Electricity Consumption (Link used)

- Rail Freight (Link Used - Downloaded excel sheet to see individual countries)

- GDP Growth (China, Vietnam, Indonesia, Bangladesh)

To calculate the Keqiang Indices (for each country), we calculated the rate of change for bank loans, electricity consumption, and rail freight; Then we took 40% of the change in bank loans, 40% of the electricity consumption, and 20% of the rail freight to calculate the Keqiang Indices.

- For gaps in the data:

  - In the edges - we averaged the data from all the dates we had and used that number to fill in the gaps

  - In the middle - we used linear interpolation (we took the last values before and after the gap, averaged the rate of change, and then linearly changed the number each year)

- Here are screenshots of our data so far (for each country) *Note highlighted areas are estimated (see above):

  - China

  - Vietnam

  - Indonesia

  - Bangladesh

We then calculated the ratio of Keqiang Index to % change in GDP, then multiplied that ratio to the Keqiang Index change to predict a country's GDP

- Here are screenshots of these calculations (for each country):

  - China

  - Vietnam

  - Indonesia

  - Bangladesh