The Impact of COVID-19 on the Chinese Economy: Subnational Data and Preliminary Results

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Outline

- **Introduce the CARD COVID-19 Economic Database: China (`https://www.card.iastate.edu/china/covid-19/`**
  - Purposes
  - Data sources and categories
  - Details on data compilation
- **Showcase preliminary results of a multi-region modeling of the impact of COVID-19 on the Chinese economy**

Figure 1: Database website

Main Purposes

- Track and understand COVID-19's impact on China's economy across regions and sectors
- Facilitate quantitative economic modeling of China's economy at the subnational and sectoral level
  - **Mi et al. (2018)**. A multi-regional input-output table mapping China's economic outputs and interdependencies in 2012. *Scientific Data*, 5, 180155. (Data avaialble at figshare)
  - Inter-regional and inter-sectoral economic flows among 30 economic sectors in 30 regions/provinces for 2012
- Facilitate research on COVID-19's global impact via economic linkages with China

China's MRIO Table

- China is a vast country with substantial regional variations
- Most available MRIO models demonstrate inter-country economic relationships
  - Global Trade Analysis Project (GTAP), World Input-Output Database (WIOD), Organisation for Economic Cooperation and Development Inter-Country Input-Output (OECD-ICIO)
- China MRIO tables
  - Previous releases for 30 provincial units and 30 sectors: 2007 MRIO tables in 2012, 2010 MRIO tables in 2014
  - Mi et al. (2018) 30 provinces/cities by 30 sectors for 2012, which is based on the 2012 official China MRIO table (Liu et al. 2018) published in 2018

China's MRIO Table for 2012 (Mi et al., 2018)

- Based on the input-output tables (IOTs) for 30 Chinese provinces that are published by the National Statistics Bureau
- The IOTs demonstrate the economic linkages among 42 economic sectors at the provincial level
- All provincial IOTs were aggregated into 30 sectors to build a time-series MRIO table database for China
- Estimated interregional trade flows from single-regional input-output tables using gravity models
- Inter-regional sector-level input are proportionally assigned, as opposed to real data; in contrast, provincial-sector imports are real data from provincial statistical yearbooks

China's MRIO Table for 2012 (Mi et al., 2018)

- Structure

Figure 2: Structure of the MRIO table 2012 (Mi et al., 2018)

China's MRIO Table for 2012 (Mi et al., 2018)

- Excel Snapshot

China's 2012 MRIO for 30 provinces and 30 sectors

				1 Beijing								
		Unit: 10,000 RMB	Codes	Agriculture	Coal mining	Petroleum and gas	Metal mining	Nonmetal mining	Food processing and tobaccos	Textile	Clothing, leather, fur, etc.	
		Codes	-	1	2	3	4	5	6	7	8	
1	Beijing	Agriculture	1	138923	107	0	7	18	355907	8819	1939	
		Coal mining	2	4356	1951878	0	10037	792	4600	259	828	
		Petroleum and gas	3	0	0	0	0	0	0	0	0	
		Metal mining	4	0	18	0	99085	0	1	0	0	
		Nonmetal mining	5	0	110	0	4152	25186	131	3	0	
		Food processing and tobaccos	6	214316	45	20	296	317	1047562	317	1299	
		Textile	7	122	71	1	111	524	1075	24432	86245	
		Clothing, leather, fur, etc.	8	0	375	33	830	1268	2649	193	67487	
		Wood processing and furnishing	9	2474	191	7	106	180	1424	387	869	
		Paper making, printing, stationery, etc.	10	526	17	10	83	338	15856	68	1225	
		Petroleum refining, coking, etc.	11	8293	401	82	10931	28416	2340	271	1138	
		Chemical industry	12	48122	2382	4	5917	50745	114217	12605	8344	
		Nonmetal products	13	138	786	1	1342	5132	42564	15	275	
		Metallurgy	14	61	159	0	1529	322	74	3	12	
		Metal products	15	6804	1061	4	2308	6830	47062	100	1199	
		General and specialist machinery	16	7220	1583	48	12599	96643	4936	198	1507	
		Transport equipment	17	7310	382	9	2563	9580	492	17	181	
		Electrical equipment	18	0	745	10	2671	3814	833	71	395	
		Electronic equipment	19	0	149	5	257	4559	511	32	432	
		Instrument and meter	20	0	60	17	121	16283	301	2	21	
		Other manufacturing	21	340	311	20	1601	1660	1562	217	1218	
		Electricity and hot water production and supply	22	36622	4924	366	71310	6003	43683	4200	8646	

Figure 3: MRIO table 2012 (Mi et al., 2018)

Timeline and Data Sources

Timeline

- Started in Feb 2020; First published on April 28, 2020; Updated May 22, 2020 for data in April 2020; Will be updated this week for data in May 2020

Data Sources

- Official sources: China's National Bureau of Statistics (NBSC); Provincial bureaus of statistics; Ministry of Transport; Ministry of Agriculture and Rural Affairs

- Search engines: Baidu

- For ag trade data: USDA Global Agricultural Trade System (GATS); USDA Export Sales Query System

Data Structure

- Excel Snapshot

Figure 4: CARD COVID-19 Economic Database: China

Data Categories

- Seven types of data
  - IO sector-level data (Monthly)
  - GTAP sector-level data (Monthly)
  - Province-level data (Monthly, weekly, bi-weekly)
  - Province by IO sector-level data (Monthly)
  - Province by GTAP sector-level data (Monthly)
  - Concordance and sector classification
  - Raw datasets
- Two categories added in May update
  - Industrial and province-level GDP (Quarterly)
  - Agricultural trade (Monthly, weekly)

Type 1: IO Sector-level Data

Table 1. IO Sector-level Cumulative Value-added Growth Rate							GO BACK TO INDEX
Sectors	Codes	2020-04	2020-03	2020-02	2019-12	2019-11	
Coal mining	2	0.6	-0.6	-8.2	5.5	5.1	
Petroleum and gas	3	0.1	1.3	2.1	3.7	3.6	
Metal mining	4	-4.2	-6.9	-14.7	5.1	5.6	
Nonmetal mining	5	-9.3	-16.9	-25.5	0.2	-0.6	
Food processing and tobaccos	6	-3.5	-6.0	-12.7	4.7	4.6	
Textile	7	-10.6	-16.8	-27.2	1.3	1.4	
Clothing, leather, fur, etc.	8	-16.3	-20.3	-28.7	1.5	1.7	
Wood processing and furnishing	9	-12.4	-16.5	-27.6	2.4	2.1	
Paper making, printing, stationery, etc.	10	-10.9	-13.8	-25.7	2.6	2.7	
Petroleum refining, coking, etc.	11	-6.3	-8.1	-7.8	5.0	4.7	
Chemical industry	12	-4.6	-8.1	-15.1	7.0	7.0	
Nonmetal products	13	-7.6	-13.7	-21.1	8.9	8.9	
Metallurgy	14	0.6	-1.7	-5.3	9.6	9.8	
Metal products	15	-7.3	-15.0	-26.9	5.8	5.7	
General and specialist machinery	16	-6.6	-15.4	-26.3	5.6	5.6	
Transport equipment	17	-11.2	-19.9	-30.0	4.6	4.9	
Electrical equipment	18	-5.8	-12.9	-24.7	10.7	10.4	
Electronic equipment	19	1.8	-2.8	-13.8	9.3	8.9	
Instrument and meter	20	-7.0	NA	-27.4	10.5	10.9	
Other manufacturing	21	-16.4	-22.0	-29.7	2.7	3.3	
Electricity and hot water production and supply	22	-3.9	-5.4	-7.3	6.5	6.4	
Gas and water production and supply	23	-3.2	-4.0	-5.8	9.7	10.1	

Figure 5: IO sector-level cumulative value-added growth rate

- Only manufacturing sectors, no agricultural or service sectors.
- Cumulative growth rate:the percentage of increase over a set period of time.

Type 1: IO Sector-level Data

- Raw industry-sector level data from NBSC (Table 19)
- Concordance between IO sectors and industrial sectors in the industrial classification for national economic activities in GB/T 4754—2011 (Table 15).
- We use the average growth rate of all GB sectors that correspond to the IO sector as the growth rate of a specific IO sector.

Table 19. China's GB/T Sector-level Cumulative Value-added Growth Rate

Indicator	2020-04	2020-03	2020-02
煤炭开采和洗选业增加值累计增长(%)	0.6	-0.6	-8.2
石油和天然气开采业增加值累计增长(%)	0.1	1.3	2.1
黑色金属矿采选业增加值累计增长(%)	-5.2	-7.6	-16.2
有色金属矿采选业增加值累计增长(%)	-3.1	-6.1	-13.1
非金属矿采选业增加值累计增长(%)	-9.3	-16.9	-25.5
开采专业及辅助性活动增加值累计增长(%)	-6.8	-4.7	-3.1
其他采矿业增加值累计增长(%)	-7.8	-8.9	-18.3
农副食品加工业增加值累计增长(%)	-7	-11.1	-16
食品制造业增加值累计增长(%)	-3.3	-7.9	-18.2
酒、饮料和精制茶制造业增加值累计增长(%)	-11	-14.7	-23.6
烟草制品业增加值累计增长(%)	7.3	9.6	6.9

Table 15. Concordance between IO Sectors and GB Sectors

IO Sectors	IO Codes	GB Sectors	GB code
Agriculture	1	农、林、牧、渔业	1
Coal mining	2	煤炭开采和洗选业	2
Petroleum and gas	3	石油和天然气开采业	3
Metal mining	4	黑色金属矿采选业	4
Metal mining	4	有色金属矿采选业	5
Nonmetal mining	5	非金属矿采选业	6
Food processing and tobaccos	6	农副食品加工业	7
Food processing and tobaccos	6	食品制造业	8
Food processing and tobaccos	6	酒、饮料和精制茶制造业	9
Food processing and tobaccos	6	烟草制品业	10
Textile	7	纺织业	11
Clothing, leather, fur, etc.	8	纺织服装、服饰业	12
Clothing, leather, fur, etc.	8	皮革、毛皮、羽毛及其制品和制	13
Wood processing and furnishing	9	木材加工及木、竹、藤、棕、草	14
Wood processing and furnishing	9	家具制造业	15

Type 2: GTAP Sector-level Data

Table 3. GTAP Sector-level Cumulative Value-added Growth Rate

GTAP description	Code	GTAP codes	2020-04	2020-03	2020-02	2019-12	2019-11
Coal	coa	15	0.6	-0.6	-8.2	5.5	5.1
Oil	oil	16	0.1	1.3	2.1	3.7	3.6
Gas	gas	17	0.1	1.3	2.1	3.7	3.6
Other Extraction (formerly omn Minerals nec)	oxt	18	-6.44	-8.8	-13.9	8.3	9.3
Beverages and tobacco products	b_t	26	-1.85	-2.6	-8.4	5.7	5.5
Textiles	tex	27	-10.6	-16.8	-27.2	1.3	1.4
Wearing apparel	wap	28	-15	NA	-28.9	0.9	1.0
Leather products	lea	29	-17.5	-20.3	-28.4	2.1	2.4
Wood products	lum	30	-8.7	-12.9	-24.6	2.2	2.0
Paper products, publishing	ppp	31	-10.9	-13.8	-25.7	2.6	2.7
Petroleum, coal products	p_c	32	-6.3	-8.1	-7.8	5.0	4.7
Chemical products	chm	33	-3.9	-6.8	-12.3	4.7	4.4
Basic pharmaceutical products	bph	34	0	-2.3	-12.3	6.6	6.8
Rubber and plastic products	rpp	35	-9.4	-16.2	-25.2	4.8	4.9
Mineral products nec	nmm	36	-7.6	-13.7	-21.1	8.9	8.9
Ferrous metals	i_s	37	1.7	0.5	-2.0	9.9	9.9
Metals nec	nfm	38	-0.6	-3.8	-8.5	9.2	9.6
Metal products	fmp	39	-7.3	-15.0	-26.9	5.8	5.7
Motor vehicles and parts	mvh	43	-15	-26.0	-31.8	1.8	0.7
Transport equipment nec	otn	44	-7.3	-13.7	-28.2	7.4	9.0
Electrical equipment	eeq	41	-5.8	-12.9	-24.7	10.7	10.4
Computer, electronic and optical products	ele	40	1.8	-2.8	-13.8	9.3	8.9
Machinery and equipment nec	ome	42	-7	NA	-27.4	10.5	10.9
Manufactures nec	omf	45	-16.4	-22.0	-29.7	2.7	3.3
Electricity	ely	46	-3.9	-5.4	-7.3	6.5	6.4
Gas manufacture, distribution	gdt	47	-5.3	-5.8	-7.3	11.5	12.4
Water	wtr	48	-1.1	-2.1	-4.2	7.9	7.8

Figure 6: GTAP sector-level cumulative value-added growth rate

- Only manufacturing sectors, no agricultural or service sectors.

Type 2: GTAP Sector-level Data

- Raw industry-sector level data from NBSC (Table 19)
- Concordance between GTAP sectors and GB industrial sectors (Table 16).
- We use the average growth rate of all GB sectors that correspond to the GTAP sector as the growth rate of a specific GTAP sector.

Table 16. Concordance between GB Sectors and GTAP Sectors

GTAP Sectors	Code	GTAP codes	GB sectors	GB Codes
Paper products, publishing	ppp	31	文教、工美、体育和娱乐用品制造业	18
Petroleum, coal products	p_c	32	石油、煤炭及其他燃料加工业加工业	19
Chemical products	chm	33	化学原料和化学制品制造业	20
Basic pharmaceutical products	bph	34	医药制造业	21
Rubber and plastic products	rpp	35	橡胶和塑料制品业	23
Mineral products nec	nmm	36	非金属矿物制品业	24
Ferrous metals	i_s	37	黑色金属冶炼和压延加工业	25
Metals nec	nfm	38	有色金属冶炼和压延加工业	26
Metal products	fmp	39	金属制品业	27
Computer, electronic and optical products	ele	40	计算机、通信和其他电子设备制造业	33
Electrical equipment	eeq	41	电气机械和器材制造业	32
Machinery and equipment nec	ome	42	仪器仪表制造业	34
Motor vehicles and parts	mvh	43	汽车制造业	35
Transport equipment nec	otn	44	铁路、船舶、航空航天和其他运输设备制造业	31
Manufactures nec	omf	45	废弃资源综合利用业	35
Electricity	ely	46	电力、热力生产和供应业	37

Figure 7: Concordance between GB Sectors and GTAP Sectors

Type 3: Province-level data

- Province-level cumulative value-added growth rate

Table 5. Province-level Cumulative Value-added Growth Rate

Provinces	Codes	2020-04	2020-03	2020-02	2019-12	2019-11
Shanxi	4	1.6	-3.5	-11.7	5.3	5.5
Inner Mongolia	5	1.6	-2.9	-4.7	6.1	6.3
Liaoning	6	2.1	-8.5	-7.7	6.7	6.7
Jilin	7	4.3	-12.2	-22	3.1	1.3
Heilongjiang	8	2.9	-8.6	-10.9	2.8	2
Shanghai	9	2.8	-17.7	-21.1	0.4	-0.4
Jiangsu	10	8.1	-7.8	-17.1	6.2	5.9
Zhejiang	11	9.5	-10.2	-18.5	6.6	6.2
Anhui	12	9.1	-5.3	-12.1	7.3	7.3
Fujian	13	4.5	-6.8	-13.3	8.8	8.8
Jiangxi	14	6.6	-6.1	-14.4	8.5	8.6
Shandong	15	3.9	-5.8	-10.6	1.2	0.7
Henan	16	6.6	-6.8	-13	7.8	7.9
Hubei	17	-2.4	-45.8	-46.2	7.8	7.8
Hunan	18	6.2	-2.1	-7.4	8.3	8.3
Guangdong	19	3.6	-15.1	-23.2	4.7	4.4
Guangxi	20	1	-8.8	-14.3	4.5	4.3
Hainan	21	-6.1	-9.7	-9.7	4.2	4
Chongqing	22	9.2	-10.6	-24	6.2	5.9
Sichuan	23	6.3	-0.9	-5.2	8	8
Guizhou	24	2.9	-1.9	-10.5	9.6	9.2
Yunnan	25	1.7	-3.0	-3.8	8.1	7.5
Shaanxi	26	5.8	-3.0	-7.1	5.2	4.7
Gansu	27	9	-4.4	-4	5.2	4.8
Qinghai	28	3	-0.3	-6.5	7	6.2
Ningxia	29	7	0.6	-3.8	7.6	6.4
Xinjiang	30	7	2.2	-0.7	4.7	5

Type 3: Province-level data

Baidu resumption index (Weekly)

Table 7. Baidu Huiyan Province-level Resumption Index

Province	Codes	2020-02-23	2020-03-03	2020-03-10	2020-03-17	2020-03-24
Beijing	1	0.2955	0.4889	0.5347	0.5765	0.6137
Tianjin	2	0.3008	0.5233	0.5845	0.6469	0.7024
Hebei	3	0.3435	0.5621	0.6275	0.689	0.7418
Shanxi	4	0.3659	0.5391	0.6705	0.7275	0.7757
Inner Mongolia	5	0.3513	0.6237	0.6941	0.7511	0.8053
Liaoning	6	0.4021	0.6727	0.7249	0.768	0.8065
Jilin	7	0.3983	0.6721	0.7268	0.7776	0.8232
Heilongjiang	8	0.3323	0.5148	0.5615	0.6145	0.7092
Shanghai	9	0.3256	0.5723	0.6391	0.697	0.7444
Jiangsu	10	0.3329	0.5894	0.661	0.7186	0.7628
Zhejiang	11	0.2818	0.5689	0.6559	0.7177	0.7653
Anhui	12	0.3313	0.5704	0.6423	0.7011	0.7487
Fujian	13	0.3681	0.622	0.6792	0.7244	0.7597

- Resumption index = Cumulative active labor seven days after the lunar new year/baseline active labor in December 2019.

Type 4 and 5: Province by IO/GTAP sector level data

Table 18. Availability of Sector-level Province Data

Provinces	Codes	Sector-level Value-added Growth Rate (manufacturing sectors only)				
		2020-04	2020-03	2020-02	2019-12	2019-11
Beijing	1	Y	Y	Y	Y	Y
Tianjin	2		Y		Y	Y
Hebei	3	Y	Y	Y	Y	Y
Shanxi	4			Y	Y	Y
Inner Mor	5					
Liaoning	6					
Jilin	7					
Heilongjia	8					
Shanghai	9		Y	Y	Y	Y
Jiangsu	10					
Zhejiang	11		Y	Y	Y	Y
Anhui	12					
Fujian	13					
Jiangxi	14					
Shandong	15					
Henan	16	Y	Y	Y	Y	Y
Hubei	17	Y	Y	Y	Y	Y
Hunan	18					
Guangdor	19			Y	Y	Y
Guangxi	20		Y	Y	Y	Y
Hainan	21					
Chongqin	22		Y	Y	Y	Y
Sichuan	23					
Guizhou	24		Y	Y	Y	Y
Yunnan	25		Y	Y	Y	Y
Shaanxi	26		Y	Y	Y	Y
Gansu	27					
Qinghai	28	Y	Y	Y	Y	Y
Ningxia	29					
Xinjiang	30	Y	Y	Y	Y	Y

Figure 8: Availability of province by sector-level data (based on data from provincial bureaus of statistics)

Type 4 and 5: Province by IO/GTAP sector level data

Table 10. Province-IO-sector-level Value-added Cumulative Growth Rate

Province	Province code	IO Sectors	Codes	2020-04	2020-03	2020-02	2019-12
Beijing	1	Coal mining	2	-	-	-	-
Tianjin	2	Coal mining	2	-	-	-	-
Hebei	3	Coal mining	2	0.20	-0.70	6.00	1.70
Shanxi	4	Coal mining	2	-	-	-11.70	4.1
Inner Mongolia	5	Coal mining	2	-	-	-	-
Liaoning	6	Coal mining	2	-	-	-	-
Jilin	7	Coal mining	2	-	-	-	-
Heilongjiang	8	Coal mining	2	-	-	-	-
Shanghai	9	Coal mining	2	-	-	-	-
Jiangsu	10	Coal mining	2	-	-	-	-
Zhejiang	11	Coal mining	2	-	-32.10	27.60	10.80
Anhui	12	Coal mining	2	-	-	-	-

Figure 9: Province-IO-sector-level Value-added Cumulative Growth Rate (based on data from provincial bureaus of statistics)

Type 6 and 7: Concordance and Raw Datasets

- Concordance
  - GB-IO; GB-GTAP; IO-GTAP
- Raw datasets
  - Capacity Utilization
  - Industrial Sector Electrical Consumption
  - Select Provinces' Congestion Indices
  - Daily Number of Subway Passengers
  - Daily Number of Vehicular Passengers
  - Select Power Generation Groups' Coal Consumption
  - Province-level Freight Volumes
  - GDP (Quaterly)
  - Agricultural trade (Monthly, weekly)

Quantitative Modeling Example

- **Research Question:** What are the implied shock profiles that fit the observed drop in economic activity due to COVID-19?

- **Early,** COVID-19 is a domestic (China) shock:
  - **Instruments:** sectoral/provincial labor productivity.
  - **Targets:** proportional change in sectoral/provincial value added.

- **Later,** compounding external shocks with domestic recovery?:
  - **Added Instruments:** import productivity shocks (same as iceberg costs) and export-demand shifts.
  - **Added Target:** proportional changes in import supply and export demand.

- **Validation:**
  - What are the profiles of the implied trade shocks in the early period? Elasticity adjustments? Policy adjustments?

Model

- Rutherford's sub-national China model (MPSGE)
- Calibrated to 30 x 30 (Mi et al., 2018) accounts
- Trade structure:
    - CET with CE (large-open-economy, $\sigma_m(i)$) foreign export demand.
    - Sector-specific composite price for good-i (CES: $\sigma_{dm}(i) = \sigma_m(i)/2$). Components:
        1. home-region good
        2. composite of Chinese regional goods (CES: $\sigma_m(i)$)
        3. composite of foreign imports, currently a singleton (CES: $\sigma_m(i)$)
- Production: Nested CES
    - Leontief materials nest
    - Value-added nest (esub$_{va}$)
    - Short Run: sector-specific capital
- Consumer: Cobb-Douglas Utility

Some Preliminary Results

		Implied Labor Productivity Index (target: provincial value added)				
		Nov	Dec	Feb	Mar	Apr
Beijing	BJ	1.10	1.11	0.57	0.62	1.15
Tianjin	TJ	1.13	1.14	0.53	0.55	0.98
Hebei	HE	1.14	1.15	0.74	0.85	1.13
Shanxi	SX	1.20	1.19	0.69	0.90	1.05
Inner Mongolia	NM	1.23	1.22	0.78	0.85	1.07
Liaoning	LN	1.17	1.17	0.77	0.78	1.07
Jilin	JL	1.07	1.13	0.43	0.62	1.17
Heilongjiang	HL	1.12	1.15	0.61	0.69	1.14
Shanghai	SH	1.05	1.08	0.42	0.51	1.15
Jiangsu	JS	1.20	1.21	0.53	0.72	1.27
Zhejiang	ZJ	1.22	1.24	0.50	0.67	1.32
Anhui	AH	1.22	1.22	0.67	0.83	1.27
Fujian	FJ	1.22	1.23	0.65	0.79	1.13
Jiangxi	JX	1.44	1.44	0.50	0.70	1.34
Shandong	SD	1.08	1.10	0.60	0.74	1.18
Henan	HA	1.21	1.21	0.70	0.83	1.17
Hubei	HB	1.21	1.21	0.26	0.27	0.98
Hunan	HN	1.22	1.22	0.76	0.89	1.17
Guangdong	GD	1.14	1.15	0.50	0.64	1.13
Guangxi	GX	1.13	1.14	0.65	0.76	1.06
Hainan	HI	1.17	1.18	0.66	0.71	0.92
Chongqing	CQ	1.18	1.19	0.46	0.70	1.29
Sichuan	SC	1.24	1.24	0.78	0.90	1.19
Guizhou	GZ	1.29	1.30	0.69	0.89	1.11
Yunnan	YN	1.25	1.27	0.80	0.85	1.08
Shaanxi	SN	1.17	1.18	0.74	0.86	1.19
Gansu	GS	1.16	1.18	0.81	0.84	1.27
Qinghai	QH	1.24	1.27	0.75	0.93	1.12
Ningxia	NX	1.19	1.23	0.86	0.98	1.21
Xinjiang	XJ	1.16	1.16	0.88	0.98	1.20

Some Preliminary Results
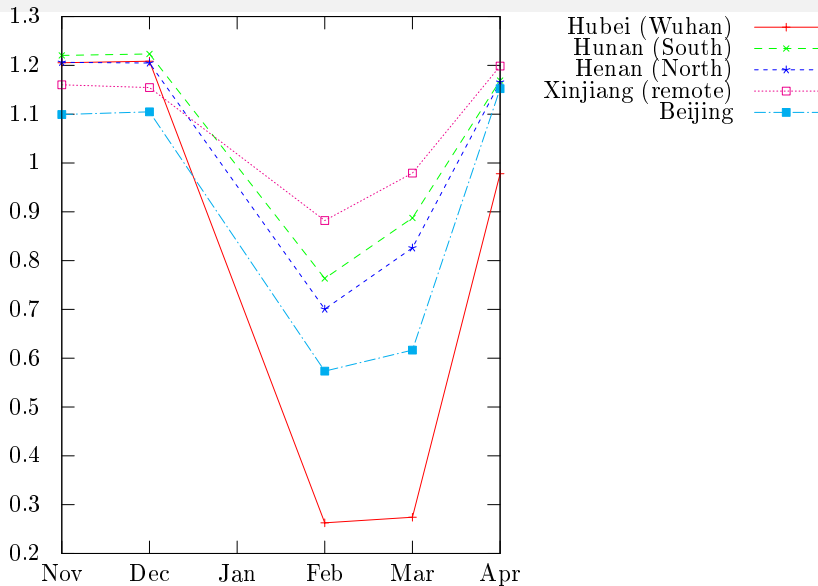
Thanks!

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