Analysis of GDP of various provinces in China in the past 20 years

This paper will discuss the analysis of GDP changes in various provinces in China in the past 20 years and the economic correlation between various industries.

In this regard, we first find suitable data, that is, the GDP data of each province in China and the GDP proportion of each industry in the past 20 years, and import these data into our data sets df and province_data.

In [32]:
```
import matplotlib.pyplot as plt
import pandas as pd
import matplotlib.font_manager as fm
!pip install xlrd

plt.rcParams['font.sans-serif'] = ['SimHei']
plt.rcParams['axes.unicode_minus'] = False


file_path = "C:/写码/暑假数据.xls"
df = pd.read_excel(file_path, engine='xlrd')

file_path_yunnan = "C:/写码/要用的数据/安徽产业.xls"
df_yunnan = pd.read_excel(file_path_yunnan, engine='xlrd')

file_path_beijing = "C:/写码/要用的数据/北京产业.xls"
df_beijing = pd.read_excel(file_path_beijing, engine='xlrd')

file_path_jilin = "C:/写码/要用的数据/吉林产业.xls"
df_jilin = pd.read_excel(file_path_jilin, engine='xlrd')

file_path_sichuan = "C:/写码/要用的数据/四川产业.xls"
df_sichuan = pd.read_excel(file_path_sichuan, engine='xlrd')

file_path_anhui = "C:/写码/要用的数据/安徽产业.xls"
df_anhui = pd.read_excel(file_path_anhui, engine='xlrd')

file_path_shandong = "C:/写码/要用的数据/山东产业.xls"
df_shandong = pd.read_excel(file_path_shandong, engine='xlrd')

file_path_shanxi = "C:/写码/要用的数据/山西产业.xls"
df_shanxi = pd.read_excel(file_path_shanxi, engine='xlrd')

file_path_guangdong = "C:/写码/要用的数据/广东产业.xls"
df_guangdong = pd.read_excel(file_path_guangdong, engine='xlrd')

file_path_jiangsu = "C:/写码/要用的数据/江苏产业.xls"
df_jiangsu = pd.read_excel(file_path_jiangsu, engine='xlrd')

file_path_jiangxi = "C:/写码/要用的数据/江西产业.xls"
df_jiangxi = pd.read_excel(file_path_jiangxi, engine='xlrd')

file_path_hebei = "C:/写码/要用的数据/河北产业.xls"
df_hebei = pd.read_excel(file_path_hebei, engine='xlrd')

file_path_henan = "C:/写码/要用的数据/河南产业.xls"
```

```
df_henan = pd.read_excel(file_path_henan, engine='xlrd')

file_path_zhejiang = "C:/写码/要用的数据/浙江产业.xls"
df_zhejiang = pd.read_excel(file_path_zhejiang, engine='xlrd')

file_path_hainan = "C:/写码/要用的数据/海南产业.xls"
df_hainan = pd.read_excel(file_path_hainan, engine='xlrd')

file_path_hubei = "C:/写码/要用的数据/湖北产业.xls"
df_hubei = pd.read_excel(file_path_hubei, engine='xlrd')

file_path_hunan = "C:/写码/要用的数据/湖南产业.xls"
df_hunan = pd.read_excel(file_path_hunan, engine='xlrd')

file_path_gansu = "C:/写码/要用的数据/甘肃产业.xls"
df_gansu = pd.read_excel(file_path_gansu, engine='xlrd')

file_path_fujian = "C:/写码/要用的数据/福建产业.xls"
df_fujian = pd.read_excel(file_path_fujian, engine='xlrd')

file_path_guizhou = "C:/写码/要用的数据/贵州产业.xls"
df_guizhou = pd.read_excel(file_path_guizhou, engine='xlrd')

file_path_liaoning = "C:/写码/要用的数据/辽宁产业.xls"
df_liaoning = pd.read_excel(file_path_liaoning, engine='xlrd')

file_path_shanxi2 = "C:/写码/要用的数据/陕西产业.xls"
df_shanxi2 = pd.read_excel(file_path_shanxi2, engine='xlrd')

file_path_qinghai = "C:/写码/要用的数据/青海产业.xls"
df_qinghai = pd.read_excel(file_path_qinghai, engine='xlrd')


province_data = {
    "yunnan": pd.read_excel("C:/写码/要用的数据/云南产业.xls", engine='xlrd'),
    "beijing": pd.read_excel("C:/写码/要用的数据/北京产业.xls", engine='xlrd'),
    "jilin": pd.read_excel("C:/写码/要用的数据/吉林产业.xls", engine='xlrd'),
    "sichuan": pd.read_excel("C:/写码/要用的数据/四川产业.xls", engine='xlrd'),
    "anhui": pd.read_excel("C:/写码/要用的数据/安徽产业.xls", engine='xlrd'),
    "shandong": pd.read_excel("C:/写码/要用的数据/山东产业.xls", engine='xlrd'),
    "shanxi": pd.read_excel("C:/写码/要用的数据/山西产业.xls", engine='xlrd'),
    "guangdong": pd.read_excel("C:/写码/要用的数据/广东产业.xls", engine='xlrd'),
    "jiangsu": pd.read_excel("C:/写码/要用的数据/江苏产业.xls", engine='xlrd'),
    "jiangxi": pd.read_excel("C:/写码/要用的数据/江西产业.xls", engine='xlrd'),
    "hebei": pd.read_excel("C:/写码/要用的数据/河北产业.xls", engine='xlrd'),
    "henan": pd.read_excel("C:/写码/要用的数据/河南产业.xls", engine='xlrd'),
    "zhejiang": pd.read_excel("C:/写码/要用的数据/浙江产业.xls", engine='xlrd'),
    "hainan": pd.read_excel("C:/写码/要用的数据/海南产业.xls", engine='xlrd'),
    "hubei": pd.read_excel("C:/写码/要用的数据/湖北产业.xls", engine='xlrd'),
    "hunan": pd.read_excel("C:/写码/要用的数据/湖南产业.xls", engine='xlrd'),
    "gansu": pd.read_excel("C:/写码/要用的数据/甘肃产业.xls", engine='xlrd'),
    "fujian": pd.read_excel("C:/写码/要用的数据/福建产业.xls", engine='xlrd'),
    "guizhou": pd.read_excel("C:/写码/要用的数据/贵州产业.xls", engine='xlrd'),
    "liaoning": pd.read_excel("C:/写码/要用的数据/辽宁产业.xls", engine='xlrd'),
    "shanxi2": pd.read_excel("C:/写码/要用的数据/陕西产业.xls", engine='xlrd'),
    "qinghai": pd.read_excel("C:/写码/要用的数据/青海产业.xls", engine='xlrd')
}
print(df)
print(province_data)
```

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Requirement already satisfied: xlrd in c:\users\haoyi\anaconda3\lib\site-packa
ges (2.0.1)
```

	省份	2023	2022	2021	2020	2019	2018	2017
0	北京	43760.7	41540.9	41045.6	35943.3	35445.1	33106.0	29883.0
1	天津	16737.3	16132.2	15685.1	14008.0	14055.5	13362.9	12450.6
2	河北	43944.1	41988.0	40397.1	36013.8	34978.6	32494.6	30640.8
3	山西	25698.2	25583.9	22870.4	17835.6	16961.6	15958.1	14484.3
4	内蒙古	24627.0	23388.9	21166.0	17258.0	17212.5	16140.8	14898.1
5	辽宁	30209.4	28826.1	27569.5	25011.4	24855.3	23510.5	21693.0
6	吉林	13531.2	12818.1	13163.8	12256.0	11726.8	11253.8	10922.0
7	黑龙江	15883.9	15831.5	14858.2	13633.4	13544.4	12846.5	12313.0
8	上海	47218.7	44809.1	43653.2	38963.3	37987.6	36011.8	32925.0
9	江苏	128222.2	122089.3	117392.4	102807.7	98656.8	93207.6	85869.8
10	浙江	82553.2	78060.6	74040.8	64689.1	62462.0	58002.8	52403.1
11	安徽	47050.6	44607.7	42565.2	38061.5	36845.5	34010.9	29676.2
12	福建	54355.1	51765.1	49566.1	43608.6	42326.6	38687.8	33842.4
13	江西	32200.1	31213.8	29827.8	25782.0	24667.3	22716.5	20210.8
14	山东	92068.7	87576.9	82875.2	72798.2	70540.5	66648.9	63012.1
15	河南	59132.4	58220.1	58071.4	54259.4	53717.8	49935.9	44824.9
16	湖北	55803.6	52741.7	50091.2	43004.5	45429.0	42022.0	37235.0
17	湖南	50012.9	47558.6	45713.5	41542.6	39894.1	36329.7	33828.1
18	广东	135673.2	129513.6	124719.5	111151.6	107986.9	99945.2	91648.7
19	广西	27202.4	26186.1	25209.1	22120.9	21237.1	19627.8	17790.7
20	海南	7551.2	6889.6	6504.1	5566.2	5330.8	4910.7	4497.5
21	重庆	30145.8	28576.1	28077.3	25041.4	23605.8	21588.8	20066.3
22	四川	60132.9	56610.2	54088.0	48501.6	46363.8	42902.1	37905.1
23	贵州	20913.3	20010.4	19458.6	17860.4	16769.3	15353.2	13605.4
24	云南	30021.1	28556.1	27161.6	24555.7	23223.8	20880.6	18486.0
25	西藏	2392.7	2150.2	2080.2	1902.7	1697.8	1548.4	1349.0
26	陕西	33786.1	32838.2	30121.7	26014.1	25793.2	23941.9	21473.5
27	甘肃	11863.8	11121.4	10225.5	8979.7	8718.3	8104.1	7336.7
28	青海	3799.1	3623.3	3385.1	3009.8	2941.1	2748.0	2465.1
29	宁夏	5315.0	5104.6	4588.2	3956.3	3748.5	3510.2	3200.3
30	新疆	19125.9	18042.7	16311.6	13800.7	13597.1	12809.4	11159.9

	2016	2015	...	2013	2012	2011	2010	2009
0	27041.2	24779.1	...	21134.6	19024.7	17188.8	14964.0	12900.9
1	11477.2	10879.5	...	9945.4	9043.0	8112.5	6830.8	5709.6
2	28474.1	26398.4	...	24259.6	23077.5	21384.7	18003.6	15306.9
3	11946.4	11836.4	...	11987.2	11683.1	10894.4	8903.9	7147.6
4	13789.3	12949.0	...	11392.4	10470.1	9458.1	8199.9	7104.2
5	20392.5	20210.3	...	19208.8	17848.6	16354.9	13896.3	12815.7
6	10427.0	10018.0	...	9427.9	8678.0	7734.6	6410.5	5434.8
7	11895.0	11690.0	...	11849.1	11015.8	9935.0	8308.3	7218.9
8	29887.0	26887.0	...	23204.1	21305.6	20009.7	17915.4	15742.4
9	77350.9	71255.9	...	59349.4	53701.9	48839.2	41383.9	34471.7
10	47254.0	43507.7	...	37334.6	34382.4	31854.8	27399.9	22833.7
11	26307.7	23831.2	...	20584.0	18341.7	16284.9	13249.8	10864.7
12	29609.4	26819.5	...	22503.8	20190.7	17917.7	15002.5	12418.1
13	18388.6	16780.9	...	14300.2	12807.7	11584.5	9383.2	7630.0
14	58762.5	55288.8	...	47344.3	42957.3	39064.9	33922.5	29540.8
15	40249.3	37084.1	...	31632.5	28961.9	26318.7	22655.0	19181.0
16	33353.0	30344.0	...	25378.0	22590.9	19942.5	16226.9	13192.1
17	30853.5	28538.6	...	23545.2	21207.2	18915.0	15574.3	12772.8
18	82163.2	74732.4	...	62503.4	57007.7	53072.8	45944.6	39464.7
19	16116.6	14797.8	...	12448.4	11303.6	10299.9	8552.4	7112.9
20	4090.2	3734.2	...	3115.9	2789.4	2463.8	2020.5	1620.3
21	18023.0	16040.5	...	13027.6	11595.4	10161.2	8065.3	6651.2
22	33138.5	30342.0	...	26518.0	23922.4	21050.9	17224.8	14190.6
23	11792.4	10541.0	...	7973.1	6742.2	5615.6	4519.0	3856.7
24	16369.0	14960.0	...	12825.5	11097.4	9523.1	7735.3	6574.4
25	1173.0	1043.0	...	828.2	710.2	611.5	512.9	445.7
26	19045.8	17898.8	...	15905.4	14142.4	12175.1	9845.2	7997.8

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27   6907.9   6556.6  ...   6014.5   5393.1   4816.9   3943.7   3268.3
28   2258.2   2011.0  ...   1713.3   1528.5   1370.4   1144.2    939.7
29   2781.4   2579.4  ...   2327.7   2131.0   1931.8   1571.7   1266.7
30   9630.8   9306.9  ...   8392.6   7411.8   6532.0   5360.2   4237.0

       2008     2007     2006     2005     2004
0   11813.1  10425.5   8387.0   7149.8   6252.5
1    5182.4   4158.4   3538.2   3158.6   2621.1
2   14200.1  12152.9  10043.0   8773.4   7588.6
3    7223.0   5935.6   4713.6   4079.4   3496.0
4    6242.4   5166.9   4161.8   3523.7   2942.4
5   12137.7  10292.2   8390.3   7260.8   6469.8
6    4834.7   4080.3   3226.5   2776.5   2455.2
7    7134.2   6126.3   5329.8   4756.4   4134.7
8   14536.9  12878.7  10598.9   9197.1   8101.6
9   30945.5  25988.4  21240.8  18121.3  14823.1
10  21284.6  18640.0  15302.7  13028.3  11482.1
11   9517.7   7941.6   6500.3   5675.9   5129.1
12  10931.8   9325.6   7468.6   6415.5   5712.1
13   6934.2   5777.6   4696.8   3941.2   3398.1
14  27106.2  22718.1  18967.8  15947.5  13308.1
15  17735.9  14824.5  11977.9  10243.5   8411.2
16  11497.5   9451.4   7531.8   6469.7   5546.8
17  11307.4   9285.5   7431.6   6369.9   5542.6
18  36704.2  31742.6  25961.2  21963.0  18658.3
19   6455.4   5474.8   4417.8   3742.1   3305.1
20   1474.7   1234.0   1027.5    884.9    802.7
21   5899.5   4770.7   3900.3   3448.4   3059.5
22  12756.2  10562.1   8494.7   7195.9   6304.0
23   3504.5   2847.5   2264.1   1939.9   1649.4
24   6016.6   5077.4   4090.7   3497.7   3136.4
25    398.2    344.1    285.9    243.1    217.9
26   7177.8   5681.8   4595.6   3817.2   3141.6
27   3071.7   2675.1   2203.0   1864.6   1653.6
28    896.9    720.1    585.2    499.4    443.7
29   1139.2    877.6    683.3    579.9    519.9
30   4142.5   3500.0   2957.3   2520.5   2170.4

[31 rows x 21 columns]
{'yunnan':       年份    第一产业     第二产业     第三产业
0   2023  4206.6  10256.3  15558.2
1   2022  4001.9  10120.3  14433.9
2   2021  3831.3   9537.2  13793.1
3   2020  3611.8   8387.5  12556.5
4   2019  3037.7   8060.4  12125.7
5   2018  2498.7   7267.5  11114.5
6   2017  2338.4   6317.8   9829.8
7   2016  2225.5   5747.4   8396.1
8   2015  2079.3   5491.7   7389.0
9   2014  2007.4   5376.5   6657.7
10  2013  1878.5   5000.5   5946.5
11  2012  1640.4   4458.4   4998.6
12  2011  1396.6   3811.4   4315.1
13  2010  1090.3   3267.7   3377.3
14  2009  1049.7   2605.4   2919.3
15  2008  1001.9   2476.1   2538.6
16  2007   849.6   2057.4   2170.4
17  2006   704.5   1674.2   1712.0
18  2005   646.3   1387.3   1464.1
19  2004   607.8   1267.8   1260.8, 'beijing':       年份    第一产业     第二产业
第三产业
0   2023  105.5  6525.6  37129.6
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1   2022  111.5  6635.6  34793.7
2   2021  111.4  7389.0  33545.2
3   2020  108.3  5739.1  30095.9
4   2019  114.4  5667.4  29663.4
5   2018  120.6  5477.4  27508.1
6   2017  121.9  5049.4  24711.7
7   2016  129.8  4665.8  22245.7
8   2015  140.4  4419.8  20218.9
9   2014  159.2  4433.0  18333.9
10  2013  159.8  4168.3  16806.5
11  2012  148.4  3856.0  15020.3
12  2011  134.5  3563.3  13491.0
13  2010  122.8  3233.1  11608.1
14  2009  116.8  2736.4  10047.7
15  2008  111.4  2526.7   9175.1
16  2007   99.4  2413.4   7912.8
17  2006   87.2  2072.1   6227.7
18  2005   86.9  1907.4   5155.5
19  2004   85.4  1773.7   4393.4, 'jilin':       年份     第一产业     第二产业
第三产业
0   2023  1644.8  4585.0  7301.4
1   2022  1689.1  4370.2  6758.7
2   2021  1553.8  4768.3  6841.7
3   2020  1553.0  4319.9  6383.1
4   2019  1287.3  4134.8  6304.7
5   2018  1160.7  4051.5  6041.6
6   2017  1095.4  3995.5  5831.2
7   2016  1130.1  3901.4  5395.5
8   2015  1270.6  3837.8  4909.6
9   2014  1270.2  3804.9  4891.5
10  2013  1250.2  3572.1  4605.5
11  2012  1195.6  3315.2  4167.2
12  2011  1105.9  2931.4  3697.4
13  2010   928.4  2485.8  2996.3
14  2009   888.6  2055.1  2491.1
15  2008   863.6  1788.0  2183.2
16  2007   755.2  1477.7  1847.5
17  2006   640.2  1097.2  1489.1
18  2005   618.7  1002.4  1155.5
19  2004   562.3   903.4   989.5, 'sichuan':       年份     第一产业     第二产业
第三产业
0   2023  6056.6  21306.7  32769.5
1   2022  5965.5  20591.4  30053.3
2   2021  5662.0  19949.7  28476.2
3   2020  5556.9  17505.6  25439.2
4   2019  4807.5  17187.9  24368.3
5   2018  4427.4  16056.9  22417.7
6   2017  4262.5  14569.2  19073.5
7   2016  3900.6  13450.1  15787.8
8   2015  3661.0  13192.5  13488.6
9   2014  3524.7  13082.7  12283.9
10  2013  3257.4  12418.9  10841.7
11  2012  3142.6  11231.1   9548.8
12  2011  2854.6  10014.4   8181.9
13  2010  2384.9   8283.2   6556.7
14  2009  2160.4   6653.2   5377.0
15  2008  2139.0   5766.5   4850.8
16  2007  1966.5   4607.7   3987.8
17  2006  1614.0   3658.1   3222.6
18  2005  1403.2   2961.2   2831.5
19  2004  1329.1   2439.7   2535.2, 'anhui':       年份     第一产业     第二产业
第三产业
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0   2023  3496.6  18871.8  24682.2
1   2022  3516.5  17946.8  23144.4
2   2021  3363.9  17240.1  21961.1
3   2020  3185.0  15216.5  19660.1
4   2019  2916.0  14970.0  18959.5
5   2018  2638.0  14094.4  17278.5
6   2017  2582.3  12681.2  14412.7
7   2016  2489.8  11517.5  12300.5
8   2015  2376.1  10838.3  10616.8
9   2014  2295.0  10982.6   9242.1
10  2013  2173.2  10233.4   8177.4
11  2012  2018.6   9247.9   7075.2
12  2011  1868.0   8189.1   6227.8
13  2010  1600.6   6396.0   5253.2
14  2009  1382.7   4918.7   4563.4
15  2008  1313.1   4194.5   4010.1
16  2007  1116.3   3371.8   3453.5
17  2006  1011.0   2653.2   2836.1
18  2005   966.5   2197.4   2512.0
19  2004   950.5   1846.2   2332.4, 'shandong':        年份      第一产业       第二产
业      第三产业
0   2023  6506.2  35987.9  49574.6
1   2022  6296.5  34562.3  46718.1
2   2021  6029.0  32834.5  44011.7
3   2020  5364.4  28456.7  38977.2
4   2019  5117.0  28171.8  37251.7
5   2018  4950.5  27523.7  34174.7
6   2017  4832.7  26925.6  31253.8
7   2016  4830.3  25565.0  28367.2
8   2015  4902.8  24814.9  25571.1
9   2014  4662.8  23588.0  22524.0
10  2013  4454.1  22615.9  20274.3
11  2012  4047.1  21275.9  17634.4
12  2011  3768.6  19926.1  15370.3
13  2010  3411.3  17733.1  12778.1
14  2009  3076.2  15919.7  10544.9
15  2008  2876.2  14911.5   9318.5
16  2007  2451.0  12529.4   7737.6
17  2006  2098.3  10568.5   6301.1
18  2005  1928.2   8841.1   5178.2
19  2004  1748.2   7327.6   4232.3, 'shanxi':        年份      第一产业       第二产业
第三产业
0   2023  1388.9  13329.7  10979.6
1   2022  1335.3  13848.5  10400.0
2   2021  1286.9  11578.1  10005.4
3   2020  1166.6   7703.2   8965.8
4   2019   825.3   7466.3   8670.0
5   2018   740.8   7074.5   8142.9
6   2017   719.2   6635.3   7129.8
7   2016   724.3   5113.6   6108.5
8   2015   726.2   5219.7   5890.5
9   2014   736.6   6378.0   4980.1
10  2013   697.6   6684.3   4605.3
11  2012   642.0   6852.7   4188.4
12  2011   586.6   6750.2   3557.7
13  2010   510.4   5349.6   3043.9
14  2009   443.5   4091.2   2613.0
15  2008   373.6   4389.0   2460.5
16  2007   303.5   3602.3   2029.8
17  2006   256.4   2799.3   1657.9
18  2005   247.8   2389.5   1442.1
19  2004   262.9   1931.6   1301.5, 'guangdong':        年份      第一产业       第二
```

```
产业      第三产业
0   2023  5540.7  54437.3  75695.2
1   2022  5350.1  52620.7  71542.7
2   2021  4984.7  50555.8  69179.0
3   2020  4732.7  43868.1  62550.8
4   2019  4350.6  43368.2  60268.1
5   2018  3836.4  41398.5  54710.4
6   2017  3611.4  38536.6  49500.7
7   2016  3500.5  35499.2  43163.5
8   2015  3189.8  33913.8  37628.9
9   2014  3038.7  31930.4  33204.0
10  2013  2876.4  29343.0  30284.0
11  2012  2711.3  27346.1  26950.3
12  2011  2553.2  26161.1  24358.5
13  2010  2199.6  22917.4  20827.6
14  2009  1946.0  19439.7  18079.0
15  2008  1920.8  18519.4  16264.0
16  2007  1663.5  16022.6  14056.6
17  2006  1494.7  13158.0  11308.5
18  2005  1395.2  11049.2   9518.6
19  2004  1219.8   9191.7   8246.8, 'jiangsu':       年份     第一产业      第二产
业      第三产业
0   2023  5075.8  56909.7  66236.7
1   2022  4964.2  54886.1  62239.0
2   2021  4721.0  52678.7  59992.7
3   2020  4537.6  44631.3  53638.9
4   2019  4297.2  43507.5  50852.1
5   2018  4141.7  42129.4  46936.5
6   2017  4045.2  39124.1  42700.5
7   2016  4039.8  35041.5  38269.6
8   2015  3952.5  33371.8  33931.7
9   2014  3607.4  31048.8  30174.3
10  2013  3447.5  29149.4  26752.5
11  2012  3241.4  27150.8  23309.8
12  2011  2908.8  25231.2  20699.2
13  2010  2409.2  21853.6  17121.0
14  2009  2143.6  18667.2  13660.9
15  2008  1988.2  17051.1  11906.2
16  2007  1715.6  14497.4   9775.4
17  2006  1468.3  11991.1   7781.4
18  2005  1390.2  10234.1   6497.1
19  2004  1300.4   8325.8   5197.0, 'jiangxi':       年份     第一产业      第二产
业      第三产业
0   2023  2450.4  13706.5  16043.2
1   2022  2466.5  13483.0  15264.4
2   2021  2334.1  13230.7  14263.0
3   2020  2243.8  11107.9  12430.2
4   2019  2057.7  10820.3  11789.3
5   2018  1877.3  10081.2  10758.0
6   2017  1835.3   9444.6   8930.9
7   2016  1794.1   8732.5   7862.0
8   2015  1714.5   8367.7   6698.8
9   2014  1626.9   8238.7   5802.3
10  2013  1540.7   7661.9   5097.7
11  2012  1439.1   6893.3   4475.2
12  2011  1320.5   6338.0   3926.0
13  2010  1147.6   5083.1   3152.5
14  2009  1062.1   3882.7   2685.2
15  2008  1014.5   3518.8   2400.9
16  2007   868.6   2950.3   1958.7
17  2006   775.1   2337.6   1584.1
18  2005   717.7   1834.7   1388.9
```

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19  2004   664.5   1505.2   1228.4, 'hebei':       年份     第一产业      第二产业
第三产业
0   2023  4466.2  16435.3  23042.6
1   2022  4408.6  16129.6  21449.8
2   2021  4030.4  16355.8  20010.9
3   2020  3880.4  13765.1  18368.4
4   2019  3518.4  13393.7  18066.4
5   2018  3338.6  12904.1  16252.0
6   2017  3130.0  12778.0  14732.8
7   2016  3082.5  12332.3  13059.3
8   2015  3100.5  11519.5  11778.4
9   2014  3164.7  11476.9  10567.3
10  2013  3141.9  11178.4   9939.3
11  2012  2914.0  10919.7   9243.8
12  2011  2702.8  10275.5   8406.4
13  2010  2473.1   8470.5   7060.0
14  2009  2121.8   7164.4   6020.7
15  2008  1956.8   6981.5   5261.8
16  2007  1737.1   5849.5   4566.4
17  2006  1401.8   4771.9   3869.3
18  2005  1345.2   4123.9   3304.2
19  2004  1333.6   3467.9   2787.1, 'henan':       年份     第一产业      第二产业
第三产业
0   2023  5360.1  22175.3  31597.0
1   2022  5731.3  22140.6  30348.2
2   2021  5626.9  23566.4  28878.2
3   2020  5354.0  22220.9  26684.5
4   2019  4635.7  23035.6  26046.5
5   2018  4311.1  22038.6  23586.2
6   2017  4139.3  20940.3  19745.3
7   2016  4063.6  18986.9  17198.8
8   2015  4015.6  17947.9  15120.7
9   2014  3988.2  17139.6  13446.9
10  2013  3827.2  15995.4  11809.9
11  2012  3577.2  15042.6  10342.2
12  2011  3349.3  14021.6   8947.8
13  2010  3127.1  12173.5   7354.4
14  2009  2665.7  10324.6   6190.8
15  2008  2575.8   9713.4   5446.7
16  2007  2156.7   7904.0   4763.8
17  2006  1869.8   6316.2   3791.9
18  2005  1844.0   5202.3   3197.2
19  2004  1647.6   4080.7   2682.9, 'zhejiang':       年份     第一产业      第二产
业      第三产业
0   2023  2332.0  33952.7  46268.6
1   2022  2185.2  32973.8  42901.6
2   2021  2211.7  31174.0  40655.1
3   2020  2166.3  26361.5  36161.3
4   2019  2086.7  26299.5  34075.8
5   2018  1975.9  25308.1  30718.8
6   2017  1933.9  23246.7  27222.5
7   2016  1890.4  21571.3  23792.4
8   2015  1771.4  20606.6  21129.8
9   2014  1726.6  19580.7  18716.2
10  2013  1718.7  18162.8  17453.1
11  2012  1610.8  17040.5  15731.1
12  2011  1535.2  16271.0  14048.6
13  2010  1322.9  14140.9  11936.1
14  2009  1134.7  11882.4   9816.7
15  2008  1073.3  11512.7   8698.6
16  2007   969.3  10122.7   7547.9
17  2006   913.2   8295.7   6093.9
```

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18  2005   881.5   6953.7   5193.2
19  2004   803.8   6160.4   4517.9, 'hainan':       年份     第一产业     第二产业
第三产业
0   2023  1507.4  1448.5  4595.3
1   2022  1417.9  1308.7  4163.1
2   2021  1254.4  1240.8  4008.8
3   2020  1136.0  1072.2  3358.0
4   2019  1079.0  1083.8  3168.1
5   2018   986.0  1053.1  2871.6
6   2017   962.8   996.4  2538.4
7   2016   924.7   904.0  2261.5
8   2015   835.4   882.9  2016.0
9   2014   793.2   826.5  1829.3
10  2013   723.6   750.9  1641.4
11  2012   683.9   747.2  1358.3
12  2011   636.6   671.3  1155.9
13  2010   521.9   528.6   970.1
14  2009   448.1   432.4   739.8
15  2008   423.6   412.6   638.5
16  2007   351.3   354.3   528.4
17  2006   310.7   291.6   425.1
18  2005   289.9   229.8   365.2
19  2004   272.0   199.6   331.1, 'hubei':       年份     第一产业     第二产业
第三产业
0   2023  5073.4  20215.5  30514.7
1   2022  4982.1  19793.7  27965.8
2   2021  4635.2  19332.1  26123.9
3   2020  4133.2  15933.8  22937.6
4   2019  3809.4  18723.0  22896.5
5   2018  3548.2  17573.9  20899.9
6   2017  3529.0  15713.9  17992.2
7   2016  3406.5  14527.0  15419.5
8   2015  3109.9  13569.5  13664.6
9   2014  3001.6  13007.9  12232.6
10  2013  2883.7  11846.3  10648.0
11  2012  2674.8  11152.6   8763.5
12  2011  2469.2   9766.1   7707.1
13  2010  2043.2   7748.3   6435.5
14  2009  1717.3   6035.5   5439.3
15  2008  1716.0   5066.2   4715.2
16  2007  1331.4   4128.9   3991.1
17  2006  1125.5   3270.8   3135.5
18  2005  1069.8   2758.8   2641.0
19  2004  1008.9   2273.5   2264.4, 'hunan':       年份     第一产业     第二产业
第三产业
0   2023  4621.3  18822.8  26568.8
1   2022  4601.4  17899.8  25057.4
2   2021  4323.0  17852.5  23537.9
3   2020  4240.7  15949.2  21352.7
4   2019  3647.2  15401.7  20845.2
5   2018  3084.2  13904.1  19341.4
6   2017  2998.4  13459.8  17369.9
7   2016  2915.6  12942.0  14995.9
8   2015  2747.9  12665.7  13125.0
9   2014  2671.0  11825.1  11385.2
10  2013  2589.2  10913.8  10042.3
11  2012  2567.9   9926.7   8712.7
12  2011  2420.0   8883.6   7611.4
13  2010  2073.2   7034.7   6466.4
14  2009  1795.8   5494.7   5482.3
15  2008  1761.8   4870.0   4675.6
16  2007  1563.8   3867.4   3854.2
```

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17  2006  1244.6   3030.7   3156.2
18  2005  1078.3   2490.2   2801.4
19  2004  1022.5   2135.6   2384.6, 'gansu':       年份     第一产业     第二产业
第三产业
0   2023  1641.3  4080.8  6141.8
1   2022  1499.7  3928.3  5693.4
2   2021  1364.8  3451.2  5409.5
3   2020  1188.1  2824.8  4966.7
4   2019  1059.3  2862.4  4796.6
5   2018   926.1  2761.6  4416.4
6   2017   859.8  2515.8  3961.2
7   2016   800.8  2483.5  3623.7
8   2015   733.4  2505.4  3317.8
9   2014   695.8  2823.3  2999.4
10  2013   658.1  2674.0  2682.4
11  2012   590.9  2493.3  2308.9
12  2011   525.6  2288.6  2002.7
13  2010   472.6  1910.4  1560.8
14  2009   418.4  1473.2  1376.6
15  2008   391.2  1429.9  1250.5
16  2007   365.9  1254.1  1055.1
17  2006   329.8   972.5   900.6
18  2005   304.3   772.2   788.1
19  2004   283.3   680.3   690.0, 'fujian':       年份     第一产业     第二产业
第三产业
0   2023  3217.7  23966.4  27171.0
1   2022  3077.6  23125.3  25562.2
2   2021  2899.9  23319.8  23346.3
3   2020  2730.8  20168.4  20709.3
4   2019  2595.5  20065.5  19665.6
5   2018  2379.0  18847.8  17461.0
6   2017  2215.1  16290.0  15337.3
7   2016  2145.1  14683.7  12780.6
8   2015  1932.8  13735.7  11150.9
9   2014  1855.9  13165.1   9921.2
10  2013  1745.2  11805.5   8953.2
11  2012  1628.9  10527.0   8034.8
12  2011  1492.2   9316.6   7109.0
13  2010  1269.9   7705.3   6027.4
14  2009  1108.8   6129.1   5180.2
15  2008  1096.1   5387.0   4448.7
16  2007   951.2   4521.8   3852.6
17  2006   828.8   3629.7   3010.1
18  2005   792.5   3095.9   2527.0
19  2004   762.9   2738.7   2210.5, 'guizhou':       年份     第一产业     第二产业
第三产业
0   2023  2894.3  7311.4  10707.5
1   2022  2862.3  7052.7  10095.4
2   2021  2730.9  6850.5   9877.2
3   2020  2539.9  6263.0   9057.5
4   2019  2280.6  5971.5   8517.3
5   2018  2156.0  5506.2   7691.0
6   2017  2032.3  4970.9   6602.3
7   2016  1861.8  4468.7   5461.8
8   2015  1642.0  4026.7   4872.3
9   2014  1281.5  3582.4   4309.3
10  2013   999.3  3171.0   3802.7
11  2012   862.7  2716.8   3162.8
12  2011   699.6  2258.9   2657.1
13  2010   602.8  1820.7   2095.5
14  2009   531.2  1574.9   1750.6
15  2008   522.6  1437.7   1544.2
```

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16  2007   430.6  1187.2   1229.7
17  2006   367.2   953.0    944.0
18  2005   362.5   797.9    779.6
19  2004   335.1   667.0    647.3, 'liaoning':       年份     第一产业      第二产
业     第三产业
0   2023  2651.0  11734.5  15823.9
1   2022  2598.0  11363.6  14864.5
2   2021  2461.9  10883.3  14224.2
3   2020  2284.8   9357.5  13369.1
4   2019  2178.0   9475.9  13201.4
5   2018  2020.6   9049.0  12441.0
6   2017  1902.3   8328.9  11461.8
7   2016  1841.2   7865.7  10685.6
8   2015  2053.7   8344.6   9811.9
9   2014  2002.0   9038.8   8984.9
10  2013  1973.4   9204.2   8031.2
11  2012  1869.3   8886.9   7092.4
12  2011  1693.4   8478.7   6182.9
13  2010  1468.9   7181.8   5245.5
14  2009  1297.3   6539.3   4979.1
15  2008  1215.7   6273.1   4648.9
16  2007  1077.3   5060.2   4154.7
17  2006   908.6   4060.7   3421.1
18  2005   854.4   3443.9   2962.5
19  2004   774.4   2957.8   2737.6, 'shanxi2':       年份     第一产业      第二产
业     第三产业
0   2023  2649.8  16068.9  15067.4
1   2022  2575.0  15937.2  14326.0
2   2021  2409.9  14019.0  13692.9
3   2020  2267.7  11222.0  12524.4
4   2019  1991.1  11779.5  12022.6
5   2018  1830.2  11215.3  10896.4
6   2017  1741.1  10114.1   9618.3
7   2016  1696.1   8906.5   8443.2
8   2015  1599.7   8664.6   7634.5
9   2014  1566.9   9045.0   6790.6
10  2013  1463.5   8418.0   6023.9
11  2012  1314.8   7612.3   5215.3
12  2011  1187.4   6484.3   4503.4
13  2010   946.7   5071.5   3827.0
14  2009   751.6   4017.5   3228.7
15  2008   717.5   3666.1   2794.2
16  2007   560.7   2865.9   2255.2
17  2006   466.2   2271.0   1858.4
18  2005   418.6   1807.8   1590.8
19  2004   356.7   1506.1   1278.8, 'qinghai':       年份    第一产业     第二产业
第三产业
0   2023  387.0  1612.8  1799.2
1   2022  379.2  1591.0  1653.0
2   2021  353.6  1364.7  1666.7
3   2020  338.0  1143.2  1528.6
4   2019  301.9  1153.9  1485.3
5   2018  268.1  1093.7  1386.2
6   2017  238.4   975.7  1251.0
7   2016  221.2   867.7  1169.3
8   2015  208.9   761.1  1041.0
9   2014  215.9   714.8   917.0
10  2013  204.7   681.0   827.6
11  2012  174.2   620.2   734.1
12  2011  152.6   553.1   664.6
13  2010  132.6   444.2   567.4
14  2009  105.3   365.7   468.7
```

```
15  2008  103.6   350.3   443.0
16  2007   81.6   275.3   363.2
17  2006   65.8   228.1   291.2
18  2005   62.8   190.3   246.3
19  2004   58.1   154.4   231.2}
```

In the above code, we have completed the import of data and displayed the organized data sets. The above two data sets are df and province_data.

In order to more intuitively see the economic differences between different provinces, different years, and different industries in the past 20 years, we will use the following six functions: draw_province_year, draw_province_year_2, all_province_year, year_gpt_chart, province_gdp_chart, and draw_province_industries to draw pictures to display the economic status.

The following part of the code is the draw_province_year function, which compares the three industries of the selected province in that year.

In [36]:
```python
def draw_province_year(province, year):
    df = province_data[province]
    detail_data = df[df['年份'] == int(year)]

    fig, ax1 = plt.subplots(figsize=(12, 7))
    ax1.set_xlabel('产业')
    ax1.set_ylabel('GDP（亿元）')

    industries = ['第一产业', '第二产业', '第三产业']
    gdp_values = detail_data[industries].values.flatten()

    ax1.bar(industries, gdp_values, color='skyblue', label=f'{year} year {prov

    plt.title(f'{year} year {province} all industry development situation')
    plt.legend()
    plt.show()
```

The following part of the code is the draw_province_year_2 function, which compares the selected year with the three industries before the selected year.

In [38]:
```python
def draw_province_year_2(province, year1, year2):
    df = province_data[province]

    data_year1 = df[df['年份'] == int(year1)]
    data_year2 = df[df['年份'] == int(year2)]

    fig, ax = plt.subplots(figsize=(12, 7))

    industries = ['第一产业', '第二产业', '第三产业']
    bar_width = 0.35
    index = range(len(industries))

    gdp_values_year1 = data_year1[industries].values.flatten()
    gdp_values_year2 = data_year2[industries].values.flatten()

    ax.bar([p for p in index], gdp_values_year1, bar_width, label=f'{year1} 年

    ax.bar([p + bar_width for p in index], gdp_values_year2, bar_width, label=

    ax.set_xlabel('产业')
```

```
    ax.set_ylabel('GDP（亿元）')
    ax.set_title(f'{year1} 年和 {year2} 年 {province} 各产业增长情况')

    ax.set_xticks([p + bar_width / 2 for p in index])
    ax.set_xticklabels(industries)
    ax.legend()

    plt.tight_layout()
    plt.show()
```

The following part of the code is the all_province_year function, which displays the GDP of all provinces in the selected year and the GDP growth rate of that year.

In [40]:
```
def all_province_year(year):
    year = int(year)
    data_year_all = year
    all_year_before =year-1
    data_year_all_before =all_year_before
    df['增长率'] = (df[data_year_all] - df[data_year_all_before]) / df[data_yea

    plot_data_all = df[['省份', data_year_all, data_year_all_before, '增长率']]
    plot_data_all = plot_data_all.sort_values(by=data_year_all, ascending=Fals

    fig, ax1 = plt.subplots(figsize=(12, 7))
    color = 'tab:blue'
    ax1.set_xlabel('省份')
    ax1.set_ylabel(data_year_all, color = color)
    ax1.bar(plot_data_all['省份'],plot_data_all[data_year_all],color=color, lab

    ax2=ax1.twinx()
    color='tab:green'
    ax2.set_ylabel('当年 GDP 增长率', color = color)
    ax2.plot(plot_data_all['省份'], plot_data_all['增长率'], color=color, marker
    plt.show()
```

The following part of the code is the year_gpt_chart function. Its function is to display the GDP comparison of all provinces in a selected year in the past 20 years and the growth rate changes obtained by comparing the selected year with the previous year and the selected number of years before.

In [42]:
```
def year_gdp_chart(year,num):
    year = int(year)
    num = int(num)
    data_year=year
    user_input_before = year-1
    data_year_before=user_input_before
    user_input_before_num=year-num
    data_year_before_num=user_input_before_num

    df['GDP增长_当年'] = (df[data_year] - df[data_year_before]) / df[data_year_
    df['GDP增长_近几年'] = (df[data_year] - df[data_year_before_num]) / df[data_

    plot_data = df[['省份', data_year, 'GDP增长_当年', 'GDP增长_近几年']]
    plot_data = plot_data.sort_values(by=data_year, ascending=False)

    fig, ax1 = plt.subplots(figsize=(12, 7))
    #画初始图形
```

```
    color = 'tab:blue'
    ax1.set_xlabel('province')
    ax1.set_ylabel(data_year,color=color)
    ax1.bar(plot_data['省份'],plot_data[data_year],color=color, label=data_year
    #画当年 GDP 体量的柱状图

    ax2=ax1.twinx()
    color='tab:green'
    ax2.set_ylabel('chose year/nearly few years GDP change')
    ax2.plot(plot_data['省份'], plot_data['GDP增长_当年'], color=color, marker='
    #画当年 GDP 增长的折线图

    color='tab:red'
    ax2.plot(plot_data['省份'], plot_data['GDP增长_近几年'], color=color, marker
    fig.tight_layout()
    ax1.legend(loc='upper left')
    ax2.legend(loc='upper right')
    plt.show()
```

The following part of the code is the province_gdp_chart function, which displays all 20 years of GDP data for a selected province.

In [44]:
```
def province_gdp_chart(province_1):
    province = str(province_1)

    plot_data = df[df['省份'] == province]
    # 提取代表年份的列：将每个列名转换为字符串后判断是否以"20"开头
    gdp_columns = [col for col in df.columns if str(col).startswith('20')]

    # 年份转换为整数（因为列名原本是整数或数字形式）
    years = [int(str(col)) for col in gdp_columns]

    # 获取对应的 GDP 数值
    gdp_values = plot_data[gdp_columns].values.flatten()

    # 绘制图表
    fig, ax1 = plt.subplots(figsize=(12, 7))
    ax1.bar(years, gdp_values, color='skyblue')

    # 添加标题和坐标轴标签
    ax1.set_title(f"{province} 省份的 GDP 变化")
    ax1.set_xlabel("year")
    ax1.set_ylabel("GDP (100 million yuan)")

    plt.xticks(years)
    plt.show()
```

The following part of the code is the draw_province_industries function. Its function is to divide the GDP of the selected provinces in 20 years into 3 industries and display it.

In [46]:
```
import matplotlib.pyplot as plt
import numpy as np

def draw_province_industries(province):
    df = province_data.get(province)
    # 按年份排序
    df = df.sort_values(by='年份')
```

```
    years = df['年份'].astype(str).tolist()
    industry_1 = df['第一产业'].values
    industry_2 = df['第二产业'].values
    industry_3 = df['第三产业'].values

    # 设定图结构
    bar_width = 0.25
    indices = np.arange(len(years))
    fig, ax = plt.subplots(figsize=(14, 8))

    # 画图
    ax.bar(indices - bar_width, industry_1, bar_width, label='第一产业', color=
    ax.bar(indices, industry_2, bar_width, label='第二产业', color='orange')
    ax.bar(indices + bar_width, industry_3, bar_width, label='第三产业', color=

    # 写标签
    ax.set_xlabel('year')
    ax.set_ylabel('GDP (100 million yuan) ')
    ax.set_title(f"{province} 各产业 20 年 GDP 变化")
    ax.set_xticks(indices)
    ax.set_xticklabels(years)

    ax.legend()
    plt.show()
```

The following part of the code is the draw_province_industries_2 function, which adds the growth rate of industry GDP on the basis of draw_province_industries.

In [48]:

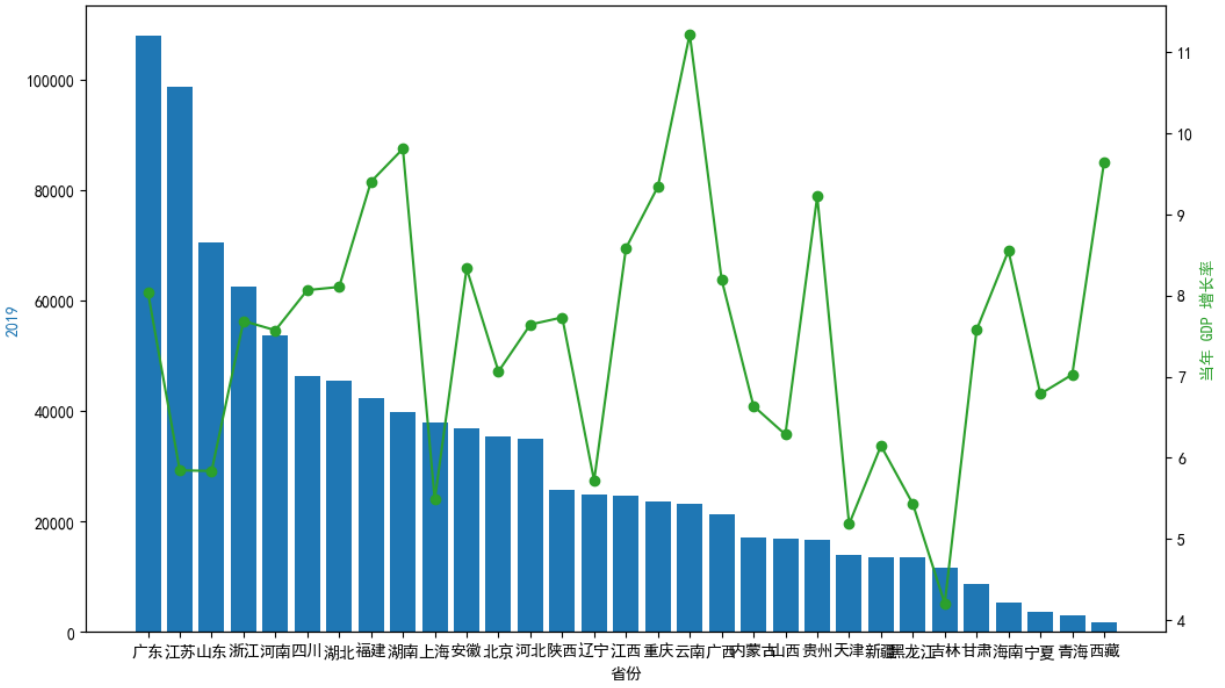
```
import matplotlib.pyplot as plt
import numpy as np

def draw_province_industries_2(province):
    df = province_data.get(province)
    # 按年份排序
    df = df.sort_values(by='年份')

    years = df['年份'].astype(str).tolist()
    industry_1 = df['第一产业'].values
    industry_2 = df['第二产业'].values
    industry_3 = df['第三产业'].values

    growth_rate_1 = [None] + [(industry_1[i] - industry_1[i - 1]) / industry_1
    growth_rate_2 = [None] + [(industry_2[i] - industry_2[i - 1]) / industry_2
    growth_rate_3 = [None] + [(industry_3[i] - industry_3[i - 1]) / industry_3

    bar_width = 0.25
    indices = np.arange(len(years))
    fig, ax1 = plt.subplots(figsize=(14, 8))

    ax1.bar(indices - bar_width, industry_1, bar_width, label='第一产业', color
    ax1.bar(indices, industry_2, bar_width, label='第二产业', color='orange')
    ax1.bar(indices + bar_width, industry_3, bar_width, label='第三产业', color

    ax1.set_xlabel('year')
    ax1.set_ylabel('GDP (100 million yuan)')
    ax1.set_title(f"{province} 各产业 20 年 GDP 变化")
    ax1.set_xticks(indices)
    ax1.set_xticklabels(years)
```

```
    ax2 = ax1.twinx()
    line_x = indices[1:]
    ax2.plot(line_x, growth_rate_1[1:], color='blue', marker='o', linestyle='-
    ax2.plot(line_x, growth_rate_2[1:], color='orange', marker='o', linestyle=
    ax2.plot(line_x, growth_rate_3[1:], color='green', marker='o', linestyle='
    ax2.set_ylabel("change rate (%) ")
    ax1.legend(loc='upper left')
    ax2.legend(loc='upper right')
    plt.show()
```

At this point we have completed running all functions. Next, we will use these functions to organize our data and draw graphs to more intuitively display the differences between them.

You may want to know the gap between the GDP of all provinces in a certain year. You can use the all_province_year function to display the chart. You will be asked to enter the year you want the GDP of all provinces to be displayed, and then press the Enter key. The chart will display the total GDP of all provinces for that year and the GDP growth rate for that year.

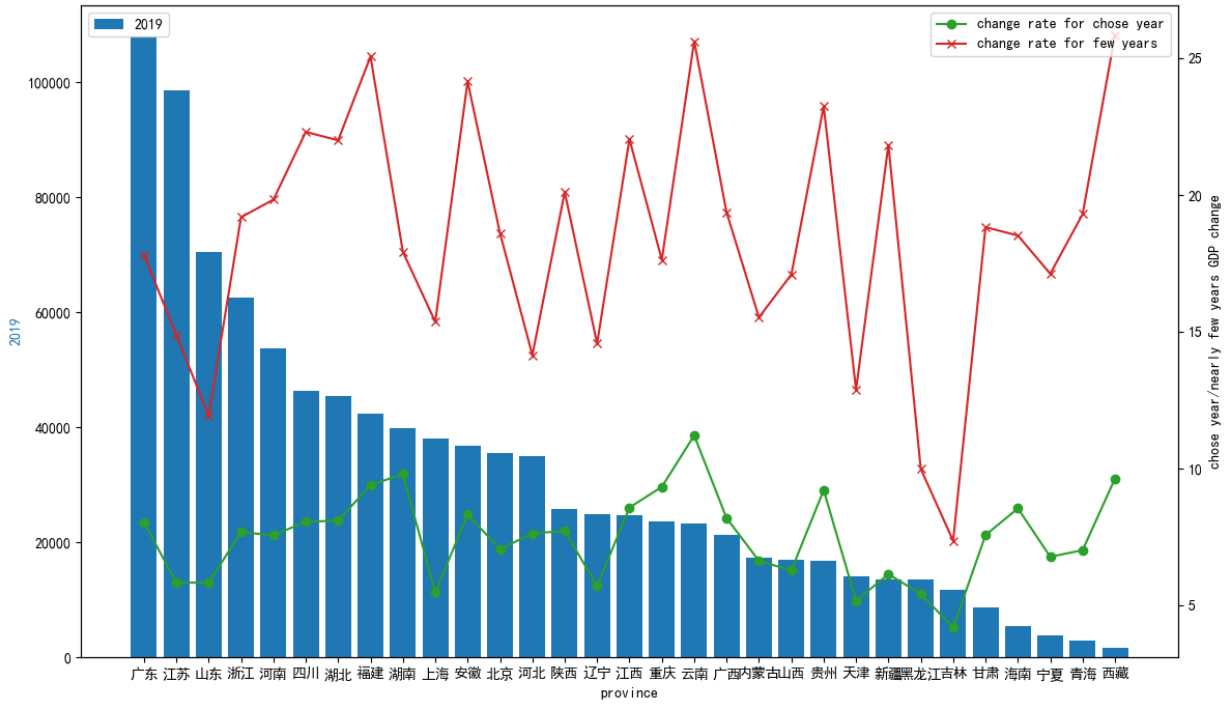
In [51]:
```
year_input =input("please input the year you want: ")

all_province_year(year_input)
```



Of course, we can not only calculate the GDP growth rate of that year, but as long as the data exists within these 20 years (that is, the year minus the number of years is greater than or equal to 2004), we can calculate the growth rate. We can use the new function year_gdp_chart. You will be asked to enter the year you want, and the number of years you want (that is, how many years forward the growth rate is). By running this function, we can see that the new chart adds the growth rate you want the number of years ahead to the previous one.

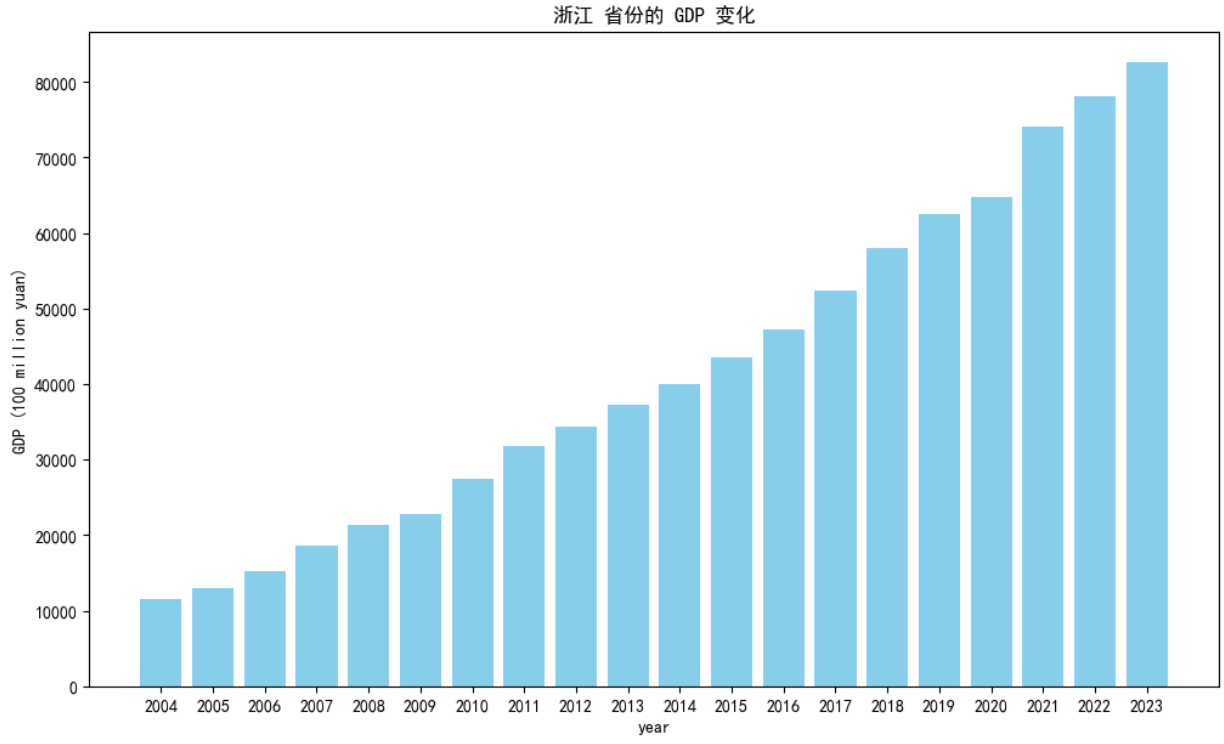
In [53]:
```
year_input =input("please input the year you want: ")
year_number_input= input("please input how many year you want：")
year_input_2 = str(int(year_input) + int(year_number_input))
```

```
year_gdp_chart(year_input,year_number_input)
```



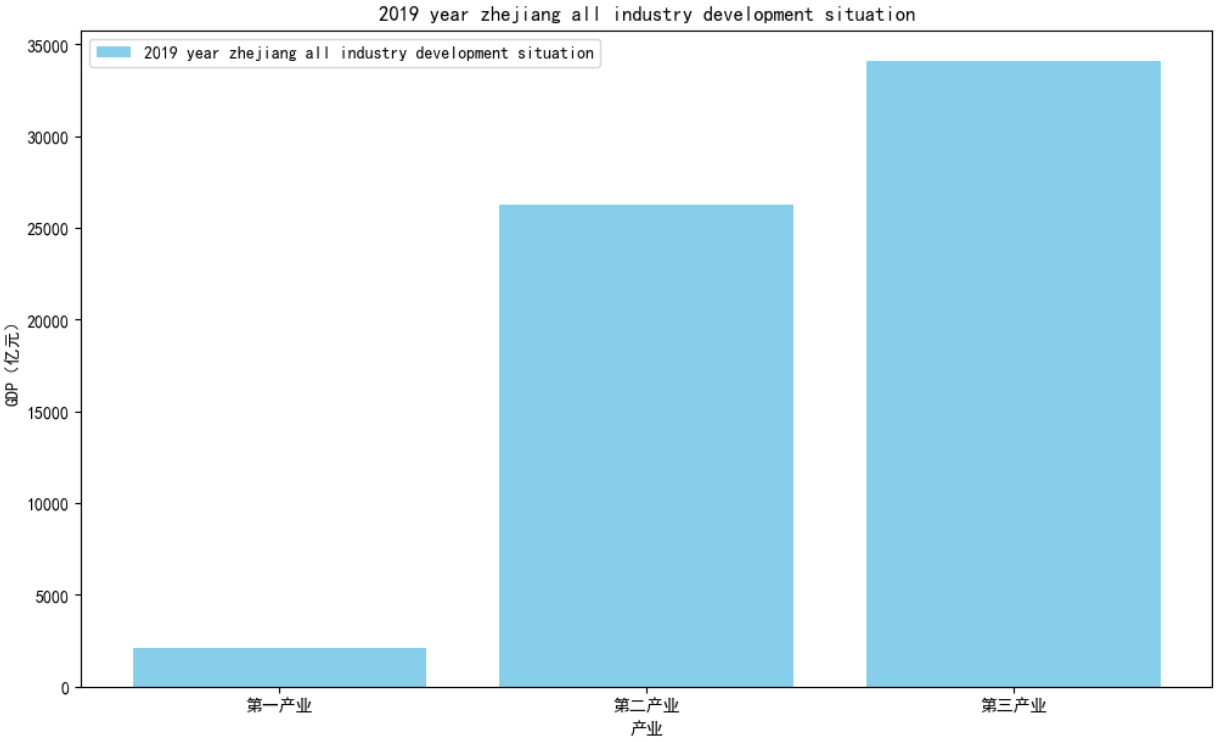
The two pictures above show the data of all provinces in a certain year. Next, we will run the province_gdp_chart function. Through this function, the content of the chart we get will be completely opposite to the two pictures above. You will be asked to enter the province, and this chart will show the province's GDP data for 20 years.

In [55]:
```
province_input = input("please input the province you want(chinese)：")
province_gdp_chart(province_input)
```



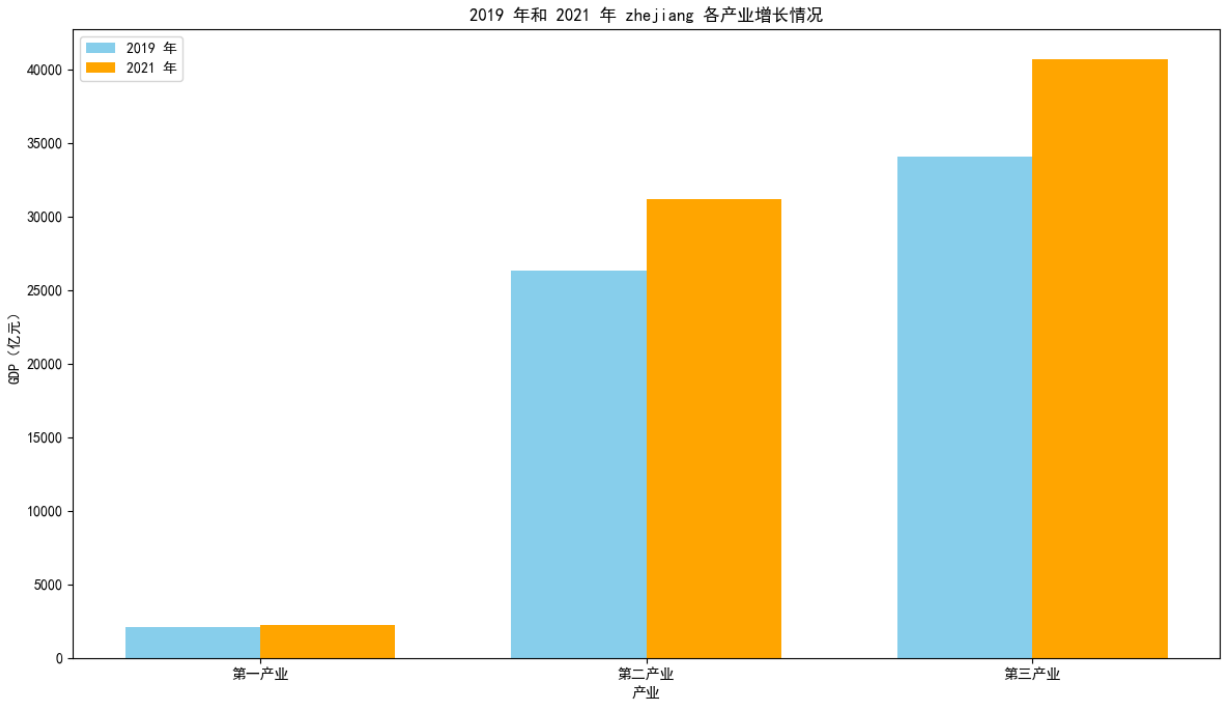
After understanding the above three pictures, you may be confused about the changes in some data. In order to understand the reasons for the changes in the data, we can refine the data by dividing GDP into 3 industries and find the main industries causing the changes in the data. We will use the draw_province_year function, and you will be asked to enter the province name and year. You will then be shown a chart showing how much GDP each of the three industries accounted for in the province you selected in the year you selected.

In [57]:
```
province_name = input("please input the province you want (all lowcase english
year_input =input("please input the year you want: ")

draw_province_year(province_name,year_input)
```



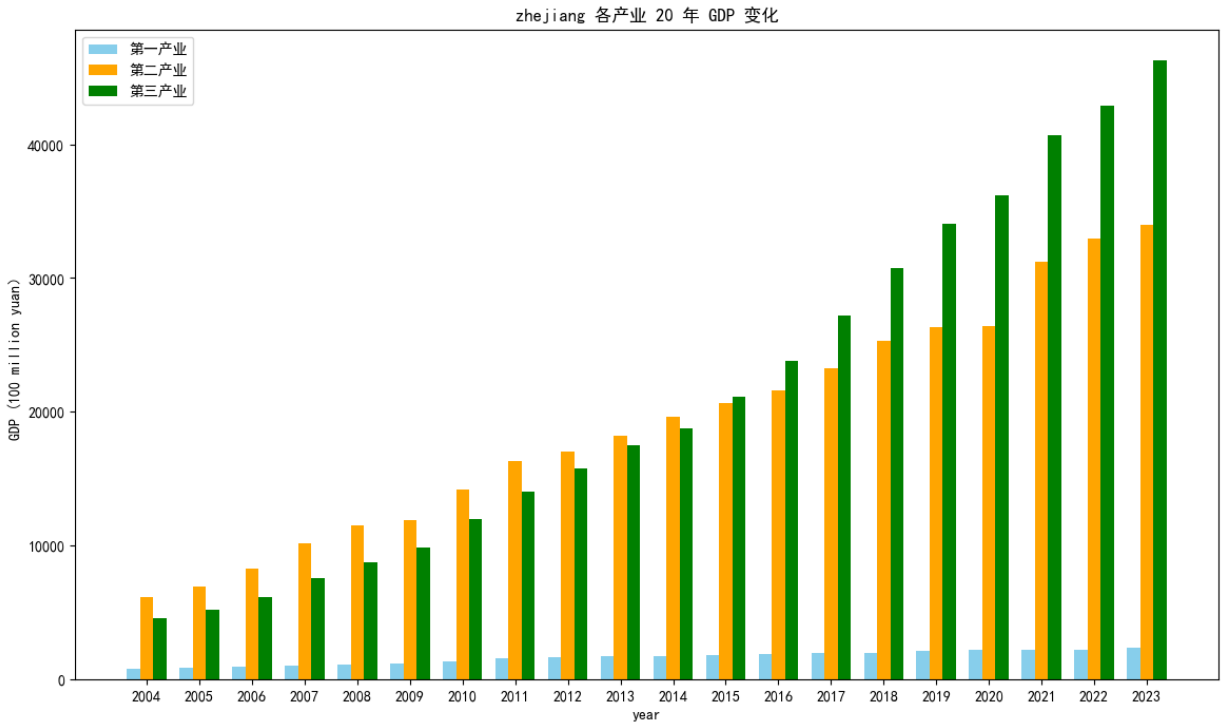
Of course, we can compare industry data with data from other years as before. Here we use the draw_province_year_2 function. You will be asked to enter the province, year, and how many years back you want to go. In this way, we will get the total GDP of the three industries in the year you selected after the selected number of years.

In [59]:
```
province_name = input("please input the province you want (all lowcase english
year_input =input("please input the year you want: ")
year_number_input= input("please input how many years you want：")
year_input_2 = str(int(year_input) + int(year_number_input))

draw_province_year_2(province_name, year_input, year_input_2)
```



If you want to have a more intuitive understanding of the changes in industrial distribution over the past 20 years, the following picture will help you. This picture uses the draw_province_industries function. You will enter the province you want and you can get the total GDP distribution of the three industries in the province in the past 20 years.

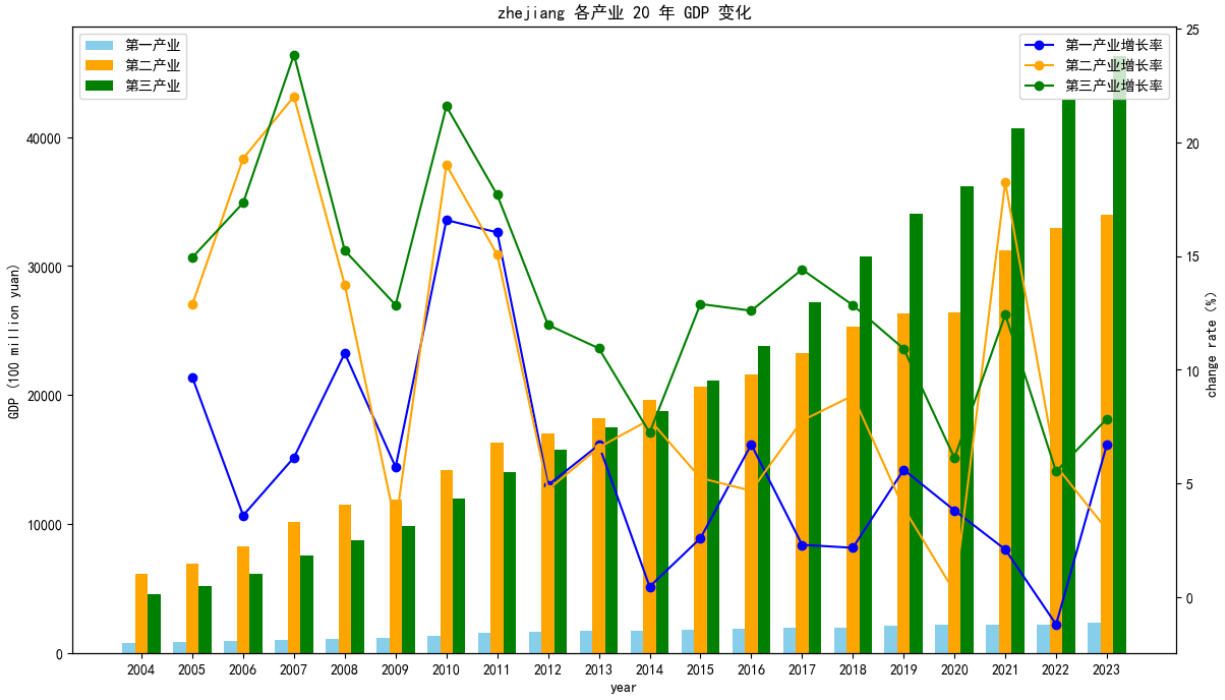
In [61]:
```
province_input = input("please input the province you want (all lowcase englis
draw_province_industries(province_input)
```



It is easy to see from the above figure that no matter which industry it is, it has been in a state of growth. It may be difficult to draw results through total observation. Therefore, we can add a line chart to represent the growth rate of the industry that year. So I improved the function to

draw_province_industries_2. This function added the function of calculating and displaying the industry growth rate of the year based on the previous one. You need to enter the province you want and after pressing enter the chart will be generated.

In [63]:
```
province_input = input("please input the province you want (all lowcase englis
draw_province_industries_2(province_input)
```



The above content is the entire analysis of China's economy in this article