Analysis and Forecast of China's Economy and Structure from 2016–2035

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Abstract: In this paper, to construct a model of China's economic system and forecast the scale and structure of the China's economy over the next twenty years, we consider the main factors affecting the potential growth of the economy and its transmission mechanism. In the benchmark scenario for 2016–2020, 2021–2025, 2025–2030, and 2031–2035, China's gross domestic product (GDP) forecast growth rates are 6.4%, 5.6%, 4.9%, and 4.5%, respectively. In 2035, China's GDP scale will be 10.06 times greater than in 2000, 3.99 times greater than in 2010, and 2.02 times greater than in 2020. Over the next 20 years, investment-driven economic growth will gradually become increasingly led by consumption demand. In the face of slowing growth in developed economies and a gradual reduction of its domestic labor force, China needs to strengthen research and education investment; improve investment efficiency, total factor productivity, and technological progress; promote the transformation and upgrading of the manufacturing industry; and accelerate tax reforms in the financial system and modify the income distribution system.

Keywords: economic forecast; economic growth; structural analysis; computable general equilibrium

1 Introduction

After thirty years of rapid growth, China's economy has begun to change from a structural growth stage to a structural reducing stage, and this kind of change is not only consistent with the general principles of economic development, but is also the result of many domestic problems (such as population aging, excess capacity, and environmental pollution) and sluggish international demand. Given these factors, what is the growth potential of China's economy? Does the economic miracle of the past 30 years imply continued rapid growth in the future? This is a matter of great concern to all parties.

Kuijs [1] analyzed China's economic growth trend up to the year 2045 with a computable general equilibrium (CGE) model and presented average annual growth rates for China's GDP during the periods of 2005–2015, 2015–2025, 2025–2035, and 2035–2045 to be 8.3%, 6.7%, 5.6%, and 4.6%, respectively.

Li et al. [2] made predictions about China's economic development up to 2030 with a DRC-CGE (developed by Development Research Center of the State Council) model by including three scenarios: a baseline scenario, the successful transformation of development, and a high-risk situation. The results showed that China's average economic growth rate during the 12th Five-Year Plan period will be 7.9% in the benchmark scenario and gave average annual growth rates of 7% and 6.2% for 2016–2020 and 2021–2030, respectively.

Goldman Sachs [3] calculates expected growth rates of China's GDP to be approximately 7.9%, 5.7%, 4.4%, and 3.6% for the periods 2011–2020, 2021–2030, 2031–2040, and 2041–2050, respectively.

Following Barro's growth model, HSBC [4] predicted that over the next 40 years, China would maintain an annual growth rate of more than 5%, specifically, 5.5%, 4.4%, and 4.1% for the periods 2020–2030, 2031–2040, and 2041–2050, respectively.

The research also showed that during 2010–2020, China's economic growth would be the fastest in the world, but that after 2020, the growth of some Asian countries will begin to exceed China's.

After considering energy and environmental constraints as well as urbanization and technological progress, which were the two main factors driving China's economic development, Zhang et al. [5] predicted China's economic growth during 2010–2030 with an aggregate production function. The results showed growth of 9.5% for the period 2010–2015, 7.3% for 2016–2020, and 5.8% for 2020–2030.

Yao [6] suggested in an international comparison that China's economic growth would remain around 8% up until 2020, given China's education standards, increases in R&D investment, and other factors.

Under the hypothesis of implementation of the "supply-side structural reform," Li et al. [7] predicted an average economic growth rate for China of 6.5% and 5.8% for the 13th Five-Year Plan period and 14th Five-Year Plan period, respectively, which is 0.2% and 0.3%, respectively, higher than the baseline scenario of China's historical trends in the inertia development.

In summary, the research literature to date has not reached a consensus on China's medium- and long-term economic development trends or China's long-term potential economic growth rate. In view of domestic and international drivers of potential output, and the transmission mechanism of China's macro-econometric model, the paper estimates the growth path of China's economy for the next 20 years.

2 Internal mechanism of China's economic growth under the "new normal"

According to economic theory, the long-term potential growth rate mainly depends on labor, capital, and total factor productivity (TFP). The Cobb-Douglas production function consistent with these three factors determines the supply side constraint. Up until now, China's high-speed growth mainly relied on large-scale cheap inputs, such as land, labor, capital, and natural resources; however, the original endowment conditions of labor and environmental resources have now changed. Economic growth, which depended on the old driving factors, was unsustainable, as the mode for growth has become primarily innovation-driven, wherein TFP is key. To date, TFP has made little contribution to China's economic growth. On the one hand, technological innovation and technological progress rates were low; on the other hand, due to an irrational institutional mechanism, which leads to low resource allocation efficiency, the level of management and production capacity have been low. Therefore, the "supply-side structural reform" must focus on resolving institutional obstacles to improve allocative efficiency, promote the improvement of TFP, and improve China's long-term potential economic growth rate. Supply-side structural reforms have the following two aspects:

(1) Technological innovation-driven. According to the basic laws of economic development, the contribution of TFP in economic growth is the decisive factor in the promotion of production efficiency under certain conditions of productive inputs. Within TFP, technological innovation is the core power of economic growth. Technological innovation and technological progress, by reducing overcapacity and ineffective production capacity, can not only improve the added value of a product and expand product market share, but can also compensate for the weakening contribution of labor and capital to economic growth. In addition, supply-side technological innovation also spurs demand side growth, through enhancing industry core competitive power—promoting product exports. In recent years, with the rapid increase of research and development (R&D) investment in China, China's science and technology industry has developed rapidly, and technological innovation is leading to China becoming a global leader in the field. Moreover, as part of the supply-side structural reform strategy, the contribution of technological progress to economic growth will become much greater.

(2) Institutional innovation-driven. The institutional system factor is also a main component of TFP, and a good system can significantly improve TFP and improve economic growth. Essentially, the supply-side structural reform enables the release of the bonus system, improves the economic and social management system in the market, and allows the market mechanism to play a decisive role in the allocation of resources. Additionally, they improve the economic development system, the relationship between government and the market, stimulate market innovation, improve the flow of resource elements and allocation efficiency, and improve the efficiency of the market economy.

As the economy is a complete organic system with interrelated variables (such as production, consumption, investment, trade, savings, distribution, population, energy, environment, financial, and other economic variables) influencing each other, to understand and solve any specific problem, there must be a link with other variables/issues. The analysis of practical problems requires the use of comprehensive data and new analytical tools, both quantitative and qualitative, to build a comprehensive model of a large-scale economic system for analysis and forecasting.

Consequently, our study established China's economy-energy-environment-tax dynamic computable general equilibrium (CN3ET-DCGE) model, which includes nine modules: production, trade, income and demand, enterprise, government revenue and expenditure, market equilibrium, social welfare, environment, and a dynamic module [8].

3 China's macroeconomic growth forecast for 2016–2035

Based on the CN3ET-DCGE model and combined with the national 13th Five-Year Plan, this study has three economic

growth scenarios: ① the inertia of historical development trend as a benchmark scenario; ② "supply-side structural reform" as a rapid growth scenario; and ③ a slower growth scenario in which both China's economic transition and supply-side structural reform are unsuccessful, and the "13th Five-Year Plan" target is unrealized[†]. Moreover, according to a basic law of economic history, when the economy experiences severe overcapacity and a labor shortage, the output elasticity of capital will be reduced slowly, and the output elasticity of labor will be a slow rising trend. Therefore, in the period 2016–2035, the study includes a capital elasticity coefficient β and a labor elasticity coefficient γ as variable coefficients. The value β drops slowly from 0.6 in 2016 to 0.45 in 2035, while the value γ rises slowly from 0.4 in 2016 to 0.55 in 2035. According to the above-mentioned economic growth mechanism and the CN3ET-DCGE model, our forecasts of the main indicators of China's economy are shown in Table 1, which shows that despite the gradual decline in China's economic growth rate, under each scenario, China's economy is able to maintain consistent growth and development through 2016–2035.

3.1 Prediction and analysis of China's GDP for 2016–2035

In the baseline scenario, the average GDP growth in 2016–2020, 2021–2025, 2026–2030, and 2031–2035 were 6.4%, 5.6%, 4.9%, and 4.5%, respectively. In the rapid growth scenario, if China successfully implements reforms such as steadily promoting urbanization, transformation and upgrading of the manufacturing industry, enhancing the international competitiveness of products, further increasing the proportion of financial education funds in the GDP, improving the quality of workers, strengthening R&D investment, improving the added value of the products, and deepening the market, then for the plan periods 2016–2020, 2021–2025, 2026–2030, and 2031–2035, we predict an average GDP growth of 6.5%, 6.0%, 5.5%, and 5.1%, respectively. However, in the slower growth scenario, average GDP growth is 6.0%, 5.2%, 4.3%, and 3.6%, in the four periods, respectively.

For the baseline scenario, the contribution of the capital stock, the labor force, and TFP to GDP growth for 2016–2035 is shown in Table 2.

Table 1. Forecast of China's potential economic growth rate for 2016–2035. %

Year	Baseline scenario	Rapid growth scenario	Slow growth scenario
2016	6.7	6.8	6.6
2017	6.5	6.6	6.2
2018	6.4	6.5	6.0
2019	6.2	6.3	5.7
2020	6.1	6.2	5.5
Average in 2016–2020	6.4	6.5	6.0
2021	5.9	6.3	5.6
2022	5.7	6.1	5.4
2023	5.6	6.0	5.2
2024	5.5	5.9	5.0
2025	5.3	5.8	4.9
Average in 2021–2025	5.6	6.0	5.2
2026	5.2	5.7	4.7
2027	5.0	5.6	4.5
2028	4.9	5.5	4.3
2029	4.8	5.4	4.2
2030	4.7	5.3	4.0
Average in 2026–2030	4.9	5.5	4.3
2031	4.6	5.2	3.9
2032	4.6	5.2	3.7
2033	4.5	5.1	3.6
2034	4.5	5.0	3.5
2035	4.4	5.0	3.4
Average in 2031–2035	4.5	5.1	3.6

[†] In this paper, some key economic forecasting is based on the assumption about exogenous variables (population growth, urbanization rate, financial education funds, research and development (R&D) driving the actual growth rate, FDI growth rate, the world GDP actual growth rate, market rate, environmental pollution control investment growth rate, capacity utilization rate etc.).

Table 2. Decomposition of China's potential economic growth rate for 2016–2035 under the benchmark scenario.

Year	GDP growth (%)	Utilization of the capital stock		Labor		Total factor productivity	
		Contribution rate (%)	Contribution degree	Contribution rate (%)	Contribution degree	Contribution rate (%)	Contribution degree
2016	6.7	55.04	3.69	1.28	0.09	43.68	2.93
2017	6.5	54.06	3.51	1.32	0.09	44.62	2.90
2018	6.4	53.36	3.42	1.31	0.08	45.33	2.90
2019	6.2	52.63	3.26	1.31	0.08	46.06	2.86
2020	6.1	51.95	3.17	1.28	0.08	46.77	2.85
Average in 2016–2020	6.4	53.41	3.42	1.30	0.08	45.29	2.90
2021	5.9	51.28	3.03	1.22	0.07	47.50	2.80
2022	5.7	50.58	2.88	1.11	0.06	48.31	2.75
2023	5.6	49.81	2.79	1.00	0.06	49.19	2.75
2024	5.5	49.13	2.70	0.83	0.05	50.04	2.75
2025	5.3	48.43	2.57	0.67	0.04	50.90	2.70
Average in 2021–2025	5.6	49.85	2.79	0.97	0.05	49.19	2.75
2026	5.2	47.70	2.48	0.46	0.02	51.84	2.70
2027	5.0	47.19	2.36	0.24	0.01	52.57	2.63
2028	4.9	46.46	2.28	−0.01	0.00	53.55	2.62
2029	4.8	45.67	2.19	−0.29	−0.01	54.62	2.62
2030	4.7	45.04	2.12	−0.59	−0.03	55.55	2.61
Average in 2026–2030	4.9	46.41	2.27	−0.04	0.00	53.63	2.63
2031	4.6	44.37	2.04	−0.88	−0.04	56.51	2.60
2032	4.6	43.69	2.01	−1.17	−0.05	57.48	2.64
2033	4.5	43.01	1.94	−1.46	−0.07	58.45	2.63
2034	4.5	42.33	1.90	−1.75	−0.08	59.42	2.67
2035	4.4	41.65	1.83	−2.04	−0.09	60.39	2.66
Average in 2031–3035	4.5	43.01	1.94	−1.46	−0.07	58.45	2.63

3.2 Prediction and analysis of the three industrial structural changes

According to the forecasting, under the benchmark scenario, in 2035 China's fixed price will be 10.06 times the GDP scale of that in 2000, 3.99 times that in 2010, and 2.02 times that of 2020's value. For the period 2016–2035, the growth of the national economy is not only reflected in this rapid increase, but also in a revised economic structure which involves three industries at different rates of growth, the result of a long-term focus on qualitative aspects. Over the next 20 years, the three-industry trend is roughly as follows (Table 3): ① in respect to industry structure, the proportion of the three industries in the economy changes steadily, namely, the proportion of the primary industry and the secondary industry decreases each year, and the tertiary industry proportion increases each year; ② during the period 2016–2035, the proportion of the primary industry is stable, only decreasing by 1.7 percentage points; the secondary industry's added value accounted for in the proportion of GDP has dropped by 10.4 percentage points; the tertiary industry has maintained its largest share in the national economy, and moreover, the pro-

portion of the tertiary industry in 2016 is more than 50%, and its position in the national economy is further consolidated; and ③ in 2035, the value-added proportion of each industry's added value in the national economy was 7.4%, 29.9%, and 62.7%.

3.3 Forecast and analysis of China's economic structure (investment, consumption, and net exports)

According to the forecast results of the CN3ET-DCGE model (Table 4), during the period 2016–2035, China's economic growth and structure will change significantly. From the perspective of its consumption structure, the proportions of rural residents' and urban residents' consumption in final consumption will increase every year, especially for urban residents. The proportion of government consumption in total consumption decreases each year because of China's strategic decision to boost urbanization. In addition, with the rapid development of urbanization, the urban population will continue to expand; hence, the income and social welfare of urban residents will be further increased. On the other hand, the series of policies to curb government's expenditures on food and drinking has been successful,

Table 3. China's GDP and three industrial structures for 2016–2035 under the benchmark scenario.

Year	GDP (trillions of yuan, current price)	GDP (trillions of yuan, year 2000 price)	GDP growth rate (%)	Value-added ratio of primary industry (%)	Value-added ratio of secondary industry (%)	Value-added ratio of tertiary industry (%)
2000	99 215	158 990	8.4	15.1	45.9	39.0
2001	109 655	172 412	8.4	14.4	45.2	40.5
2002	120 333	188 172	9.1	13.7	44.8	41.5
2003	135 823	208 043	10.6	12.8	46.0	41.2
2004	159 878	230 037	10.6	13.4	46.2	40.4
2005	185 999	256 449	11.5	12.1	47.4	40.5
2006	219 029	287 239	12.0	11.1	47.9	40.9
2007	270 844	319 832	11.3	10.8	47.3	41.9
2008	321 501	347 742	8.7	10.7	47.4	41.8
2009	348 499	372 093	7.0	10.3	46.2	43.4
2010	411 265	401 513	7.9	10.1	46.7	43.2
2011	484 753	439 292	9.4	10.0	46.6	43.4
2012	539 117	473 117	7.7	10.1	45.3	44.6
2013	590 422	509 553	7.7	10.0	44.9	45.1
2014	644 791	547 260	7.4	9.2	42.6	48.2
2015	685 506	585 568	7.0	9.1	42.0	48.8
2016	743 088	624 801	6.7	9.1	40.3	50.6
2017	806 251	664 789	6.5	9.0	39.5	51.5
2018	873 170	706 672	6.4	8.9	38.8	52.3
2019	944 770	749 216	6.2	8.8	37.7	53.5
2020	1 020 351	793 720	6.1	8.7	36.5	54.8
2021	1 099 938	838 728	5.9	8.6	36.2	55.2
2022	1 184 634	884 861	5.7	8.5	35.5	56.0
2023	1 274 666	932 911	5.6	8.4	34.8	56.7
2024	1 368 991	982 356	5.5	8.4	34.4	57.3
2025	1 468 928	1 031 969	5.3	8.3	33.8	57.9
2026	1 573 221	1 083 571	5.2	8.2	33.2	58.6
2027	1 683 347	1 135 045	5.0	8.1	32.9	59.0
2028	1 799 498	1 188 394	4.9	8.0	32.5	59.5
2029	1 921 864	1 243 063	4.8	7.9	32.0	60.1
2030	2 050 629	1 299 002	4.7	7.8	31.8	60.4
2031	2 188 021	1 356 162	4.6	7.7	31.4	60.9
2032	2 332 430	1 415 833	4.6	7.7	31.0	61.4
2033	2 486 370	1 476 009	4.5	7.6	30.6	61.8
2034	2 647 984	1 539 477	4.5	7.5	30.3	62.3
2035	2 814 807	1 603 369	4.4	7.4	29.9	62.7

The values in 2000–2015 years are historical data, and the values in 2016–2035 years are forecasted data.

and thus, its relative proportion has gradually declined.

From the perspective of economic growth, from 2016, the proportion of final consumption will exceed the rate of capital formation, thus consumption will become the main driving force for China's economic growth. Over the next 20 years, economic growth driven by investment will gradually change, becoming increasingly consumer demand-led, which will undoubtedly help to improve the investment structure and investment efficiency.

4 Conclusions and suggestions

Historical world economic development proves that when an economy develops rapidly and reaches a certain level, the speed of economic growth then slows before moving to a gradual declining stage. Similar to many developed countries, China is entering the declining stage; its potential economic growth is gradually falling. While accepting this objective principle of de-

Table 4. Forecast of China's economic growth structure (constant price) for 2016–2035.   %

Year	Consumption ratio of rural residents	Consumption ratio of urban residents	Government consumption ratio	Final consumption ratio	Capital formation ratio	Net export ratio
2016	8.32	29.48	11.38	49.18	49.16	1.65
2017	8.37	29.75	11.18	49.30	49.15	1.55
2018	8.42	30.02	10.99	49.43	49.11	1.46
2019	8.46	30.28	10.82	49.56	49.07	1.37
2020	8.51	30.54	10.66	49.70	49.01	1.29
Average in 2016–2020	8.42	30.01	11.01	49.44	49.10	1.46
2021	8.56	30.79	10.50	49.85	48.93	1.21
2022	8.61	31.03	10.36	50.00	48.85	1.15
2023	8.66	31.28	10.22	50.16	48.76	1.08
2024	8.71	31.51	10.10	50.32	48.66	1.02
2025	8.76	31.75	9.98	50.48	48.55	0.97
Average in 2021–2025	8.66	31.27	10.23	50.16	48.75	1.09
2026	8.81	31.98	9.87	50.65	48.43	0.91
2027	8.86	32.20	9.76	50.83	48.31	0.87
2028	8.91	32.43	9.66	51.00	48.18	0.82
2029	8.96	32.65	9.57	51.18	48.04	0.78
2030	9.01	32.88	9.47	51.37	47.89	0.74
Average in 2026–2030	8.91	32.43	9.67	51.01	48.17	0.82
2031	9.05	33.28	9.28	51.61	47.71	0.68
2032	9.09	33.69	9.06	51.85	47.52	0.64
2033	9.12	34.18	8.80	52.10	47.31	0.59
2034	9.16	34.66	8.60	52.42	47.04	0.54
2035	9.19	35.25	8.31	52.75	46.75	0.50
Average in 2031–2035	9.12	34.21	8.81	52.15	47.26	0.59

velopment, China is attempting to slow the decline using supply and demand factors. This is due to three reasons: China is still a developing country, its technological progress and innovation still have scope for improvement, and there still is a huge market demand for escalating consumption and investment. Therefore, our recommendations are as follows:

4.1 Deepen the reform of the administrative system and actively change the functions of the government

The key to advancing the structural reform of the supply-side and encouraging enterprises is to improve the relationship between the government and the market. Because the traditional supply-side factors of production (such as capital and labor) have shown a decreasing return to scale, future sustainable development must rely on new factors such as TFP (as the representative of information technology, innovation, management, etc.), and these new factors of production need a free market environment in cultivation, development, and growth. Therefore, the government should deepen the reform of the administrative system through the establishment of a legal "power list," "negative list," and "responsibility list" to determine the reasonable

boundaries of government and market, minimize government interference for micro-market transactions, and improve the government's decision-making. This should also help to increase efforts to further open the market, stimulate the vitality of the market, and let the market play a decisive role in the allocation of resources, establish a price formation mechanism, and a transmission mechanism of cost and returns on investment. Market development should help promote private capital market through "widespread entrepreneurship and innovation," and prevent excessive monitoring and regulation in the markets.

4.2 Break the monopoly, reform the state-owned enterprise system, and create a full and fair market environment for competition

World history and economics theories validate that monopoly not only intensifies the intensification of market contradictions and hinders industrial transformation and upgrading, but also constrains the innovation of technology and management level and leads to social conflicts; moreover, it hinders the efficiency of resource allocation and fair distribution of social wealth effect [9]. At present, the factors that seriously hinder China's

enterprise R&D initiative come from two aspects: the short-term behavior of enterprises and the monopoly of enterprises. As R&D requires a lot of money and manpower for long-term investment (while the returns are not immediately apparent), a pursuit of short-term interests of enterprises holds no advantage for R&D. In addition, when several enterprises benefit from the special monopoly status given by the government, they do not have enough incentive to carry out research and development. This pursuit of short-term benefits and excessive reliance on government monopolies and subsidies is a common problem for most state-owned enterprises in China. However, because China still has some monopoly and industrial policies, and the probability of the opening-up of telecommunications and other service areas is not high for private capital, it is difficult for private capital to enter competitive fields. Thus, it is not only inconducive to the effective allocation of resources but also disadvantageous to the development of private capital. An unfair system seriously hinders the technological innovation and incentive mechanism of the producer. Therefore, China should reform state-owned enterprises and change their cadre appointment system, eliminate monopoly, introduce competition, and evaluate the mechanism of state-owned enterprises, eliminate short-term behavior, further liberalize high-end manufacturing industries and market access of modern service industries, which are important for fostering independent research and an innovation-driven economy. Whether China can avoid the middle-income trap with independent research and become an innovative economy, a key factor is the reform and promotion of state-owned enterprises to become the backbone of independent R&D, and technological innovation waits to be seen. Therefore, regarding social management, the Chinese government should create a market environment for fair competition by introducing relevant laws and regulations, and improving and accelerating the establishment of a unified, open, competitive, and orderly market system to break geographical segmentation and industry monopoly and, thus, better stimulate economic vitality and market creativity.

4.3 Enhance the capability of independent innovation and facilitate scientific and technological innovation

Core technology is the basis of competition among modern enterprises. They must focus on scientific research and technological innovation in order to build their own core technology and enhance their long-term survival and development. At present, China's economic development is in a critical period of industrial restructuring and upgrading; hence, there is an immediate need to strengthen and rely on scientific and technological innovation. On the one hand, with the development opportunity of the "supply-side structural reform," China should formulate and improve relevant planning and industrial policies to promote independent innovation ability and willingness among enterprises. Furthermore, the Chinese government should establish and

perfect the risk investment mechanism innovation, promote the development of risk investment institutions, ensure tax reforms and optimization of enterprise science and technology R&D management regulations, encourage and guide enterprises to strengthen R&D investment, improve the willingness of independent innovation in terms of science and technology policy, and restructure investment and financing systems. Besides, China should strengthen the protection of intellectual property rights; improve the scientific and technological achievements and industry support system, technical service system, and technology property rights trading system; and establish the external environment protection of intellectual property rights of enterprises to ensure the independent innovation of enterprises' economic and social benefits [9].

4.4 Substitute quality and efficiency for quantity and increase capital utilization and labor productivity

While increasing scientific and technological innovation and striving to improve TFP, the "supply-side structural reform" also needs to improve supply efficiency and supply quality of traditional production resources. China's population growth trend in the short term cannot be changed effectively—based on the fact that in order to adapt to modern economic development needs, it needs to increase investment in human capital, promote the demographic dividend bonus to personnel changes, and improve the quality of the labor force to counteract the negative effects of human resources based on the meaning of "demographic dividend." However, through the construction of a unified labor market, China needs to optimize the allocation of labor, reduce labor costs and free flow, promote the orderly flow of labor in urban and rural areas, enterprises, universities, and scientific research institutions, and extend the technical and management personnel's retirement age. Finally, China should accelerate the implementation of financial sector reform; improve the efficiency of capital use, change monopoly profiteering of financial enterprises; accelerate the construction of a multi-level financial system coordinated with the real economy, diversification of the organization system, and three-dimensional service system; effectively integrate a variety of financial resources; accelerate the reform of the financial markets; and effectively reduce the cost.

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