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ACHIEVING EDUCATIONAL FAIRNESS: EVALUATING THE IMPACT OF TAIWAN'S HIGHER EDUCATION ADMISSION REFORMS

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ABSTRACT

Higher education plays a crucial role in cultivating professional talent and driving long-term national development. In Taiwan, the historical reliance on a single, unified national examination for university admissions has evolved into a diversified admission system since the 1990s. This study rigorously investigates whether these admission system reforms have actually enhanced equal educational opportunities across socio-economic strata. Using tax data from 2009 to 2018, we examine both the enrollment composition at top universities and the subsequent salary premiums that graduates receive after entering the labor market. The analysis reveals that, post-reform, the proportion of students from low-income households attending top-tier universities has declined while those from high-income households have increased. At the same time, graduates from disadvantaged backgrounds benefit from a larger wage premium when they attend elite institutions. These findings imply a complex interplay between admission reforms, access to prestigious education, and future economic outcomes. The policy implications are profound: while the wage returns for low-income graduates are promising, the ongoing reduction in their top-university enrollment rates suggests that reforms should focus on bolstering opportunities at the entry point to achieve both social justice and economic efficiency.

KEY WORDS

Higher Education, Admission Reforms, Socioeconomic Equity, Wage Premiums, Educational Opportunity, Taiwan

JEL Classifications: I24; I28; J62; J24; O15

1. Introduction

1.1 Background and Motivation

Over recent decades, Taiwan has undergone a remarkable transformation in its higher education system. Historically, the national joint examination, characterized by its single, high-stakes test format, determined admission to universities much in the manner of traditional imperial examinations. While this method was initially lauded for its perceived neutrality, it soon became apparent that relying solely on one

examination had several limitations: it did not capture the entire spectrum of students' abilities or talents, and it could inadvertently ignore the different socio-economic backgrounds from which candidates emerged.

Since the mid-1990s, Taiwan has witnessed a series of gradual reforms in its higher education admission system. These reforms were intended to diversify the pathways for university entry and to foster a more equitable distribution of educational opportunities among students from various family backgrounds. Figure 1 displays two critical trends from 1976 to 2020: the number of higher education institutions in Taiwan and the gross enrollment rate.

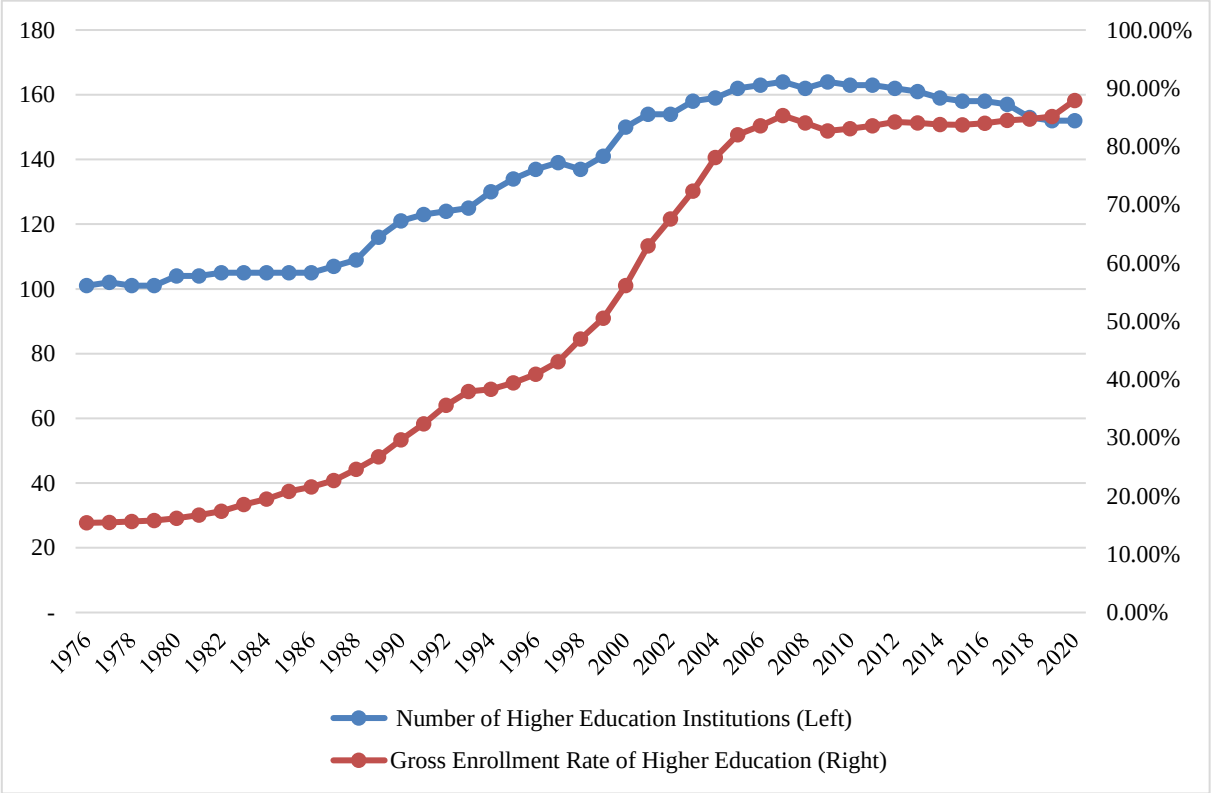

Figure 1. Number of Higher Education Institutions and Gross Enrollment Rate of Higher Education in Taiwan: 1976-2020

Source: Statistics of Colleges and Universities, Department of Statistics, Ministry of Education, Republic of China.

The series illustrates the progressive expansion of the higher education system in Taiwan. For instance, the number of institutions increased from 140 in the 1995 academic year to over 160 by the 2005 academic year, with subsequent gradual growth. The gross enrollment rate, defined as the ratio of total enrollment (in higher education) to the population of the relevant age cohort, has risen steadily. Taiwan surpassed a 50% enrollment rate by 1999, symbolizing the transformation from an elite stage to a mass and eventually universal higher education system.

The concurrent evolution of institutional numbers and enrollment rates provides a backdrop against which the nuances of admission reform can be analyzed. Although more students now have access to higher education, the distribution of top-university opportunities still appears skewed toward students from affluent regions and backgrounds.

1.2 Educational Fairness and Economic Efficiency

Higher education is both an engine for social mobility and an effective means of reducing income inequality. From a human capital perspective, education substantially influences individual income and overall wealth formation. In Taiwan, studies by Chuang and Chen (2011) and Shen and Lin (2019) demonstrate how educational attainment can help lower-income families ascend the social ladder—even as affluent families leverage education to reinforce their already advantaged positions.

At the crux of this research lies the principle of educational fairness. When students from disadvantaged backgrounds are given equitable access to top universities, the resulting wage premiums may help bridge income disparities. Conversely, if reforms do little to promote true equality of opportunity, then the existing gap in socio-economic outcomes may widen over time. Hence, this study examines both the admission process itself and the subsequent labor market returns that serve as indicators of economic efficiency and social mobility.

1.3 Research Objectives and Contributions

The primary objectives of this study are threefold:

Examine the impacts of admission system reforms on enrollment patterns at top universities. By analyzing microdata from tax records and household registration, we quantify the enrollment rates of students from different income groups across successive reform periods.

Estimate wage premiums for graduates that vary by family background. Implementing a Mincerian wage equation framework, we detail how salary returns differ for graduates of elite institutions compared to non-elite institutions, with a focus on contrasting low- and high-income households.

Discuss the policy implications of these empirical findings. Our results carry significant implications for policymakers seeking to promote a more socially equitable distribution of educational opportunities and, by extension, to foster economic efficiency.

In addressing these objectives, this paper contributes to the existing literature by providing updated empirical evidence from Taiwan's admission reforms, offering a nuanced assessment of how these changes have affected both educational opportunities and labor market outcomes.

2. Literature Review

2.1 Theoretical Perspectives on Educational Inequality

The academic literature has offered several theoretical frameworks to explain the persistence and evolution of educational inequality. Two prominent theories—the Maximally Maintained Inequality (MMI) theory and the Effectively Maintained Inequality (EMI) theory—are particularly relevant to understanding the dynamics at play in Taiwan.

Raftery and Hout's (1993) MMI theory suggests that as educational opportunities expand, the advantage enjoyed by children from affluent families persists until those opportunities reach saturation. In this view, the elimination of inequality within a given educational level requires that the enrollment rate among advantaged groups be maximized to the point where additional opportunities primarily benefit disadvantaged groups.

Contrasting with MMI, Lucas (2001) introduced the EMI theory, which argues that even when access appears equalized numerically, the quality of educational opportunities remains stratified. According to EMI, elite families will continue to use their resources—both financial and social—to secure placements in higher quality institutions, thereby sustaining a parallel hierarchy within the educational system.

2.2 Empirical Evidence from Asia and Taiwan

Empirical studies across Asia have long documented the correlation between high educational attainment and superior labor market outcomes. Taiwan, known as one of the "Four Asian Tigers," exhibits unique characteristics in terms of both its economic development and its educational policies. Chu et al. (2015) and Lien et al. (2021) provide evidence that income inequality has been intensifying in Taiwan, with disparities in income distribution increasingly reflecting differences in access to high-quality education.

A notable contribution by Shen and Lin (2019) documented that the proportion of students from affluent backgrounds attending nationally prestigious universities far exceeds that of their less advantaged

peers. Their findings underscore persistent resource gaps and highlight a "money-based" admission tendency that further disadvantages low-income households. This paper extends that work by investigating whether recent admission system reforms have redressed—or compounded—these trends.

2.3 Diversification of Admission Systems in Taiwan

Since the 1990s, Taiwan has transitioned from a single exam-based admission model to a multi-channel system that includes:

School Recommendation: Where high schools nominate students based on performance and other criteria.

Individual Application: Students submit applications directly, sometimes incorporating supplementary materials.

Examination Admission: The traditional subject-specific examinations remain part of the process.
Promising Stars Plan/Recommendation: Initiatives specifically designed to increase the admission rates among disadvantaged groups, particularly those from rural or low-income backgrounds.

This diversification was intended to broaden the scope of candidate evaluation, yet it has raised concerns regarding its potential for uneven implementation and unintended effects on educational fairness.

2.4 Summary and Research Gaps

Although previous studies have addressed the impact of diversified admission channels and the persistent patterns of inequality, few have provided a detailed, multi-period analysis using administrative tax data that spans several years of reform. This paper fills that gap by linking household income data, student admission data, and post-graduation salary information. Our approach not only provides a more robust measure of educational opportunity inequality but also examines the downstream economic benefits—thereby offering insights into both social mobility and economic efficiency.

3. Data Sources and Methodology

3.1 Data Sources

The empirical analysis in this study relies heavily on administrative data, primarily sourced from the Fiscal Information Agency of the Republic of China (Taiwan). The tax data used in our analysis covers the period from 2009 to 2018 and includes comprehensive details on household income, academic records, and household registration information.

3.1.1 Household Income and Tax Data

The tax data, maintained by the Fiscal Information Agency, encompasses various income categories including: Dividends, Business income, Royalties, Salaries, Bond and savings interest, Rental income, Income from property transactions and lotteries, Retirement and other miscellaneous sources.

Household income is calculated as the average annual income of the parents over the preceding three years. Given the stringent legal measures in place against tax evasion, these records are regarded as highly reliable and comprehensive.

3.1.2 Educational Data and Household Registration

The admission system data is reconstructed by linking household registration records to academic records of graduates. This enables accurate identification of the household's region of residence and income classification. The household registration areas are aggregated into four distinct regions:

North: Taipei City, Keelung City, New Taipei City, Taoyuan County, Hsinchu City, Hsinchu County
Central: Taichung City, Miaoli County, Nantou County, Changhua County
South: Tainan City, Kaohsiung City, Chiayi City, Chiayi County, Yunlin County, Pingtung County
East: Hualien County, Taitung County, Kinmen County, Penghu County, Lienchiang County

Income groups are defined by dividing households into deciles using the disposable income measure from the household income and expenditure survey. For this study, we classify households into:
Low Income (L): 1st decile
Lower-middle Income (M1): Above first decile but below the fifth decile
Upper-middle Income (M2): Above the fifth decile but below the tenth decile
High Income (H): 10th decile
Approximately 40% of the samples fall into the low-income category, with the high-income category representing about 10% of the sample.

3.2 Phases of the Admission System

Taiwan's higher education admission system has undergone several significant reforms, which we divide into three phases:

Phase I (2004–2006): This period featured a three-pronged approach comprising School Recommendation, Individual Application, and Examination Admission.
Phase II (2007–2010): The introduction of the Promising Stars Plan expanded the system to include the aforementioned channels plus a targeted plan for disadvantaged students.
Phase III (2011–Present): In this phase, the Promising Stars Plan was merged with the school recommendation system into a unified "Promising Stars Recommendation."

Our analysis uses graduate cohorts as follows:
Graduates of 2009–2010 belong to Phase I.
Graduates of 2011–2014 are associated with Phase II.
Graduates of 2015–2018 represent Phase III.

3.3 Empirical Methodology and Model Specifications

To assess educational opportunity inequality and wage returns, the study employs a two-pronged empirical strategy.

3.3.1 Educational Opportunity Inequality

We first calculate the proportions of households with specific income levels (L, M1, M2, H) attending both top and non-top universities. By comparing these proportions, we measure educational opportunity inequality. Concretely, the difference between the proportion attending top universities and the proportion attending non-top universities serves as our metric for inequality, while controlling for macroeconomic factors that affect everyone in the same year. Data is segmented by admission system phase and by region.

3.3.2 Wage Premium Estimation

Following the approach popularized by Mincer (1974), we estimate a wage regression model written as:

$$\ln w = \beta_0 + \beta_1 S + \beta_2 M + \beta_3 A + \beta_4 X + \beta_5 X^2 + \varepsilon \qquad (1)$$

Where:
lnw is the natural logarithm of real wage in the final year recorded (2018),
S denotes a gender dummy (female is the reference),
M indicates marital status (unmarried is the reference),
A captures the region of residence (eastern region is the reference group),
X stands for years of work experience.

In order to capture the differential returns based on the prestige of the institution, we extend the model to include dummy variables for top universities and interaction terms with income categories. In a simplified specification, let

E=1 represent graduates of top universities and

L=1 for low-income households. The wage model is then written as:

$$\ln w = \delta_0 + \delta_1 E + \delta_2 L + \delta_3 EL + \varepsilon. \quad (2)$$

In this specification, the coefficients are interpreted as follows:

δ_0 represents the wage of non-top university graduates from high-income families.
δ_1 indicates the wage premium for attending a top university for high-income students.
δ_2 captures the wage differential within non-top university graduates (low-income vs. high-income).
δ_3 is the additional wage premium enjoyed by low-income graduates at top universities relative to their high-income counterparts.

Table 1 presents the results of organizing the meanings of the coefficients.

Table 1. Estimated Wage Premiums for Top Universities

	ln w		
Universities	Low-income household	High-income household, H	Difference
Top U.	$\delta_0 + \delta_1 + \delta_2 + \delta_3$	$\delta_0 + \delta_1$	$\delta_2 + \delta_3$
Non-Top U.	$\delta_0 + \delta_2$	δ_0	δ_2
Difference	$\delta_1 + \delta_3$	δ_1	δ_3

We further expand the model to include additional income categories (M1 and M2 for lower-middle and upper-middle incomes, respectively) as well as a vector of institution-level dummy variables to estimate the full model:

$$\ln w = \beta_0 + \beta_1 S + \beta_2 M + \beta_3 A + \beta_4 X + \beta_5 X^2 + \beta_6 T + \delta_1 E + \delta_2 L + \delta_3 M1 + \delta_4 M2 + \delta_5 EL + \delta_6 EM1 + \delta_7 EM2 + \varepsilon \quad (3)$$

This model enables us to quantify the wage premium differences between graduates of top universities from diverse family income backgrounds by observing the size and significance of the interaction terms. Coefficients δ_5, δ_6, and δ_7 indicate the differences in wage premiums between low-income, lower-middle-income, upper-middle-income, and high-income backgrounds for attending top universities. By observing the sizes of these coefficients, one can determine the economic benefits of attending top universities for students from different family backgrounds. Positive and larger coefficients indicate higher economic benefits for low-income students attending top universities.

3.4 Variable Construction and Controls

The empirical specifications carefully control for several confounding factors:
Personal characteristics: Gender, marital status, and work experience are incorporated to isolate the impact of university prestige.

Regional differences: Given the disparities in resource allocation and educational quality across different regions in Taiwan, region dummies are included.
Time effects: A time dummy T is utilized to control for macroeconomic fluctuations affecting all students simultaneously.

By integrating these controls, the models ensure that the estimated wage premiums accurately reflect the effects of educational opportunity expansion and the changes in admission policies on long-term labor market outcomes.

4. Empirical Analysis: Educational Opportunity Inequality

4.1 Enrollment Patterns and Socioeconomic Composition

One of the primary indicators of educational fairness is the proportion of students from various socio-economic backgrounds attending top versus non-top universities. Table 2 below reports the annual enrollment ratios (in percentage terms) for different income categories among university students.

Table 2. Proportions of Different Income Levels Attending University Education

Year	Low Income (L)	Low to Middle Income (M1)	Middle to High Income (M2)	High Income (H)
2009	39.03%	29.60%	20.87%	10.50%
2010	39.96%	29.41%	20.69%	9.93%
2011	40.78%	28.16%	20.87%	10.19%
2012	38.96%	29.17%	21.34%	10.53%
2013	38.20%	28.85%	21.85%	11.11%
2014	39.07%	27.78%	21.87%	11.28%
2015	39.02%	27.62%	22.02%	11.34%
2016	37.72%	27.85%	22.91%	11.52%
2017	36.93%	28.37%	23.01%	11.68%
2018	36.48%	28.03%	24.09%	11.40%

This table shows the distribution of income groups among university-going students over a ten-year period. Notice that roughly 40% of the students come from low-income households each year, whereas high-income households consistently comprise around 10%. Although the overall enrollment in higher education has become nearly universal, these figures serve as the basis for further analyses regarding entry into top universities.

4.2 Impact of Admission Reforms on Access to Top Universities

In addition to overall enrollment, a critical aspect of educational fairness is the differential access to top institutions. Taiwan's admission reforms have sought to enhance opportunities for disadvantaged students. Yet, our findings reveal that while the reforms have increased the overall enrollment in higher education, they have not equally benefited low-income students in terms of admission to elite or 'top' universities.

4.2.1 Regional Disparities

Table 3 presents the distribution of students by household registration area for different tiers of top universities during three distinct reform periods. The household registration areas are grouped into Taipei City, New Taipei City, the four major cities, and other counties/cities.

Table 3. Distribution of Students by Household Registration Area (unit: %)

(I) 2009 ~ 2010				
	Top1	**Top5**	**Top10**	**Top20**
Taipei City	41.90	31.70	25.99	23.40
New Taipei City	20.47	19.83	20.57	24.34
Four Major Cities	21.09	28.20	29.69	26.94
The Other Cities	16.54	20.27	23.75	25.32
(II) 2011 ~ 2014				
	Top1	**Top5**	**Top10**	**Top20**
Taipei City	37.28	27.23	22.77	21.16
New Taipei City	23.47	20.01	19.94	24.54
Four Major Cities	20.54	28.81	30.39	26.88
The Other Cities	18.71	23.95	26.90	27.42
(III) 2015~ 2018				

	Top1	**Top5**	**Top10**	**Top20**
Taipei City	32.98	25.12	20.79	19.79
New Taipei City	22.48	19.80	19.73	23.95
Four Major Cities	21.98	29.04	30.89	27.19
The Other Cities	22.56	26.04	28.59	29.07

The table demonstrates that students from Taipei and New Taipei (the urban core) disproportionately attend top universities. Over the three admission reform phases, there is a noticeable decline in the proportion coming from Taipei and New Taipei, concurrent with an increase from the other regions and the four major cities. This trend is partly attributed to the implementation of the Promising Stars Recommendation system, which was designed to enhance regional balance in university admissions.

4.2.2 Enrollment Ratios by Income and University Tier

To further analyze educational opportunity inequality, we present data on the enrollment ratios of different income groups for the very top university (Top 1) as a representative case. Table 4 summarizes the enrollment ratios for Top 1 universities segmented by income group, comparing 2009–2010, 2011–2014, and 2015–2018 periods.

Table 4. The Enrollment Ratio of the Top 1 University

Year	Low-income (L)	Low to Middle-income (M1)	Middle to High-income (M2)	High-income (H)
2009–2010				
2009	14.46%	19.42%	24.61%	41.51%
2010	18.60%	17.73%	24.10%	39.58%
Average	16.53%	18.58%	24.36%	40.55%
2011–2014				
2011	19.24%	17.21%	24.76%	38.79%
2012	16.58%	19.79%	24.52%	39.11%
2013	14.76%	18.79%	25.79%	40.66%
2014	15.13%	16.61%	25.18%	43.09%
Average	16.43%	18.10%	25.63%	40.41%
2015–2018				
2015	14.71%	15.67%	25.57%	44.06%
2016	14.31%	15.78%	27.04%	42.87%
2017	15.77%	16.05%	25.42%	42.75%
2018	15.52%	17.24%	26.87%	40.36%
Average	15.08%	16.19%	26.23%	42.51%

This table highlights a persistent disparity in which the proportion of students from low-income households attending the top university consistently remains below that of high-income students. Moreover, over time, the share for low-income households has slightly declined, particularly in the later phase (2015–2018), while high-income representation has increased.

4.2.3 Pairwise Comparisons: Top Versus Non-Top Universities

To isolate the impact of the admission process and control for macroeconomic factors that affect all students equally, the study computes pairwise differences between the enrollment ratios of top and non-top universities. Table 5 illustrates this approach for Top 1 universities versus non-Top 1 universities.

Table 5. The Enrollment Ratio of Top 1 Minus Non-Top 1 Universities

Year/Phase	Low-income (L)	Low to Middle-income (M1)	Middle to High-income (M2)	High-income (H)
2009–2010				
2009	-25.68%	-9.90%	4.30%	31.27%
2010	-22.54%	-11.31%	3.95%	29.92%
Average	-24.11%	-10.61%	4.13%	30.40%
2011–2014				
2011	-22.89%	-10.53%	4.48%	28.94%
2012	-23.78%	-8.99%	3.80%	28.98%
2013	-25.08%	-9.56%	4.70%	29.94%
2014	-25.52%	-10.67%	4.11%	32.08%
Average	-24.32%	-9.94%	4.27%	30.00%
2015–2018				
2015	-26.02%	-11.35%	4.32%	33.05%
2016	-24.97%	-44.49%	4.84%	31.61%
2017	-22.70%	-11.76%	3.23%	31.22%
2018	-22.48%	-10.07%	3.57%	28.97%
Average	-24.04%	-11.17%	3.99%	31.21%

The table clearly shows that the gap between enrollment rates in top versus non-top universities remains wide for low-income households, which consistently register negative differentials, while high-income households show large positive differences. This suggests that students from affluent backgrounds benefit from a significantly higher likelihood of attending top universities compared to their low-income counterparts. Notably, the table directly calculates the average of the differences mentioned above.

To explore how changes in the admission system have affected the proportion of students from different family backgrounds attending top universities, the averages of different admission systems are subtracted. Taking Top 1 as an example, Table 4 contains three groups, I, II, and III, each with their own averages. To explore how changes from I to II and II to III in the admission system affected the proportion of low-income students attending Top 1 universities, the average of L in group II minus the average of L in group I gives the result in Table 5, where the difference for Top 1 between II and I for L is -24.32% + 24.11% = -0.21%, and for III and II, the difference for L is -24.04% + 24.32% = 0.28%. Table 6 presents the main findings of this study. Table 6 shows that for students from low-income backgrounds, their proportion of attendance at top universities, whether Top 1, Top 5, Top 10, or Top 20, has consistently decreased after two rounds of multi-admission reforms, with the decline being more pronounced for Top 20 universities. Only after the second admission reform did the enrollment rate of low-income students in Top 1 universities see a slight increase. Conversely, the enrollment rates of high-income students in Top 1, Top 5, Top 10, and Top 20 universities continued to rise across several reforms, with the Top 20 schools showing the most significant increase.

Table 6. Difference in Difference for the Enrollment Ratio of Different Admission Policy

	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
Top1				
(II) - (I)	-0.208%	0.667%	0.148%	0.610%
(III) - (II)	0.275%	-1.23%	-0.283%	1.227%
Top5				
(II) - (I)	-1.388%	0.060%	0.720%	0.248%
(III) - (II)	-0.105%	-0.583%	-0.315%	0.995%
Top10				
(II) - (I)	-1.308%	-0.433%	1.005%	0.863%
(III) - (II)	-0.673%	-0.753%	-0.028%	1.323%
Top20				
(II) - (I)	-1.465%	-0.733%	0.820%	1.743%
(III) - (II)	-1.413%	-1.123%	-0.0725%	2.605%

The data indicates that the proportion of high-income students enrolling in top universities has steadily increased across all three admission reforms, signifying that their enrollment in top universities is consistently greater than their enrollment in non-top universities. However, for low-income students, the opposite trend is observed: their enrollment proportion in top universities has decreased across the three admission reforms, showing an increasing gap where their enrollment in top universities is less than that in non-top universities. This trend is similar for middle-low-income students, while middle-high-income students show a pattern akin to high-income students.

We conclude that the two admission reforms have not improved the enrollment proportion of low-income households in top universities. The data shows that regardless of family background, there has been no significant increase or decrease in the enrollment proportions in top universities. For students from affluent families, the enrollment rates in top universities have remained stable, with no declining trend. Therefore, we infer that changes in the admission system have not significantly improved the proportion of low-income households attending top universities.

Currently, Taiwan's top universities are predominantly national universities, which receive substantially more government subsidies than private universities. This discrepancy in subsidies results in significantly lower tuition fees for students at public universities (approximately half that of private universities). The current government subsidies for universities represent a regressive income distribution across society. Children from disadvantaged backgrounds often cannot attend national universities, while children from affluent families predominantly attend national or top-tier private universities. Consequently, government subsidies for universities mostly benefit affluent families, while disadvantaged children receive relatively few benefits. This highlights another aspect of unfair resource distribution and underscores the importance of fair educational opportunities for children from disadvantaged families to attend top universities.

5. Empirical Analysis: Wage Premiums and Socioeconomic Returns

5.1 Empirical Findings on Wage Premiums

We then estimate how changes in the admission system affect the salary premiums of students from different family backgrounds who graduate from top or non-top universities and compare these differences. First, we observe the salary premiums for graduates from various top universities. As shown in Figure 2, the higher the ranking of the university from which one graduates, the higher the salary premium, which aligns with intuition. The average salary decreases gradually because the selected salaries are from the final year, 2018; hence, the later the graduation year, the shorter the work experience, resulting in lower average salaries. However, we can still discern the salary differences for graduates from different tiers of top universities. For example, in 2009, graduates from Top 1 and Top 20 universities had a salary gap of over 200,000 NTD; even between Top 5 and Top 20, the gap approached 200,000 NTD. This indicates that the university attended significantly impacts future salaries.

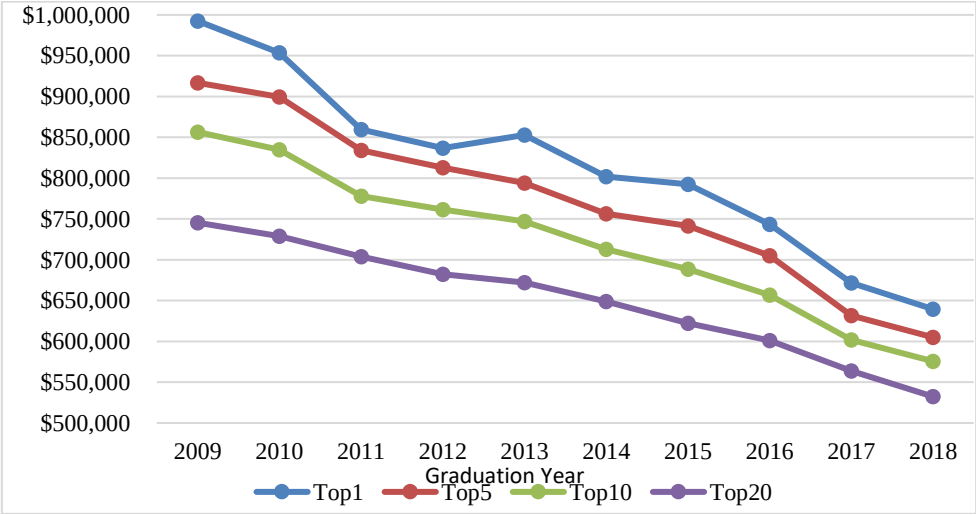

Figure 2. Salaries of Graduates from Various Cohorts at Leading Universities

This emphasizes the importance of equal educational opportunities, i.e., whether university admission reforms are becoming more equitable to allow fair competition among students from disadvantaged and advantaged families for top university placements.

Table 7 summarizes the results from the wage regressions for graduates of top-tier universities. The table presents the estimated wage premium coefficients (measured on the logarithmic wage scale) separated by income groups and by four rankings of universities: Top 1, Top 5, Top 10, and Top 20.

Table 7. Wage Premiums of Top Universities Graduates with Different Family Backgrounds

	Top1	Top5	Top10	Top20
	ln ω	ln ω	ln ω	ln ω
E_1	0.306***			
	(0.006)			
L	-0.115***	-0.103***	-0.096***	-0.080***
	(0.001)	(0.001)	(0.001)	(0.002)
E_1L	0.081***			
	(0.011)			
M_1	-0.116***	-0.105***	-0.099***	-0.085***
	(0.001)	(0.001)	(0.001)	(0.002)
E_1M_1	0.072***			
	(0.011)			
M_2	-0.082***	-0.073***	-0.069***	-0.058***
	(0.001)	(0.001)	(0.001)	(0.002)
E_1M_2	0.049***			
	(0.010)			
E_5		0.300***		
		(0.004)		
E_5L		0.044***		
		(0.006)		
E_5M_1		0.053***		
		(0.006)		
E_5M_2		0.023***		
		(0.006)		
E_{10}			0.273***	
			(0.003)	
$E_{10}L$			0.013***	
			(0.005)	
$E_{10}M_1$			0.022***	
			(0.005)	
$E_{10}M_2$			0.007	
			(0.005)	
E_{20}				0.215***
				(0.002)
$E_{20}L$				-0.008***
				(0.003)
$E_{20}M_1$				-0.003
				(0.003)
$E_{20}M_2$				-0.008***
				(0.003)
Constant	12.254***	12.229***	12.217***	12.189***
	(0.004)	(0.004)	(0.004)	(0.005)
Observations	1,099,789	1,099,789	1,099,789	1,099,789
R-squared	0.126	0.137	0.142	0.149

Note: All regressions have controlled for personal variables such as gender, marital status, place of birth, years of work experience, and year of enrollment. Robust standard errors in parentheses, and ***, **, and * stand for $p < 0.01$, $p < 0.05$, $p < 0.1$, respectively.

The results indicate that high-income students (serving as the baseline) enjoy a wage premium when they graduate from top universities. However, the interaction terms (e.g., E_1L) reveal that low-income students receive an additional positive wage premium when attending top universities, suggesting that the "top university halo" is relatively stronger for disadvantaged students. This differential effect diminishes, though, in lower-ranked institutions (e.g., Top 20 universities) where the effect of family background becomes more pronounced.

5.2 Variation in Wage Premiums Across Admission Phases

To observe differences between admission systems, we further divide the data into three groups according to the admission systems and run regressions for each. The key variables for salary premiums are presented in Tables 8. Table 8 documents how the wage premiums vary by admission system phase for graduates from top institutions. The estimates are provided separately for the graduate cohorts corresponding to 2009–2010, 2011–2014, and 2015–2018.

Table 8. Wage Premiums of Top Universities under Different Admission Policy

	2009-2018				
		Top1	**Top5**	**Top10**	**Top20**
	High-income household δ_1	0.306	0.300	0.273	0.215
	Low-income household $\delta_1 + \delta_5$	0.387	0.344	0.286	0.207
	Low to Middle-income household $\delta_1 + \delta_6$	0.378	0.353	0.295	0.212
	Middle to High-income household $\delta_1 + \delta_7$	0.355	0.323	0.280	0.207
(I)	2009-2010				
		Top1	**Top5**	**Top10**	**Top20**
	High-income household δ_1	0.345	0.376	0.349	0.253
	Low-income household $\delta_1 + \delta_5$	0.457	0.375	0.310	0.210
	Low to Middle-income household $\delta_1 + \delta_6$	0.443	0.397	0.342	0.234
	Middle to High-income household $\delta_1 + \delta_7$	0.467	0.396	0.346	0.237
(II)	2011-2014				
		Top1	**Top5**	**Top10**	**Top20**
	High-income household δ_1	0.320	0.318	0.291	0.237
	Low-income household $\delta_1 + \delta_5$	0.408	0.370	0.309	0.223
	Low to Middle-income household $\delta_1 + \delta_6$	0.392	0.379	0.317	0.230
	Middle to High-income household $\delta_1 + \delta_7$	0.358	0.340	0.295	0.221
(III)	2015-2018				
		Top1	**Top5**	**Top10**	**Top20**
	High-income household δ_1	0.277	0.261	0.254	0.185
	Low-income household $\delta_1 + \delta_5$	0.333	0.308	0.254	0.191
	Low to Middle-income household $\delta_1 + \delta_6$	0.333	0.311	0.254	0.187
	Middle to High-income household $\delta_1 + \delta_7$	0.314	0.287	0.245	0.184

The table reveals that for the earliest admission phase (2009–2010), high-income students benefited from higher salary premiums compared to their disadvantaged counterparts. However, for more recent cohorts (2011–2014 and 2015–2018), the wage premium advantage shifts: low-income students experience a greater wage increase relative to high-income students when graduating from top universities. These dynamic changes are likely attributable to inflation, the diminishing effect of the top university halo over time, and sector-specific shifts (e.g., the growing importance of STEM fields).

6. Discussion and Conclusion

6.1 Synthesis of Empirical Findings

The extensive empirical analyses yield several important conclusions:

Education Expansion and Persistent Inequality: Despite the systematic expansion of higher education and the introduction of diversified admission channels, the data consistently indicate that students from high-

income households have a substantial advantage in accessing top universities. Enrollment figures for top-tier institutions show that while overall access is near universal, disparities remain at the most competitive levels.

Regional Divergence: Urban areas, especially Taipei and New Taipei, continue to produce a higher proportion of top-university graduates. The differentiation is partially reduced by policies such as the Promising Stars Recommendation, yet disadvantaged regions still lag behind.

Enhanced Wage Returns for Disadvantaged Students: The wage premium analysis reveals that when low-income students do succeed in entering top universities, their salary returns are disproportionately higher relative to their high-income peers. This finding implies a "compensatory" effect where disadvantaged students leverage the prestige of elite institutions to overcome their familial constraints.

Timing Effects and Policy Shifts: Our phased analysis of admission systems indicates that admission policy reforms have not significantly increased the share of low-income students in elite institutions overall. Rather, while wage returns for those from disadvantaged backgrounds have improved, the absolute numbers entering top universities have declined.

6.2 Policy Implications

Given the multifaceted empirical evidence, several policy implications emerge:

Redefining Admission Criteria: The current admissions strategy may need recalibration so that increased attention is paid not only to test scores and high school recommendations but also to indicators of disadvantage. A more nuanced, multidimensional evaluation system may yield fairer outcomes.

Targeted Support for Disadvantaged Students: Government agencies should design and implement interventions that help disadvantaged students prepare for the high-stakes aspects of admissions. These interventions could include scholarships, preparatory courses, and mentoring programs targeted at low-income communities.

Balanced Allocation of Government Subsidies: The current subsidy structure—where national universities receive significantly higher funding than private institutions—has resulted in a regressive distribution of resources. Policymakers should consider mechanisms that channel more support to institutions that predominantly serve disadvantaged populations.

Reassessment of Regional Imbalances: The persistent urban–rural divide in top-university enrollment points to the need for region-specific policies that boost educational quality and access outside the major metropolitan areas.

6.3 Theoretical Contributions and Practical Relevance

From a theoretical perspective, our findings reinforce the EMI theory. Even as educational opportunities become numerically universal, elite channels remain reserved mainly for those with greater family resources. The reward structure—namely, the wage premiums—further underscores that disadvantaged students who manage to access top-tier institutions can achieve significant economic mobility. However, the fact that fewer disadvantaged students make it through the admissions pipeline calls for a reexamination of the criteria and mechanisms underpinning these reforms.

Practically, these findings are critical for debating the best path forward. If educational opportunities are truly to facilitate equity in society, the admission system must not only expand access but also actively mitigate the residual advantages conferred by socio-economic status. Our study demonstrates that simply increasing the quantity of higher education is insufficient if the qualitative aspects of access remain inequitable.

6.4 Limitations and Directions for Future Research

While this study introduces valuable insights, several limitations must be acknowledged:

Data Constraints: Our reliance on tax and household registration data (available only from 2007 onwards) limits our ability to analyze earlier cohorts. Future research that incorporates longer panel data could better capture the long-term evolution of educational reforms.

Unobserved Heterogeneity: Although the models control for several individual and regional characteristics, unobserved factors—such as differences in academic discipline or individual motivation—may also significantly affect both admission outcomes and subsequent wages.

Program-specific Effects: The present study does not differentiate between academic programs within universities. Given that academic major is a well-known determinant of wage outcomes, future studies should endeavor to link departmental data with admission channels to further refine the analysis.

External Labor Market Conditions: Macroeconomic shocks, sector-specific downturns, and changes in labor market demands (e.g., the rise of STEM and ICT fields) may influence wage premiums in ways that are not fully captured by the current model.

Future research may also explore the role of social capital and non-academic advantages by integrating qualitative data and conducting field studies to assess how these factors mediate the relationship between admission system reforms and economic mobility.

6.5 Final Remarks

The evolution of Taiwan's higher education system, marked by rapid expansion and admission system diversification, represents an admirable effort to democratize access. However, as our comprehensive analysis demonstrates, reforms have yet to fully overcome entrenched socio-economic disparities. This study provides both empirical evidence and policy prescriptions that can serve as a roadmap for future reforms aimed at achieving genuine educational fairness and equitable economic growth.

Conflict of Interest Statement

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Data Availability Statement

The original administrative tax data used in this paper can be accessed by submitting a research purpose application to the Fiscal Information Agency of the Republic of China (Taiwan). Process data underlying the empirical analysis are available upon request from the authors.

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Appendix

Table A1. Classification of Taiwan's Top Universities

Level	University
Top1	National Taiwan University
Top5	Top1 National Tsing Hua University National Chiao Tung University National Cheng Kung University National Cheng Chi University
Top10	Top5 National Central University National Chung Hsing University National Sun Yat-sen University National Chung Cheng University National Taipei University
Top20	Top10 Taipei Medical University China Medical University Chung Shan Medical University Chang Gung University Kaohsiung Medical University Mackay Medical College Fu Jen Catholic University Tamkang University Feng Chia University Soochow University

Note: Based on the key subsidized universities in the Executive Yuan's Five-Year, 50 Billion NTD Plan, the Teaching Excellence Project, and the Higher Education Sprout Project, we define Taiwan's top universities (hereafter referred to as TOP) and categorize them into four tiers: Top 1, Top 5, Top 10, and Top 20

Table A2. Enrollment Ratio of Top 5 university

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I) 2009-2010				
2009	20.15%	21.29%	24.96%	33.60%
2010	21.21%	21.21%	24.24%	33.34%
Average	20.68%	21.25%	24.60%	33.47%
2011-2014				
2011	21.12%	20.04%	25.73%	33.11%
2012	19.31%	21.67%	25.57%	33.45%
2013	19.04%	19.48%	26.41%	35.07%
2014	18.46%	19.58%	25.69%	36.28%
Average	19.48%	20.19%	25.85%	34.48%
(II) 2015-2018				
2015	14.74%	18.40%	26.44%	37.42%
2016	17.65%	17.83%	26.87%	37.65%
2017	17.92%	19.70%	26.40%	35.97%
2018	17.90%	19.84%	28.20%	34.07%
Average	17.80%	18.94%	26.98%	36.28%

Table A3. Enrollment Ratio of Top 10 university

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
2009-2010				
2009	23.18%	23.53%	24.68%	28.61%
2010	25.16%	23.63%	23.63%	27.57%
Average	24.17%	23.58%	24.16%	28.09%
2011-2014				
2011	24.86%	21.84%	25.32%	27.98%
2012	23.08%	23.04%	25.37%	28.50%
2013	22.61%	21.57%	26.35%	29.47%
2014	21.79%	21.75%	25.57%	30.88%
Average	23.09%	22.05%	25.65%	29.21%
2015-2018				
2015	21.37%	20.28%	26.21%	32.13%
2016	20.84%	20.00%	26.82%	32.34%
2017	20.68%	21.33%	27.06%	30.92%
2018	20.62%	21.02%	28.14%	30.22%
Average	20.88%	20.66%	27.06%	31.40%

Table A4. Enrollment ratio of Top 20 university

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I) 2009-2010				
2009	28.16%	26.30%	24.21%	21.33%
2010	28.73%	25.57%	24.35%	21.35%
Average	28.45%	25.94%	24.28%	21.34%
(II) 2011-2014				
2011	29.52%	24.66%	24.67%	21.16%
2012	26.99%	24.95%	25.59%	22.47%
2013	26.12%	23.90%	26.06%	23.92%
2014	26.00%	23.02%	26.01%	24.97%
Average	27.16%	24.13%	25.58%	23.13%
(III) 2015-2018				
2015	25.12%	22.21%	26.05%	26.61%
2016	24.13%	22.06%	27.07%	26.75%
2017	24.44%	23.07%	26.66%	26.17%
2018	23.67%	22.48%	28.17%	25.68%
Average	24.26%	22.46%	26.99%	26.30%

Table A5. Enrollment ratio of Non-Top 1 university

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I) 2009-2010				
2009	40.14%	29.32%	20.31%	10.24%
2010	41.14%	29.04%	20.15%	9.66%
Average	40.64%	29.18%	20.23%	9.95%
(II) 2011-2014				
2011	42.13%	27.74%	20.28%	9.85%
2012	40.36%	28.78%	20.72%	10.13%
2013	39.84%	28.35%	21.09%	10.72%
2014	40.65%	27.28%	21.07%	11.01%
Average	40.75%	28.04%	20.79%	10.43%
(III) 2015-2018				
2015	40.73%	27.02%	21.25%	11.01%
2016	39.28%	27.27%	22.20%	11.26%
2017	38.47%	27.81%	22.19%	11.53%
2018	38.00%	27.31%	23.30%	11.39%
Average	39.12%	27.35%	22.24%	11.30%

Table A6. Enrollment ratio of Non-Top 5 university

Year	Low-income household *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I) 2009-2010				
2009	40.42%	29.44%	20.22%	9.20%
2010	41.50%	29.15%	20.07%	9.27%
Average	40.96%	29.30%	20.15%	9.23%
(II) 2011-2014				
2011	42.52%	27.86%	20.16%	9.45%
2012	40.75%	28.90%	20.61%	9.73%
2013	40.24%	28.54%	20.97%	10.26%
2014	41.09%	27.41%	20.96%	10.54%
Average	41.15%	28.18%	20.68%	9.99%
(III) 2015-2018				
2015	41.16%	27.17%	21.13%	10.54%
2016	39.71%	27.45%	22.10%	10.75%
2017	38.97%	27.97%	22.07%	10.99%
2018	38.46%	27.45%	23.17%	10.92%
Average	39.58%	27.51%	22.12%	10.80%

Table A7. Enrollment ratio of Non-Top 10 university

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I) 2009-2010				
2009	40.74%	29.52%	20.13%	9.62%
2010	41.77%	29.21%	20.00%	9.01%
Average	41.26%	29.37%	20.07%	9.32%
(II) 2011-2014				
2011	42.83%	27.95%	20.05%	9.16%
2012	41.06%	29.00%	20.50%	9.44%
2013	40.57%	28.64%	20.83%	9.46%
2014	41.45%	27.48%	20.85%	10.22%
Average	41.48%	28.27%	20.56%	9.57%
(III) 2015-2018				
2015	41.53%	27.28%	21.02%	10.18%
2016	40.09%	27.57%	21.98%	10.36%
2017	39.33%	28.08%	21.92%	10.67%
2018	38.82%	27.58%	23.04%	10.56%
Average	39.94%	27.63%	21.99%	10.44%

Table A8. Enrollment ratio of Non-Top 20 university

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I) 2009-2010				
2009	42.08%	29.77%	19.63%	8.53%
2010	43.22%	29.56%	19.40%	7.82%
Average	42.65%	29.67%	19.52%	8.53%
(II) 2011-2014				
2011	44.21%	28.18%	19.51%	8.09%
2012	42.45%	29.35%	19.90%	8.31%
2013	41.86%	28.99%	20.30%	8.85%
2014	42.79%	27.86%	20.28%	9.06%
Average	42.83%	28.60%	20.00%	8.58%
(III) 2015-2018				
2015	42.92%	27.66%	20.53%	8.89%
2016	41.54%	28.00%	21.43%	9.03%
2017	40.67%	28.48%	21.45%	9.40%
2018	40.23%	28.02%	22.49%	9.26%
Average	41.34%	28.04%	21.48%	9.15%

Table A9. Enrollment ratio of Top 5 minus Non-Top 5 universities

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I)				
2009	-20.27%	-8.15%	4.74%	24.40%
2010	-20.29%	-7.94%	4.17%	24.07%
Average	-20.28%	-8.05%	4.46%	24.24%
(II)				
2011	-21.40%	-7.82%	5.57%	23.66%
2012	-21.44%	-7.23%	4.96%	23.72%
2013	-21.20%	-9.06%	5.44%	24.81%
2014	-22.63%	-7.83%	4.73%	25.74%
Average	-21.68%	-7.99%	5.18%	24.48%
(III)				
2015	-23.42%	-8.77%	5.31%	26.88%
2016	-22.06%	-9.62%	4.77%	26.90%
2017	-21.05%	-8.27%	4.33%	24.98%
2018	-20.56%	-7.61%	5.03%	23.15%
Average	-21.77%	-8.57%	4.86%	25.48%

Table A10. Enrollment ratio of Top 10 minus Non-Top 10 universities

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I)				
2009	-17.56%	-5.99%	4.55%	18.99%
2010	-16.61%	-5.58%	3.63%	18.56%
Average	-17.09%	-5.79%	4.09%	18.78%
(II)				
2011	-17.97%	-6.11%	5.27%	18.82%
2012	-17.98%	-5.96%	4.87%	19.06%
2013	-17.96%	-7.07%	5.52%	20.01%
2014	-19.66%	-5.73%	4.72%	20.66%
Average	-18.39%	-6.22%	5.10%	19.64%
(III)				
2015	-20.16%	-7.00%	5.19%	21.95%
2016	-19.25%	-7.57%	4.84%	21.98%
2017	-18.65%	-6.75%	5.14%	20.25%
2018	-18.20%	-6.56%	5.10%	19.66%
Average	-19.07%	-6.97%	5.07%	20.96%

Table A11. Enrollment ratio of Top 20 minus Non-Top 20 universities

Year	Low-income household, *L*	Low to middle-income household, *M1*	Middle to High-income household, *M2*	High-income household, *H*
(I)				
2009	-13.92%	-3.47%	4.58%	12.80%
2010	-14.49%	-3.99%	4.95%	12.82%
Average	-14.21%	-3.73%	4.77%	12.81%
(II)				
2011	-14.69%	-3.52%	5.16%	13.07%
2012	-15.46%	-4.40%	5.69%	14.16%
2013	-15.74%	-5.09%	5.76%	15.07%
2014	-16.79%	-4.84%	5.73%	15.91%
Average	-15.67%	-4.46%	5.58%	14.55%
(III)				
2015	-17.80%	-5.45%	5.52%	17.72%
2016	-17.41%	-5.94%	5.64%	17.72%
2017	-16.56%	-5.41%	5.21%	16.77%
2018	-16.56%	-5.54%	5.68%	16.42%
Average	-17.08%	-5.59%	5.51%	17.16%