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DETECTING THE EFFECT OF POLICY INTERVENTION FOR OVERSUPPLY HIGHER EDUCATION SYSTEM

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Abstract. *Oversupply has become a new crisis in higher education in Taiwan. When the declining in enrollment accompanies with the oversupply higher education by coincidence, what might happen in this system? Affected by declining of graduates in secondary education, the higher education enrollment has decreased dramatically in 2016. 203 departments left 2,953 vacant seats in 23 universities in 2016. Specifically, six universities cannot attract 50 percent of their required enrollment in this year. Facing the crisis, this study aims to explore how the declining of birth rate and enrollment might challenge the oversupply higher education system. We applied time series data and related policy intervention to interpreting the impact on the oversupply system. The estimated result reveals the enrollment will decrease 78 thousand in 2023. It means the university's revenue will decrease 28 billion when comparing 2016 and 2023. Reviewing the policy intervention for higher education, this study shows that cutting the enrollment is the most wanted strategy for MOE, while it only reveals short-term effect for the temporary treatment. For long run, this study suggests remodeling the higher education system to fit the global competition, universities cooperation and merge, deregulating and building multiple management systems for sustainable development.*
Keywords: Declining enrollment, Higher education, Oversupply, Policy intervention, Effect of policy intervention

1. **Introduction.** The popularization of education has led to a rapid increase in student enrollment, although the figure has leveled off in the last decade. The number of students increased from 299,486 (1976) to 576,623 (1999), and the GER (Gross Entrance Ratio) increased from 15% to 50% within 23 years in the system. According to "2015 Education Statistical Indicators", the tertiary education GER reached 83.88% in 2013, higher than those in most other Asian countries [1]. With the unprecedented growth in the number of private universities and technological and vocational institutions that has occurred since 1994, the higher education has become more accessible to younger generations from 18 to 22 years [2]. This is the main contribution of the expansion in this system. As a result of the increasing number of universities, more students can enroll in higher education institutions (HEIs) regardless of their social background, gender, ethnicity, and age. Prior to the academic year 2012-2013, undergraduates comprised less than three-quarters of the population: approximately 15% were master students, and the remaining were doctoral students [3]. Recently, the higher education system has changed and oversupply has become a new crisis in higher education in Taiwan.

When the declining of enrollment accompanies with the oversupply higher education by coincidence, what might happen in the system? Affected by declining of graduates in secondary education, the enrollment in higher education has decreased significantly in 2016. 203 departments in 23 universities provided 2,953 vacant seats in 2016 [4]. Specifically, six universities cannot attract 50 percent of their required enrollment within the system in this year. Facing for uncertain future, this higher education system has confronted new challenges. In order to realize the issues, this study addresses the crisis of declining enrollment with the trend of student number and interprets how the oversupply higher education can be adjusted. In addition, following the trend, how much cost should pay in the declining system? The finding may provide useful information for policy makers.

To explore the higher education issues and provide better solutions, we applied two stages method to estimating the effect of policy intervention in higher education enrollment. With regard to this issue, this paper begins with a brief introduction to the crises in Taiwan's higher education based on the development. The second section addresses the method we conducted to transform the data for further interpretation. The third section deals with the issues based on our estimation. Finally, we provide some suggested strategies for Taiwan's higher education institutions based on the findings.

2. Algorithm for Determining Policy Effect.

In this study, the enrollment data in undergraduate students is cited from Ministry of Education [5,6]. We estimated the student enrollment decreasing by using trend analysis and considered the policy intervention. The procedures for determining the policy effect are listed as follows:

1) Preparing target enrollment data in the system. In the beginning, the expected enrollment approved by Ministry of Education (MOE) by annual basis has been considered. Two stages of exploration have been designed, which include reviewing the previous enrolled numbers in higher education and projecting the future development in enrollment.
2) Selecting the models to interpret the effect of policy intervention. We defined the effect policy intervention which can be explained by fluctuated effect (FE) and fixed effect (FXE). The declining enrollment numbers will base on the estimations in two stages.
3) Determining the fluctuated effect (FE). In our model, the expected enrollment (EE) and actual enrollment (AE) have been calculated in their fluctuated effect, e.g., $FE_i = EE_i - AE_i$. We assume the fluctuated effect (FE_i) is the gap between policy intervention and market response (actual enrollment) in the oversupply system.
4) Determining the fixed effect of policy intervention (FXE). The FXE_i means the related policy intervention in a specific year in terms of the actual enrolled numbers followed the approved numbers by MOE in each school year. The year of 2004 has been selected as critical policy intervention point for evaluating the effect of MOE's implementation of the cutting enrollment strategy. Based on the enrollment in 2004, the FXE will be calculated by using $FXE_i - FXE_{i+1}$ in this stage.
5) Projecting the numbers of future enrollment. In the second stage, the expected enrollment will be calculated from 2017 to 2023. This study conducts ARIMA model in SPSS (Statistical Package for Social Science) to transform the data set in last four decades. The ARIMA model has been conducted in different settings [7,8]. Previous studies have provided alternative approaches to solve the prediction problems in different fields [9-13]. This model focuses on the enrollment issue in higher education which is different from previous prediction studies. We assumed a seasonal univariate ARIMA (p, d, q), (P, D, Q) model is given by
$\Phi(B)[\Delta yt - \mu] = \Theta(B)_t = 1, \ldots, N$, where $\Phi(B) = \varphi p(B)\Phi P(B)\Theta(B) = \theta q(B)\Theta Q(B)$
6) In this study, the ARMA parameters are initialized following an ARMA (p, q). We select the difference is zero for this series, e.g., the (p, q) model with mean 0 [14,15].

7) Consider the demands from oversea. The international student recruitment has been taken into account in the estimation process. New coming international students have shown increasing in next few years. The increasing numbers of international students have been estimated regardless the students are long or short-term stay.
8) Determining the fixed effect of policy intervention. Based on the related information, this study detects the actual role of policy intervention and its effect in future.
9) Calculating the revenue lost. In the final section, based on the estimated enrollment in future, we project the revenue of the higher education institutions which might lose in 2023. Basically, the enrollment students will stay four years in universities and each year they should pay 100 thousand for tuition based on private university standard. We assume the calculation of revenue loss may happen in private universities which have suffered more severity of shortage problem.

3. **Results.** Based on the expected enrollment (the government approved student numbers that universities can recruit in each school year) and actual enrollment, this study displays the gaps between them in the first stage. Then, the study reviewed the trend of previous development in the second stage. The estimated enrollments have considered the policy intervention and international student recruitment.

3.1. **The fluctuated effect between expected enrollment and actual enrollment.** Figure 1 displays the gaps between expected enrollment and actual enrollment from 2004 to 2016 in undergraduate level of higher education. Even though the government limited the enrollment more seriously during this period, the actual enrollment in higher education has shown steadily decreasing. The gaps that exist between expected enrollment and actual enrollment reflected their fluctuated effect of policy intervention. The real numbers of gaps, from 2004 to 2016, have been demonstrated in Figure 1. It implies that similar trends may reflect the fluctuated effect of policy intervention is limited under the oversupply system.

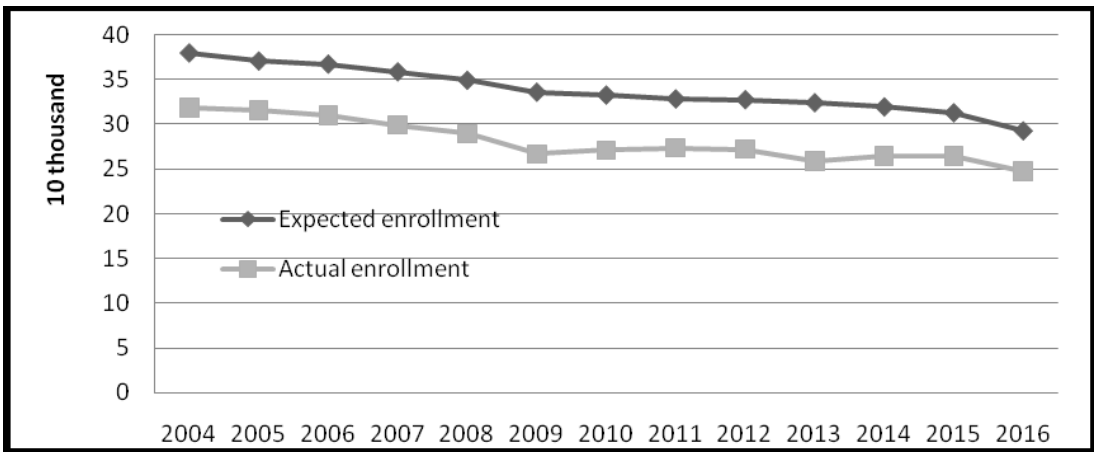

FIGURE 1. The fluctuated effects between expected enrollment and actual enrollment in the higher education

3.2. **Fixed effects of policy intervention for enrollment.** As previous section mentions, facing the decline of student numbers, the government has taken more seriously intervention to limit the enrollment in the higher education system. The actual enrollment can be viewed as fixed effect derived from the policy of MOE based on each school year. According to the actual enrollment in 2004, which is the baseline for result of policy intervention, we can calculate the fixed effect of policy intervention by using $FXE_i - FXE_{i+1}$ in this stage. Table 1 demonstrates the fixed effect of policy intervention based on actual enrollment in 2004, the enrollment number has dropped from $-3,065$ (2005) to $-63,699$

TABLE 1. The effects of policy intervention for enrollment in higher education

Year	Expected enrollment (EE_i)	Actual enrollment (AE_i)	Fluctuated effect (FE_i) $FE_i = EE_i - AE_i$	Fixed effect (AE declining) (based on 2004)
2004	**379454**	**318983**	−60471	0
2005	370481	315918	−54563	−3065
2006	367140	310408	−56732	−8575
2007	358405	299231	−59174	−19752
2008	349053	289638	−59415	−29345
2009	335827	266818	−69009	−52165
2010	332650	271152	−61498	−47831
2011	328358	273713	−54645	−45270
2012	327474	272288	−55186	−46695
2013	324171	258771	−65400	−60212
2014	319428	264554	−54874	−54429
2015	312924	264720	−48204	−54263
2016	292782	255284	−37498	−63699

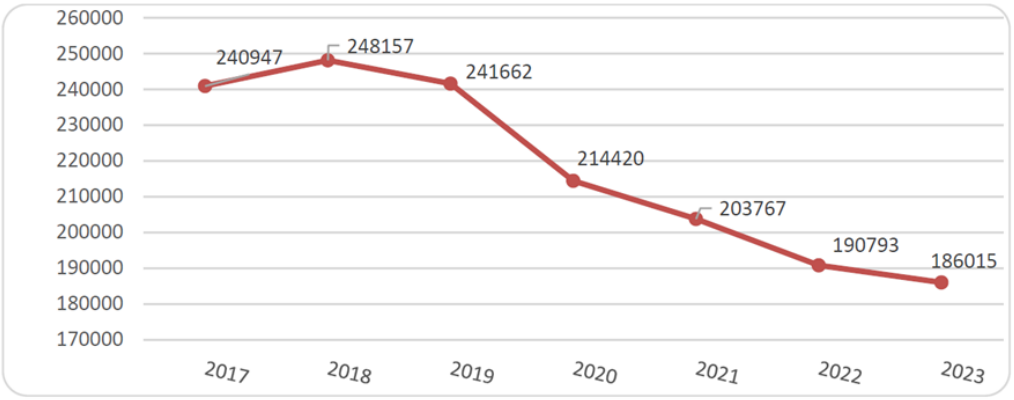

FIGURE 2. Projection of the enrollment declining from 2017 to 2023

(2016). If the government did not do anything for this issue after 2004, the gap will enlarge gradually as we expected.

3.3. **Projecting enrollment and its fixed effect in next seven years.** Figure 2 displays the enrollment declining in higher education from 2017 to 2023 based on the forecasting model. During these seven years, the number of freshmen will decline from 240,947 (2017) to 186,015 (2023) in terms of 30 percent drop.

Based on the trend of enrollment in this higher education system, Table 2 demonstrates the expected fixed effect by using the projected enrollment in next seven years. The estimated effect will extend from $-78,036$ (2017) to $-132,968$ (2023) in this model. Comparing the fixed effects in both stages, this study found the fixed effect of policy intervention, based on 2016, will increase from 5.62% in 2017 to 27.13% in 2023. If we based on 2004 actual enrollment and using the projected enrollment, the fixed effect of policy invention will enlarge from 24.46% to 41.68% in future. It is clear that the higher education policy needs to reflect this issue directly.

3.4. **Can international students be an optimal solution for declining enrollment?** According to the international students increasing, most of international students have reported from oversea for degree or non-degree purposes, which also include oversea Chinese and Mainland Chinese students. In 2016, there are 51,741 international students

TABLE 2. Projecting enrollment and expected gaps in higher education

year	Actual enrollment (AE)	FXE (AE declining) (based on 2004)	FXE declining rate (%)	
Stage I (Based on 2004∼2016)				
2004	318983	0	0.0000	
2005	315918	−3065	−0.0096	
2006	310408	−8575	−0.0269	
2007	299231	−19752	−0.0619	
2008	289638	−29345	−0.0920	
2009	266818	−52165	−0.1635	
2010	271152	−47831	−0.1499	
2011	273713	−45270	−0.1419	
2012	272288	−46695	−0.1464	
2013	258771	−60212	−0.1888	
2014	264554	−54429	−0.1706	
2015	264720	−54263	−0.1701	
2016	255284	−63699	−0.1997	
Stage II (Based on 2016∼2023)				
	Projecting enrollment (PE)	FXE (AE declining) (based on 2004)	FXE declining rate (based on 2004)	FXE declining rate (based on 2016)
2017	240947	−78036	−0.2446	0.0562
2018	248157	−70826	−0.2220	0.0279
2019	241662	−77321	−0.2424	0.0534
2020	214420	−104563	−0.3278	0.1601
2021	203767	−115216	−0.3612	0.2018
2022	190793	−128190	−0.4019	0.2526
2023	186015	−132968	−0.4168	0.2713

(44.4%) looking for degrees, and 64,675 students (55.6%) for non-degree purposes. Specifically, the students came from China 28%, oversea Chinese 21.2%, Chinese and literature study 17.2%, the other 33.6% [16]. Table 3 presents the international students increasing rate from 2008 to 2016 based on the statistics of MOE. It is steadily reflected at least 10 percent of international student numbers increasing, while it has dropped to 5 percent in 2016. Can we attract international students as a solution for the declining enrollment in the higher education system? The answer is still uncertain for overcoming the crisis that the current higher education confronted. As our observation, the international students might enroll in higher reputation universities, while the actual vacant seats still exits in the low competitive institutions.

3.5. **Calculating the revenue loss.** According to the actual enrollment (2016) and projected enrollment (2023) in Table 2, the total numbers of students in higher education institutions will decrease from 1,021,136 ($255,284 \times 4$ years) to 744,060 ($186,015 \times 4$ years). We assume each student should pay 100 thousand each year in a private university. It means the total university's revenue will decrease NT$ 27.7 billion when comparing 2016 and 2023. When we considered the international recruitment, based on the data of 2016 with the projected numbers in 2023, the result of revenue loss is:

$$78705 \times 4 \text{ (4-year program)} - 116,400 \text{ (international students enrollment)}$$
$$= 198,420 \text{ (student shortage in 2023)}$$

$$198,420 \times 100,000 \text{ (tuition pay in each year)} = 19.842 \text{ billion}$$

TABLE 3. International students and its increasing rate from 2007 to 2016

Years	International students	Increasing rate (%)
2007	30500	0
2008	33600	0.10
2009	39500	0.18
2010	45400	0.15
2011	57900	0.28
2012	67000	0.16
2013	79700	0.19
2014	93600	0.17
2015	111300	0.19
2016	116416	0.05

We assume that 78,705 is projected shortage based on expected enrollment in 2023. The 116,400 international students is the actual recruitment in 2016 and the similar number will exist in 2023 as our expectation. In our calculation, the revenue of the system might lose NT$ 19.842 billion in 2023.

4. **Conclusions.** Oversupply has become a new crisis in higher education in Taiwan. The popularization of education has led to a rapid increasing in student enrollment, although the figure has leveled off in the last decade. The tertiary education GER has reached 84%, higher than most of other Asian countries. Unfortunately, the oversupply higher education system suffered from the declining of birth rate. Therefore, serous declining problem has happened within the higher education system.

We examined the assumption: when the declining in enrollment accompanies with the oversupply higher education by coincidence, the serious problem might happen in the system. The expected enrollment and actual enrollment have been calculated to interpret the gaps of policy intervention. We assume the gaps can explain by the effect of policy intervention under the oversupply system with fluctuated and fixed effect. The international student recruitment has been taken into account in the estimation process. However, the effect of policy intervention by MOE is still limited. Based on the estimated numbers, we suggest the revenue of the higher education institutions might drop in future. This phenomenon has happened in some universities, especially some low competitive technological universities.

In general, we believe the effective higher education policy could overcome the declining enrollment in higher education. However, the serious declining enrollment might threaten the higher education institutions regardless of the current policy intervention only by way of cutting enrollment numbers.

The study suggests more strong policy intervention needed including close some universities directly, reinvent the higher education to fit the students' needs, and provide more effective attractions for international students which might maintain the enrollment in future for the higher education system. For long term, this study suggests remodeling the higher education system to fit the global competition, universities cooperation and merge, deregulating and building multiple management systems for sustainable development. These suggestions should be set a reasonable schedule to implement which might shift the decreasing trend. This study may provide an example to tackle the issue of balancing supply and demand in higher education system. For further studies, related factors which might impact the enrollment control in higher education should be considered to reinforce the estimated model.

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