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Fan Hu† Zidong An‡

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JEL classification: E24, J20, J21, I25

Keywords: Okun's Law, Unemployment, Business Cycles, Higher Education Expansion

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1. Introduction

How do China's economic fluctuations affect its labor market? Starting with Okun's 1963 seminal paper, a rich empirical literature has established a short-run response of an economy's overall unemployment to its output dynamics (see Ball et al., 2017 and Aaronson et al., 2019 for comprehensive reviews). This stable empirical relationship, known as Okun's law, is viewed as a natural consequence of producers adjusting hiring and firing procedures in response to fluctuations in aggregate demand.[1] Given relatively stable labor force participation, the response of total employment would cause the unemployment rate to change in an opposite direction with a similar magnitude. However, due to the rapid expansion in the higher education sector, China's labor force participation may also respond to economic fluctuations, and it remains a challenge to assess the fitness of Okun's law in China.

Following the Okun's law literature, recent studies find that economic fluctuations have asymmetric impacts on the labor market between business cycles, and output growth shows relatively smaller negative effects on the unemployment rate during economic upturns (Gordon, 2010). More importantly, the labor market responses could be influenced by a country's macroeconomic conditions (Donayre, 2022) and institutional factors (Furceri et al., 2020). With a centrally coordinated policy design across government agencies, economic sectors, and regions, as well as a vertical structure of policy transmission, one would expect to see a strong policy influence on the responses of the labor market to economic growth in China.

How does China's higher education expansion policy influence the short-run relationship between the labor market and economic fluctuations? Higher education has been shown to effectively improve human capital accumulation and enhance economic growth (see Hanushek, 2013 for a comprehensive review). Aside from its long-term impacts on economic growth,

[1] Other studies argue the causal relationship runs in the opposite direction, with employment fluctuations pinning down the output (e.g., see Daly et al. 2013). We do not take a stance in this debate and instead focus on their statistical relationship.

higher education expansion policy can also adjust labor force participation in the short run and mitigate the mismatch between labor demand and supply (Ou and Zhao, 2022). With a comprehensive analysis using province-level data, this paper provides novel empirical evidence and sheds some light on achieving a more inclusive economic growth through education policy. To the best of our knowledge, this paper is the first to study how education policy influences the relationship between the labor market and aggregate demand conditions.

Our baseline results confirm that the Okun's law generally holds in China, and the unemployment rate is expected to be 0.013 percentage points lower for each 1 percentage point increase in output growth. Further decomposing the response of unemployment into the difference between responses of labor force participation and total employment, our results confirm Okun's initial argument that economic conditions and labor returns can lead to workers entering or exiting the labor force, which masks the response in total employment.

Our second key finding is that economic growth shows asymmetric impacts on the labor market, and it is relatively larger during economic downturns than upturns. We interact output fluctuations with province-specific indicators of economic upturns and downturns and find that the result of larger impacts during economic downturns hold across unemployment rate, total employment, and labor force. These results also indicate that it is generally more difficult for a worker to exit than to re-enter the labor force.

Finally, we show novel empirical evidence that higher education expansion policy has a buffering effect on the short-run relationship between economic fluctuations and job market responses, especially during economic downturns. Based on a *de jure* (years of policy implementation) and a *de facto* (growth in new enrollment) measure that complements each other, this paper studies the influence of higher education expansion using an interacted variable analysis. Empirical results show that the higher education expansion effectively adjusts the

amount of working-age population entering the labor force, which cancels out the changes in total employment and leads to a smaller change in the unemployment rate during downturns.

This paper builds upon the vast empirical literature on Okun's law. Within this field, our paper particularly relates to two strands of research. One strand focuses on the asymmetric and time-varying features of the Okun coefficient. Harris and Silverstone (2001) put forward the theoretical and policy importance of studying the asymmetry of Okun's law, and they show possible determinants including factor substitution, adjustment cost, mismatch, and labor force participation. Silvapulle et al. (2004) argue that the asymmetric impacts could raise from the different hiring and firing processes due to policy reasons or firms' preferences. Furceri et al., (2020) further investigate the time-varying feature of the Okun's law, and they identify several policy factors that affect the variation in the Okun coefficient. These studies also lead to the second strand of research, which emphasizes the importance of macroeconomic conditions and policy factors in the output-labor relationship. For example, heterogeneity in the degree of short-run labor market sensitivity reflects the differences in the unemployment condition and economic development stage (Ball et al., 2017); the persistence of output and unemployment (Gil-Alana et al., 2020); economic shocks such as recessions and financial crises (Grant 2018; Bartolucci et al. 2018; Aguiar-Conraria et al. 2020); and structural policies, such as business and labor market regulations (Ball et al., 2019; An et al., 2022).

This paper also relates to the literature on the impacts of higher education policy on economic growth and labor market in China. Wan (2006) argues that China's higher education expansions were led by factors including the expectation to stimulate domestic consumption and to ease the immediate pressure on the labor market. Fleisher et al. (2011) show that higher education effectively raises labor productivity, which in turn promotes economic growth. Ou and Zhao (2022) find that the expansion of higher education decreases China's unemployment rate in the short run. This paper contributes to the literature by connecting the two tracks of

literature and empirically investigating the influence of higher education policy on the short-run relationship between aggregate demand and the labor market captured by Okun's law.

The rest of this paper proceeds as follows. Section 2 reviews China's higher education expansion policies and describes the data used in this paper. Section 3 discusses the econometric methods and baseline results. Section 4 investigates the asymmetric responses of the labor market to economic fluctuations between economic upturns and downturns. Section 5 examines the buffering effects of higher education expansion policy on Okun's law. Section 6 concludes.

2. Data

This section discusses the *de jure* and *de facto* measures of China's higher education expansion policy and describes the data used in this paper.

2.1 Higher Education Expansion Policies in China

Higher education is regarded as the sector for fostering talents to facilitate modernization and national development (Liu, 2012; Wang and Liu, 2010). Higher education reform has been continuously implemented as an effective national strategy to accumulate human capital and enhance sustainable economic development in China (Zhang and Liu, 2013). Aside from its impact on long-term economic growth, higher education expansion policy can also delay the working-age population from entering the labor force in the short run and mitigate the mismatch between labor demand and labor supply (Ou and Zhao, 2022).

Table 1 documents the major country-wide higher education expansion policies targeting undergraduate and graduate levels in China since the 1990s. Following Jiang and Ke (2021), these policies are retrieved and summarized from the policy documents published by the Ministry of Education of China (MOE) and other central government agencies. China conducted a country-wide reform in the state-owned enterprise in the late 1990s which caused mass layoffs and job displacement. With the additional external shock of the 1997-1998 Asian

Financial Crisis, China's domestic investment continued to decline and domestic consumption became insufficient (Wang, 1999). Against this background, the central committee of the Chinese Communist Party announced the "Decision on Deepening Education Reform and Promoting Quality Education in an All-around Way" in 1999. In the same year, the MOE issued the "Action Plan for Revitalizing Education in the 21st Century". The 2003 postgraduate education expansion was implemented under the background of the excess supply of college-level labor force owning to the initial 1999 expansion and the deficient demand due to the SARS pandemic.

Facing the 2008-2009 Global Financial Crisis, the MOE and National Development and Reform Commission jointly issued the "Notice on Preparation, National Postgraduate Admissions Plan" in 2009, which aimed at increasing the master's degree enrollment in 2009 by approximately 5% and the doctoral degree enrollment by 1.7%. In addition, the MOE also established new Full-time Professional Master's degree programs in different majors that are work-orientated, compared with the original research-originated master's programs. In contrast, the 2016 "Notice on Coordinating the Management of Full-time and Part-time Postgraduates" and the 2017 "Notice on National Master Enrollment Program Preliminary Arrangements" of the MOE were issued under the background of China's downward pressure mostly due to internal economic conditions.

The "National Vocational Education Reform Implementation Plan" was issued in 2019 to ensure a sufficient supply of highly trained labor for the development of the modern economic system, and to provide high school graduates, currently employed and unemployed people who are willing to receive higher education with a variety of enrollment modes. In response to the impact of COVID-19 on the macro economy and the labor market, the "Opinions on Strengthening Employment Stabilization Measures in Response to the Impact of COVID-19" was issued in 2020. As summarized above, even though there is no official statement directly

connecting the design of every education policy with aggregate economic conditions, most of the policy implementation years correspond with major economic shocks.

As a *de jure* measure of China's higher education expansion policy, we use a binary indicator that equals one for the years of policy implementation and those years following the announcement, and zero for other years. As an alternative *de facto* measure, we rely on the actual enrollment in general higher education at undergraduate and graduate levels retrieved from the National Bureau of Statistics and the education statistical yearbook, respectively. Different from the *de jure* measure that qualifies the education expansion based on policy documents, the *de facto* measure quantifies the actual levels of policy implementation in different provinces. However, the province-level enrollment data only covers the 2005 to 2019 period due to data availability.

Figure 1 shows the growth rate of the country-level new enrollment in undergraduate and postgraduate education as well as that in selected provinces, with vertical lines indicating the implementation years of higher education expansion policies.[2] The growth rate dynamic in new enrollment generally reflects the implementation of higher education expansion policy, as it rises significantly during these specific years. Besides, growth rates in different provinces show a clear tendency for comovement, indicating effective policy transmission from central government to state governments. Despite the tendency of comovement, the growth rate shows considerable heterogeneity in magnitudes across provinces. In this paper, we focus on the province-level analysis of the labor market responses to economic fluctuations, and the two measures above complement each other. Though the *de jure* measure of China's higher education expansion policy provides a longer series, it is a country-wide binary indicator and

[2] The rapid growth of China's higher education sector mostly happens after the expansion policy in 1999 (Li et al., 2014; Mok and Jiang, 2018; Jiang and Ke, 2021).

different provinces have to share the same values. In comparison, the *de facto* measure better quantifies the effectiveness of policy changes in different provinces.

2.2 Other Data

We also retrieve province-level real output, unemployment rate, total employment, and labor force participation data from the National Bureau of Statistics of China. Our data covers the 30 provinces in Chinese mainland (Tibet excluded due to the missing data) from 1981 to 2020. Table 2 reports summary statistics and pooled correlation coefficients. The unemployment rate stabilizes around 3.21 with limited variation. Growth rates in total employment and labor force participation show similar average values and standard deviations, and they tend to move together and both show positive correlations with output growth. The growth rate of new enrollment shows positive correlations with both the unemployment rate and output growth.

3. Short-Run Response of Labor Market to Output Fluctuations

This section discusses the econometric methods of estimating the baseline Okun's law and unpacks it into the responses of total employment and labor force. This section also lays the framework to quantify the impact of higher education expansion on the Okun coefficient.

3.1 Okun's Law and Its Decomposition

Okun's law has been widely used in the literature to study the short-run relationship between the labor market and total output, and it describes a negative empirical relationship between fluctuations in output and unemployment changes as a natural consequence of producers adjusting the hiring and firing decisions in response to changes in aggregate demand. Following Ball et al. (2017), the econometric specification of this relationship can be expressed as follows:

$$\Delta u_{it} = \beta \Delta y_{it} + \mu_i + \varepsilon_{it} \,, \tag{1}$$

in which Δu_{it} is the change in unemployment rate of province i ($i = 1, \dots, n$) in year t ($t = 1, \dots, T$), and Δy_{it} is the growth rate of real output. Province fixed effects, denoted by μ_i, control

for any potential cross-province differences in time-invariant characteristics, and ε_{it} is the zero-mean error term and it is assumed to be uncorrelated with the output growth. The Okun coefficient β measures the short-run responsiveness of the unemployment change to output growth, and it is expected to be negative.

Following An et al. (2022), we further decompose Okun's law into short-run responses of total employment and labor force participation to output fluctuations. On the one hand, verifying how much total employment response to output fluctuation is important in understanding how much of the Okun coefficient is driven by the labor participation margin. As Okun discussed, an increase in employment can raise the returns to job search, which induces workers to enter the labor force. On the other hand, given the data limitation that China's urban unemployment rate only provides a partial picture of labor market conditions in China, it is particularly informative to study the responses of total employment and labor force to aggregate demand conditions.

To see this formally, the unemployment rate can be written as one minus the ratio of total employment to the labor force: $u_{it} = 1 - E_{it}/L_{it}$, where E_{it} and L_{it} indicate the levels of employment and labor force participation of province i in year t, respectively. Further rearranging and taking the natural logarithm, we obtain the following relationship:

$$u_{it} \approx -ln(1 - u_{it}) = ln(L_{it}) - \ ln(E_{it}) \, . \tag{2}$$

As we can see, the unemployment rate can be approximated by the difference between the log levels of labor force participation and total employment. We then replace u_{it} with either $ln(E_{it})$ or $ln(L_{it})$ in the empirical specification of Okun's law to estimate the short-run responses of total employment and labor participation:

$$\Delta ln(E_{it}) = \beta^E \Delta y_{it} + \mu_i^E + \varepsilon_{it}^E \, , \tag{3}$$

$$\Delta ln(L_{it}) = \beta^L \Delta y_{it} + \mu_i^L + \varepsilon_{it}^L \, , \tag{4}$$

where $\Delta ln(E_{it})$ and $\Delta ln(L_{it})$ are the growth rates of total employment and labor force, respectively, and β^E are β^L measure the responses of total employment and labor force to output fluctuations; μ_i^E and μ_i^L are province fixed effects, and $\varepsilon_{i,t}^E$ and $\varepsilon_{i,t}^L$ are error terms with zero mean in each equation. We estimate the specifications discussed above using least squares regression for panel data. Standard errors are clustered at the province level and are robust to heteroskedasticity and autocorrelation.

Different from Ball et al. (2017), who estimate country-specific Okun's law, this paper focuses on the pooled coefficient estimates. Pooling data allows us to overcome the data limitation, especially in the short time span of the unemployment rate series. A similar strategy has been applied by Huang and Yeh (2013) and Ibragimov and Ibragimov (2017) who estimate Okun's law based on panel data.

3.3 Baseline Results

Table 3 shows the baseline short-run responses of the unemployment rate, total employment, and labor force to output growth, estimated from Equations (1), (3) and (4), respectively. These results are based on China's provincial-level data and they are estimated using Ordinary Least Square (OLS) regressions with robust standard errors clustered at the province level. The coefficient estimates are of the expected signs and are statistically significant at the 1% level. The unemployment rate is expected to be 0.013 percentage points lower for each 1 percentage point rise in output growth (Column 1). Though considered to be relatively low compared with other emerging economies, this result is consistent with the empirical findings in the literature. For example, Ball et al. (2019) find the Okun coefficient in China to be -0.015 using country-level data.

The low responsiveness is partially affected by the measurement of the unemployment rate, as China's urban registered unemployment rate is often criticized for not considering the possible unemployment of the rural labor force (Feng et al., 2015). Based on this measurement,

the unemployment rate stabilizes at around 3.2% with low variation, and this can decrease the observed sensitivity of the labor market. This also points to the importance of further unpacking the Okun coefficient into responses of total employment and labor force to output fluctuations.

As shown in Column (2), in response to each 1 percentage point increase in output growth, total employment is estimated to be 0.160 percentage points higher. More importantly, labor force participation also responds to output fluctuations (Column 3), which can mask the sensitivity of the unemployment rate. For each 1 percentage point increase in output growth, labor force participation is estimated to be 0.146 percentage points higher. This confirms Okun's initial argument that economic conditions and returns to labor affect workers' decisions to enter or exit the labor force.[3]

3.4 Robustness Checks

The baseline results are estimated using the "change version" of Okun's law. Its underlying assumption is that, without external shocks, the unemployment rate and the potential growth rate of output are both constant. As a robustness check, we estimate the Okun coefficient using an alternative "gap version", in which the short-run relationship is estimated as the response of the cyclical components in labor market indicators to the cyclical component in output. The underlying assumption of the gap version is that there exists a natural rate of unemployment rate and corresponding natural levels of total employment and output. In practice, these natural levels and their corresponding gaps (defined as deviations from the natural levels) can be estimated with econometric filters under a set of additional statistical assumptions. Under

[3] The low Okun coefficient is due to the low responsiveness of total employment to output fluctuations. An et al., (2022) decompose the Okun coefficient into short-run responses of labor force and total employment to output fluctuations, and they find the coefficients to be 0.15 and 0.30 for emerging economies, respectively. Applying the same strategy, we find a response coefficient of labor force participation of 0.146. However, the coefficient of total employment is 0.16, which is lower than in other emerging economies. This could be driven by informality. Unfortunately, due to data availability, we could not examine the impact of informality.

perfect assumptions, the coefficient estimates based on the gap version are comparable with those based on the change version, therefore serving as robustness checks to our baseline results.

Panels A and B of Table 4 report these robustness check results, and the cyclical components in the unemployment rate, total employment, labor force, and real output are estimated using the Hodrick and Prescott (1997, HP hereafter) filter and the Hamilton (2018) filter. With similar magnitudes, both approaches confirm that a positive output gap is expected to decrease the unemployment rate gap and increase total employment and labor force gaps from their natural levels. Therefore, we are confident that our results are robust to different empirical approaches, and we rely on the change version in the following analysis.

Comparing the two econometric filters, the HP filter has been widely used in the literature. However, as Hamilton (2018) discussed, the HP filter could introduce spurious dynamics that have no basis in the underlying data generation process, and cause the filtered values at the end of the series different from those in the middle. Considering our data has a relatively short time span in each province, such issues with the HP filter could affect the estimated Okun coefficient. In this paper, we are not trying to assess whether the change version or the gap version, or which filtering technique is more suitable for China's province-level data. Instead, we rely on different specifications with complementary assumptions to ensure the reliability of our empirical results.

The main results are based on the change version, and we also decompose the short- and long-run components using the HP and Hamilton filters. This presupposes a long-run relationship between the labor market indicator and output, which raises a concern that short-run specifications (1), (3), and (4) fail to control for the error correction term. As a robustness check, we estimate the responses of change in the unemployment rate, total employment growth, and labor force growth to output growth using the Autoregressive Distributed Lag (ARDL) Error Correction model. As shown in Panel C of Table 4, while the response coefficients of total

employment and labor force decrease to 0.089 and 0.073, respectively, the results are generally robust.[4]

4. Asymmetric Responses between Economic Upturns and Downturns

The asymmetric labor market response to output fluctuations has been widely documented in the literature, and the response tends to be stronger during an economic downturn than during an economic upturn. We extend the baseline analysis to allow for varying sensitivity according to the business cycles. Specifically, we interact output fluctuations with indicators for economic upturns and downturns:

$$\Delta u_{it} = \beta_u \Delta y_{it}(1 - D_{it}) + \beta_d \Delta y_{it} D_{it} + \gamma D_{it} + \mu_i + \varepsilon_{it} \,, \tag{5}$$

where the binary indicator D_{it} equals 1 if province i is facing an economic downturn in year t, and 0 if otherwise. With this specification, coefficients β_u and β_d respectively measure the response of unemployment rate change to output growth during economic upturns and downturns, and β_d is expected to be relatively larger in magnitude which indicates a stronger response during economic downturns. Similar to the decomposition of Okun's law, we replace the response variable in Equation (5) with log levels of total employment and labor force participation to estimate their asymmetric sensitivities to output fluctuation.

Table 5 reports the estimated responses of the unemployment rate, total employment, and labor. Economic upturns and downturns are respectively defined as those years with growth rates above or below the province-specific average growth rate. Column (1) confirms the asymmetric labor market response to economic fluctuation. The unemployment rate is expected

[4] As an additional robustness check, we conduct a rolling-window analysis of the short-run response of the labor market to output. For each rolling-window subsample of 15 years, we estimate the short-run responses specified in Equations (1), (3), and (4) and record the coefficient and 95% confidence interval. We report the results in the Appendix. As shown in Figure A1, for the change in unemployment rate (Panel A), the response coefficient generally varies between -0.02 and -0.01, while for the growth rates of total employment (Panel B) and labor force participation (Panel C), there exists an upward trend. This could also be driven by informality. Unfortunately, due to data availability, we could not examine the impact of informality.

to be 0.017 percentage points lower for each 1 percentage point rise in output growth, and 0.024 percentage points higher for each 1 percentage point decrease in output growth.

Unpacking the response of unemployment rate, both total employment and labor force are more responsive under economic downturns than under upturns. For each 1 percentage point increase in output fluctuation, employment is estimated to be 0.176 percentage points higher during economic upturns, while the magnitude increases to 0.215 during economic downturns. Similar results are found in the literature (see, e.g., Daly et al., 2013; Furceri et al., 2020). Facing declines in aggregate demand during economic downturns, firms adjust not only by stopping the hiring process but also by firing current employees. Such a different adjustment would be reflected as a larger magnitude in the Okun-type coefficients during economic downturns.

As for the labor force, it is expected to be 0.160 percentage points higher for each 1 percentage points rise in output growth, and 0.190 percentage points lower facing economic downturns. As Okun discussed, changes in economic conditions and labor returns can also induce workers to enter or exit the labor force. However, as these results show, it is more difficult for a worker to exit, rather than to enter the labor force, as the response parameter is larger in magnitude during economic downturns.

5. Buffering Effects of Higher Education Expansion Policy

As discussed above, aside from the long-term enhancing effects on human capital accumulation and economic development, higher education expansion can also adjust the amount of working-age population entering the labor market in the short run. Based on the Okun framework, this section investigates the influence of higher education expansion policy on the response of the labor market to output fluctuation. Specifically, we introduce a second layer of interaction with the policy measure into the empirical specifications:

$$\begin{aligned}\Delta u_{it} = {} & \beta_u \Delta y_{it} \cdot (1 - D_{it}) + \beta_{u,edu} Edu_{it} \cdot \Delta y_{it} \cdot (1 - D_{it}) + \beta_d \Delta y_{it} \cdot D_{it} \\ & + \beta_{d,edu} Edu_{it} \Delta y_{it} \cdot D_{it} + \gamma_{d,edu} Edu_{it} \cdot D_{it} + \gamma_{edu} Edu_{it} + \delta_d D_{it} + \mu_i + \varepsilon_{it} , \end{aligned} \quad (6)$$

where Edu_{it} indicates the *de facto* or *de jure* measure of higher education expansion policy of province i in year t. The parameters $\beta_{u,edu}$ and $\beta_{d,edu}$ measure the nonlinear short-run responses of unemployment to output that can be potentially explained by the higher education expansion policy when a province is facing economic upturns and downturns. Considering that education policies are stipulated by the Ministry of Education and implemented by the local government, we estimate Equation (6) using Generalized Least Squares regressions controlling for cross-sectional dependence.

Besides unemployment, we also estimate the responses of total employment and labor force based on Equation (6). Our main hypothesis is that the higher education expansion policy delays the working-age population from entering the labor market and, hence can buffer the shocks of economic fluctuation and aggregate demand. Since the unemployment rate is negatively associated with output in the short run, the parameter of interest, $\beta_{d,edu}$, is expected to be positive when the unemployment rate is included as the response variable. On the contrary, since total employment and labor force are positively associated with output in the short run, those parameters of interest are expected to be negative.

Table 6 reports the empirical results based on the *de jure* measure of higher education expansion policy. Specifically, we define a binary index for the policy implementation years and the ones after based on the official documents from the Ministry of Education. Three points are worth noting. First, original results on the asymmetric effect of economic fluctuation on the labor market continue to hold after including the binary policy measure: negative for unemployment rate, positive for total employment and labor force, and larger effect during economic downturns. Second, education expansion policies are mostly implemented during country-wide shocks, and the interaction terms show significant coefficients only for economic downturns. Third, education expansion shows significant buffering impacts. Comparing the three labor market indicators, the buffering impact on the unemployment rate is 0.005; and it

shows similar magnitudes, -0.223 for total employment and -0.199 for labor force participation. This indicates that most of the buffering effect on the labor market works by delaying the working-age population from entering the labor force.

Table 7 reports the empirical results based on the *de facto* measure of higher education expansion policy. The expansion policy is measured as the growth rate of new undergraduate and graduate enrollment for each province. Compared with the *de jure* measure that qualifies the years of policy implementation, the *de facto* measure can quantify the degree of expansion and it is comparable across provinces and along the time. However, due to the data limitation, this measure restricts our sample to the 2005-2020 period. The results are generally consistent with those reported in Table 6.

Economic fluctuations have larger impacts on the labor market during economic downturns than upturns, and these impacts show strong nonlinearity and can be altered by higher education expansion. Focusing on economic downturns, when holding new enrollment at the same level, total employment is expected to be 0.741 percentage points lower in response to each 1 percentage points decrease in output growth. The response coefficient is negatively influenced by enrollment growth. For each 1 percentage point rise in new enrollment growth, the response coefficient is expected to decrease by 1.471. Similar results are found for labor force participation (-1.240), which indicates that the buffering effect of higher education expansion during economic downturns mostly works through adjusting the labor force.

Table 8 reports the empirical results by replacing the growth rate of new enrollment in higher education (undergraduate + graduate) with that of undergraduate and graduate education separately. The buffering effect works mostly through the sector of undergraduate education, as the interacted term between the indicator for economic downturns and the measure of undergraduate education expansion shows a negative and significant coefficient for both total employment (-1.347) and labor force participation (-1.442). In contrast, the interacted term of

interest shows a significant coefficient estimate with a much smaller magnitude for total employment (-0.624) and labor force participation (-0.606).

Compared with graduate education, the opportunity for undergraduate education is more competitive in China. Taking the year 2018 for example, there is a total number of 9.8 million applicants, of which only 4.2 million get admitted into undergraduate education. Of the rest, 1.7 million choose to reapply after preparing for an additional year. In contrast, graduate education is more of a personal decision, since an undergraduate degree is generally considered adequate for the job market. Therefore, the expansion policy in undergraduate education can be more effective in adjusting the labor force, than that of graduate education.

6. Conclusion

Starting with Okun's 1963 seminal paper, a rich empirical literature has established a negative short-run relationship between an economy's overall unemployment to its aggregate demand conditions. More recent studies document that such a relationship can be asymmetric between economic upturns and downturns, and more importantly, it can be influenced by a country's policies and macroeconomic conditions. Higher education reform has been continuously implemented as a national strategy since the 1990s in China. Aside from its long-term impacts on economic development, higher education expansion policy can also mitigate the mismatch between labor demand and supply in the short run by adjusting its labor force participation. Building upon the Okun's law framework, this paper empirically investigates the short-run relationship between the labor market and economic fluctuations using China's province-level data, and further studies how higher education expansion policy influences such a relationship.

While the responsive coefficient is relatively smaller than that in other emerging economies, the Okun's law generally holds in China. We find that besides total employment, labor force participation also responds to economic fluctuations and it results in a low sensitivity in the unemployment rate. This finding confirms Okun's initial argument that economic conditions

and labor returns can lead to workers entering or exiting the labor force. Looking into the asymmetric response, we show that economic growth tends to have larger impacts on the labor market indicators during economic downturns than upturns, indicating different adjusting behavior in the hiring and firing processes due to policy reasons or firms' preferences.

With both the *de jure* and *de facto* measures, we show novel evidence that higher education expansion policy has a buffering effect on the relationship between labor market and aggregate demand conditions during economic downturns. Further unpacking higher education into undergraduate and graduate sectors, we show that the undergraduate sector has larger buffering effect. To the best of our knowledge, this paper is the first to study how education policy influences the labor market responses to changes in the aggregate demand conditions. Like most emerging economies, the opportunity for higher education, especially undergraduate education, is competitive in China. Higher education expansion can adjust the gap between labor demand and supply in the short run, and enhances economic development, hence promoting labor market conditions in the long run. The empirical findings in this paper shed some light on achieving a more inclusive economic growth in emerging economies through education policy.

At the end of this paper, two points are worth discussing. First, on the relationship between the labor market and output, the cyclical and trend components should be investigated separately. Between two versions of empirical strategies, the "change version" assumes that without external shocks, the unemployment rate and potential output growth are both constant; the "gap version" assumes there exists a natural rate of unemployment and a steady-state path of output. Second, this paper focuses on the short-run relationship between the labor market and output, and how education policy affects this relationship. We rely on a linear static relationship, while this relationship can be time-varying and can be affected by other factors. However, this goes beyond the scope of this paper, and we leave it to future research to address this limitation.

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Table 1. Higher Education Expansion Policies in China

Year	Higher Education Expansion Policy	Background
1999	Decision on Deepening Education Reform and Promoting Quality Education in an All-around Way Action Plan for Revitalizing Education in the 21st Century	State-owned Enterprise Reform Asian Financial Crisis
2003	Key Points of the Ministry of Education Work in 2003	SARS Pandemic
2009	Notice on Preparation, National Postgraduate Admissions Plan Full-time Professional Master's Degree Programs	Global Financial Crisis
2017	Notice on National Master Enrollment Program Preliminary Arrangements	China's economy faces downward pressures
2019	National Vocational Education Reform Implementation Plan Plan of Special Work for Enrollment Expansion of Higher Vocational Education	Promotion of higher education
2020	Opinions on Strengthening Employment Stabilization Measures in Response to the Impact of COVID-19	COVID-19 Pandemic

Notes: This table summarizes the major country-wide higher education expansion policies in China since the 1990s. These policies are retrieved from the policy documents published by the Ministry of Education of China (MOE) and other central government agencies.

Table 2. Summary Statistics and Pairwise Correlations

	(1) Unemp.	(2) Total Emp.	(3) Labor Force	(4) Output	(5) New Enroll.
Panel A. Summary Statistics					
Mean	3.21	1.56	1.51	9.10	5.12
St Dev	1.10	2.46	2.39	2.92	4.78
Num of Provinces	30	30	30	30	30
Obs	1182	1151	1151	1151	420
Panel B. Pairwise Correlations					
Unemployment Rate	1				
Total Emp. Growth	-0.02	1			
Labor Force Growth	-0.02	0.98	1		
Output Growth	-0.03	0.21	0.20	1	
New Enroll. Growth	0.19	0.06	0.06	0.37	1

Notes: This table presents summary statistics and correlation coefficients of the main variables. Panel united-root test results are reported in Table A1.

Table 3. Short-run Response of Labor Market to Output

	(1) Unemployment Rate	(2) Total Employment	(3) Labor Force
Output Growth (β)	-0.013***	0.160***	0.146***
	(0.004)	(0.026)	(0.026)
R-sq	0.04	0.30	0.29
Obs	1151	1151	1151

Notes: This table presents estimates from Equations (1), (3), and (4). Robust standard errors clustered at the province level in parentheses. Significant at *10%, **5%, and ***1%.

Table 4. Short-Run Response of Labor Market to Output: Robustness Checks

	(1) Unemployment Rate	(2) Total Employment	(3) Labor Force
Panel A. Hodrick and Prescott Filter			
Cyc. Comp in Output	-0.031***	0.118***	0.094***
	(0.004)	(0.025)	(0.025)
R-sq	0.07	0.03	0.02
Obs	1181	1181	1181
Panel B. Hamilton Filter			
Cyc. Comp in Output	-0.022***	0.160***	0.134***
	(0.005)	(0.032)	(0.030)
R-sq	0.07	0.05	0.06
Obs	1061	1061	1061
Panel C. ARDL Error Correction			
Output Growth	-0.016***	0.089***	0.073**
	(0.005)	(0.033)	(0.033)
R-sq	0.36	0.47	0.47
Obs	1151	1151	1151

Notes: Panels A and B present estimates based on the gap version of Okun's law. Cyclical components in the unemployment rate, total employment, labor force, and real output are estimated using the Hodrick and Prescott filter (Panel A) and the Hamilton filter (Panel B). Panel C presents results based on the change version of Okun's law, and they are estimated using the ARDL Error Correction model. Robust standard errors clustered at the province level in parentheses. Significant at *10%, **5%, and ***1%.

Table 5. Asymmetric Responses between Economic Upturns and Downturns

	(1) Unemployment Rate	(2) Total Employment	(3) Labor Force
Output Growth			
Upturn (β_u)	-0.017***	0.176***	0.160***
	(0.004)	(0.031)	(0.030)
Downturn (β_d)	-0.024***	0.215***	0.191***
	(0.006)	(0.047)	(0.046)
R-sq	0.04	0.31	0.30
Obs	1151	1151	1151

Notes: This table presents estimates for unemployment rate, total employment, and labor force from Equation (5). Robust standard errors clustered at the province level in parentheses. Significant at *10%, **5%, and ***1%.

Table 6. Buffering Effects of Higher Education Expansion: *De Jure* Measure

	(1) Unemployment Rate	(2) Total Employment	(3) Labor Force
Output Growth			
Upturn (β_u)	-0.004***	0.155***	0.145***
	(0.001)	(0.005)	(0.006)
Upturn × Edu ($\beta_{u,edu}$)	0.003	0.007	0.022
	(0.002)	(0.012)	(0.015)
Downturn (β_d)	-0.006***	0.251***	0.236***
	(0.001)	(0.008)	(0.009)
Downturn × Edu ($\beta_{d,edu}$)	**0.005****	**-0.223*****	**-0.199*****
	(0.002)	**(0.018)**	**(0.021)**
Obs	1,120	1,120	1,120

Notes: This table presents estimates for unemployment rate, total employment, and labor force from Equation (6). Higher education expansion policy is measured as a binary index for the policy implementation years and the ones after. Robust standard errors clustered at the province level in parentheses. Significant at *10%, **5%, and ***1%.

Table 7. Buffering Effects of Higher Education Expansion: *De Facto* Measure

	(1) Unemployment Rate	(2) Total Employment	(3) Labor Force
Output Growth			
Upturn (β_u)	-0.017***	0.599***	0.536***
	(0.003)	(0.016)	(0.020)
Upturn × Edu ($\beta_{u,edu}$)	-0.011	-0.734***	-0.545***
	(0.017)	(0.148)	(0.114)
Downturn (β_d)	-0.028***	0.741***	0.678***
	(0.004)	(0.022)	(0.027)
Downturn × Edu ($\beta_{d,edu}$)	**0.087*** **	**-1.471*** **	**-1.240*** **
	(0.025)	**(0.190)**	**(0.214)**
Obs	420	420	420

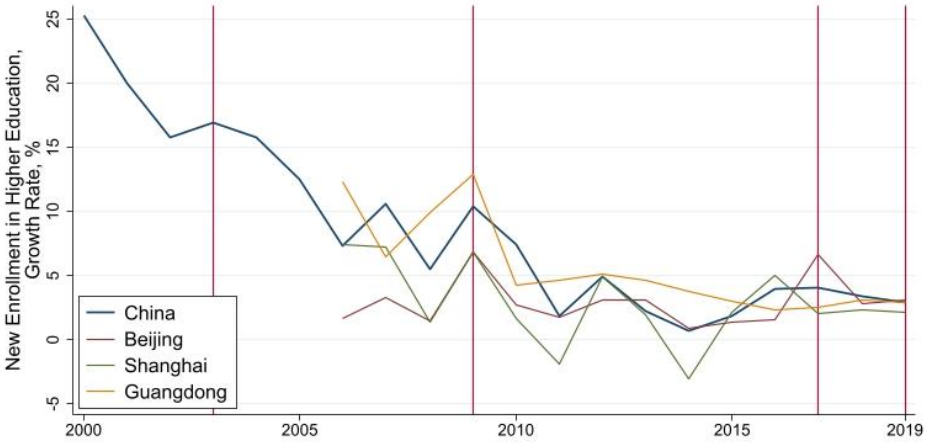
Notes: This table presents estimates for unemployment rate, total employment, and labor force from Equation (6). Higher education expansion policy is measured as the growth rate of new undergraduate and graduate enrollment in each province. Robust standard errors clustered at the province level in parentheses. Significant at *10%, **5%, and ***1%.

Table 8. Buffering Effects of Higher Education Expansion: Under- vs Graduate

	A. Undergraduate			**B. Graduate**		
	(1) Unemp Rate	(2) Total Emp	(3) Labor Force	(4) Unemp Rate	(5) Total Emp	(6) Labor Force
Output Growth						
Upturn (β_u)	-0.019***	0.606***	0.547***	-0.021***	0.505***	0.478***
	(0.004)	(0.016)	(0.026)	(0.003)	(0.022)	(0.022)
Upturn × Edu ($\beta_{u,edu}$)	0.006	-0.704***	-0.373***	0.036***	0.237	0.297*
	(0.017)	(0.129)	(0.099)	(0.009)	(0.178)	(0.179)
Downturn (β_d)	-0.028***	0.741***	0.689***	-0.031***	0.706***	0.672***
	(0.005)	(0.021)	(0.038)	(0.004)	(0.033)	(0.033)
Downturn × Edu ($\beta_{d,edu}$)	**0.059*** **	**-1.347*** **	**-1.442*** **	**0.059*** **	**-0.624*** **	**-0.606*** **
	(0.022)	**(0.189)**	**(0.267)**	**(0.020)**	**(0.161)**	**(0.163)**
Obs	420	420	420	549	549	549

Notes: This table presents estimates for unemployment rate, total employment, and labor force from Equation (6). Higher education expansion policy is measured as the growth rate of new undergraduate (Panel A) or graduate enrollment (Panel B) in each province. Robust standard errors clustered at the province level in parentheses. Significant at *10%, **5%, and ***1%.

Figure 1: Growth Rate of New Higher Education Enrollment



Notes: This figure shows growth rates of country-level new enrollment in higher education as well as that in selected provinces. Vertical lines indicate implementation years of higher education expansion policies.

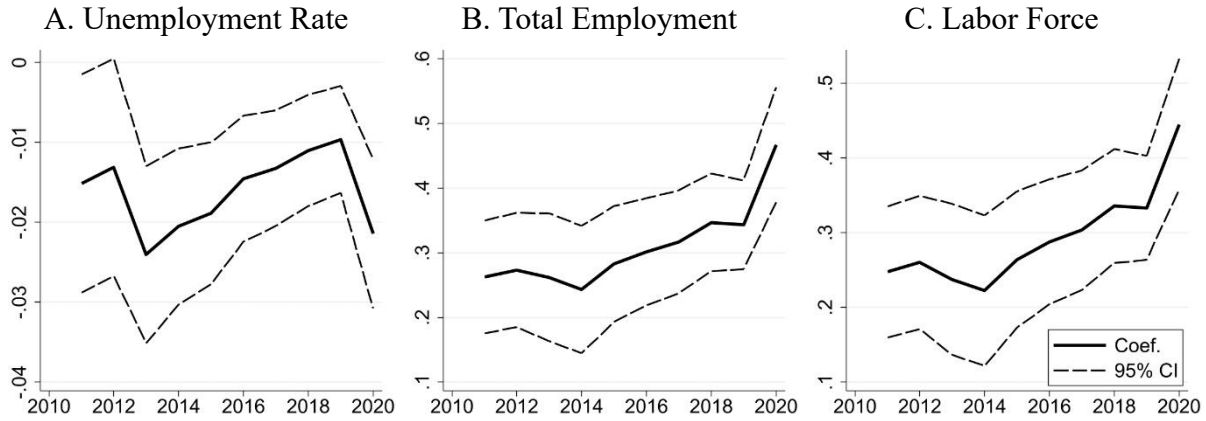
Appendix

Table A1. Panel United-root Tests

	(1) Unemployment Rate	(2) Total Employment	(3) Labor Force	(4) Real Output
ADF				
Inverse chi-sq	0.00	0.03	0.01	0.00
Modified inv. chi-sq	0.00	0.02	0.01	0.00
Phillips-Perron				
Inverse chi-squared	0.00	0.00	0.00	0.00
Modified inv. chi-sq	0.00	0.00	0.00	0.00
Im-Pesaran-Shin				
W-T-bar	0.00	0.00	0.00	0.00

Notes: This table reports p-values from the unit-root tests, including the Augmented Dickey Fuller test, the Phillips-Perron test, and the Im-Pesaran-Shin test. The four series being tested are (1) change in unemployment rate, (2) growth rate of total employment, (3) growth rate of labor force participation, and (4) growth rate of output growth. The null hypothesis is that all panels contain unit roots, and the alternative hypothesis is that at least one panel is stationary.

Figure A1. Short-Run Response of Labor Market to Output: Rolling-window Analysis



Notes: This figure shows coefficient estimates from a rolling-window analysis of the short-run response of the labor market to output. For each rolling-window subsample of 15 years, we estimate the short-run responses specified in Equations (1), (3), and (4) and record the coefficient and 95% confidence interval. The indicators being tested are (A) change in unemployment rate, (B) growth rate of total employment, and (C) growth rate of labor force participation.