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Non-parametric Duration Models in the First Job for Young Graduates in Tunisia

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Abstract

This paper aims to analyze using reduced-form econometric estimates, the individual unemployment durations of young graduates, focusing on the influence of search mode choices in accessing the first job. Duration models are estimated with right-censored data. Non-parametric duration estimation procedures (Kaplan-Meier estimator) are statistical models that do not make assumptions about the distribution of the data, allowing for a more flexible analysis of the transition process. This paper uses these models to estimate the length of time it takes for young graduates to transition from school to work, and to identify factors that may impact the duration of this process, such as educational level, type of study program, and other demographic and socioeconomic variables. Kaplan-Meier estimator allow the evaluation of the hazard function to be conducted directly by accounting for right censoring without incorporating the impact of individual characteristics.

Keywords: *Kaplan-Meier Estimator, Search Mode Choices, Access to the First Job, Hazard Function, Duration Unemployment of Young Graduates, Nonparametric Duration Estimation.*

Introduction

The Tunisian labor market presents a complex landscape characterized by significant structural challenges and economic constraints. With a total labor force of 4.45 million in 2023, the market exhibits notably low participation rates, particularly among women, who represent only 27.5% of the workforce compared to 65.9% for men. The unemployment rate remains persistently high, reaching 16% in the second quarter of 2024, with youth unemployment dramatically exceeding 40%.

The economic context further complicates labor market dynamics, with limited growth of 0.6% in the first half of 2024 and projected annual growth of merely 1.2%. The informal sector plays a substantial role, absorbing approximately 44.8% of total employment, which underscores the precarious nature of work opportunities (Ragui Assaad et Mongi Boughzala2018). Key challenges include a significant skills mismatch, high fiscal pressure on labor, and limited economic diversification.

On the other hand, the proportion of young graduates with higher education degrees has risen sharply. The combination of these two phenomena has led to a sharp decline in the unemployment rate of these young graduates. The unemployed Tunisian graduates of higher education represent about (25%), a quarter of all unemployed Tunisians, their unemployment rate soared from 18.7% in 2007 to 23.3% in 2010 and 33.2% in 2012.

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The considerable increase in the number of graduates over the last two decades, and the growing diversification of the training offer, have quantitatively and qualitatively transformed the flow of graduates from higher education, to solve the question of their professional integration.

Indeed, young graduates are more qualified when they enter the labor market, but their integration remains largely dependent on the economic situation. Marie Duru-Bellat (2006) denounces an "inflation of graduates" and attributes to massification the reason for their "devaluation", which in turn results in a "downgrading" of young graduates on the labor market. Several studies on entry-level employment have highlighted the crucial role of the diploma in access to employment. However, the most recent studies invite the use of other indicators to better assess the quality of the jobs to which young people have access.

The objective of this paper is to analyze, using reduced-form econometric estimates, individual unemployment durations that focus on the influence of search mode choices in accessing the first job. Models of durations are estimated with right-censored data.

Contribution

Nonparametric duration estimation procedures allow an evaluation of the hazard function to be made directly by accounting for right censoring without incorporating the impact of individual characteristics. The estimator used here is that of Kaplan Meier (1958), which consists of counting for each unit of time, the proportion of young graduates of the four Tunisian universities (Jendouba, Monastir, Gafsa and Gabes) who are unemployed out of the total number of respondents.

Literature Review: Job Search Behavior: (Job Search Methods Used)

Empirical studies have shown the impact of search strategies on unemployment duration. On the other hand, (Granovetter (1973), (1995), Holzer (1988)) have pointed out that the social network mode increases the probability of finding a job. Osberg (1993), Giret Karaa and Plassard (1996) and Lindeboom and Van Ours (1997), Pellizzari (2003), have also looked the discriminatory impact of job search modes on unemployment exit rates.

The results of the different studies are very heterogeneous depending on the population considered and the estimation methods adopted. For example, they do not all use the same classification of modes of access to employment (dominant modes, modes used) and do not take into account the specificities of the rule of selection of modes by individuals. Nevertheless, most econometric studies agree on the lower efficiency of public placement services compared to market procedures and the social network (Gregg, Wadsworth, 1996; Debattre and Sebatier (2003)). However, the results of experiments (Meyer, 1995) are less positive about the negative effect of using public employment agencies. They show that by controlling for the characteristics of individuals using the agencies, intermediaries can reduce the duration of unemployment. Thomas (1997) confirms this conclusion econometrically by correcting for the selection bias in the choice of intermediaries. He thus shows that public employment agencies are an effective search method provided they are used from the beginning of unemployment.

Data and Methodology

The Database

The sample of our database 2015 includes 1535 graduates, drawn from a survey on the professional integration of young people conducted among graduates of four Tunisian

universities Jendouba, Monastir, Gafsa, and Gabes, from License 2010-2011. This project is carried out by Tempus ISLAH through a long cooperation of the lead partner - the AlmaLaurea Consortium - with European and Maghrebian partners of the project (Morocco and Tunisia), 7 universities for the country of Morocco and 4 universities for the country of Tunisia.

Right-Censored Data

A lifetime is said to be right-censored if the individual did not experience the event at his last observation. In this case, the unemployment durations of young graduates are not all observed; for some of them, the only information we have is that they are greater than a certain known value.

Two reasons, in the survival analysis, for which, we can meet the censorship on the right:

- The young graduate had not yet experienced the event at the end of the survey, this is referred to as "living censoring".

- The young graduate left the current study at a date when he or she had not yet experienced the event, because he or she had moved, or refused to continue participating in the survey, this is called "lost to follow-up". Indeed, one can imagine that unemployed graduates are no longer followed up because their condition has seriously deteriorated due to a cause related to the event studied. The graduates most at risk will be removed from the survey, resulting in an overestimation of survival.

A common and convenient analytical expression that allows us to represent the right-censored data and associate each graduate with a pair of random variables (Y, δ) with :

$$Y = \min(X, C)$$

$$\delta = \begin{cases} 0 & (1) \\ 1 & if X \succ C \\ & otherwise \end{cases}$$

The duration X and the censoring date C are independent.

Non-Parametric Approach (Kaplan-Meier Estimator)

The Kaplan-Meier (1958) estimator method reasons as follows: to survive after a time t, is to not yet have undergone the event at the time t, is to not have undergone it just before t and not to have undergone it in t. (Janssen, P., Veraverbeke, N. (2024)) and (Bladt, M., & Furrer, C. (2023).

If $t_1 \prec \ldots\ldots\ldots \prec t_k$ the different observed event times (unemployment and censorship) are distinct and arranged in increasing order, since to survive after t_j, it is of course necessary to have already survived for at least one t_j duration and not to have suffered it in t_j, to calculate the Kaplan-Meier estimator of the survival function, we use the conditional probability theorem :

$$\hat{S}(t_j) = \hat{P}(X \succ t_j) \qquad (2)$$

$$= \hat{P}(X \succ t_j / X \succ t_{j-1})\hat{P}(X \succ t_{j-1})$$

$$= \hat{P}(X \succ t_j / X \succ t_{j-1}) \ldots \hat{P}(X \succ t_2 / X \succ t_1)$$

$$= \prod_{k=1}^{j} P(X \succ t_k / X \succ t_{k-1})$$

$$= P_j P_{j-1} \ldots\ldots\ldots P_1 \qquad (3)$$

With $t_0 = 0$, we can define d_j as the number of individuals experiencing the event at time t_j (in our case, this parameter represents the number of uncensored observations, i.e. the number of individuals who exited unemployment at date t_j).

n_j is the number of individuals who would have to know the event in question between t_{j-1} excluded and t_j that n_j is the number of individuals at risk just before the time j (likely to exit the unemployment state just before t_j).

In the case of the existence of censored durations between t_{j-1} included and t_j excluded, the convention adopted is not to take into account the individuals concerned in the calculation of n_j.

To calculate the number of individuals at risk (number of individuals who are unemployed just before t_j), we have the following relationship:

$$n_j = n_{j-1} - c_{j-1} - d_{j-1} \text{ With } j = 1, 2, \ldots\ldots, k$$

We can estimate $P(X \succ t_j / X \succ t_{j-1})$ par $\hat{P}_j = \dfrac{(n_j - d_j)}{n_j}$ (4)

The Kaplan-Meier estimator $(\hat{S}(t))$ is also called Limit Product because it is obtained as the limit of a product, is obtained in the following way:

$$\hat{S}(t) = \prod_{j=t_j \le t} \frac{n_j - d_j}{n_j} \qquad (5)$$

$$= \prod_{j=t_j \le t} (1 - \frac{d_j}{n_j}) \qquad \text{Avec} \qquad (\hat{S}(0)) = 1$$

(6)

The function $\hat{S}(t)$ is survival in the unemployment state which is a decreasing step function,

constant between two consecutive event times with a step at each observed event time, and it makes no assumptions about the form of the relationship between the exogenous variables and the dependent variable.

This function is not defined beyond the last observation, if this one is censored (the function is not null for this last observation but beyond the number at risk being null, it cannot be calculated).

Mean and Median Survival

To describe the data through the hazard functions and survival functions for the sample, the Kaplan-Meier estimators have a descriptive role because they allow us to have a representation of the distribution of durations, we must specify the number of events, graph the survival function or hazard function and also specify the median or average follow-up time of individuals.

Concerning the survival time, we prefer to present the median survival time rather than the average. The median survival time is the time t for which : $\hat{S}(t) = 0.5$

Indeed, because of the right censoring, the mean cannot be correctly estimated. This is not the case for the median survival. But, when the number of events is not large enough, the median of survival, in this case can not be estimated.

Two cases to give an average, either all individuals undergo the event, and in this case does not pose a problem. Or, we calculate an average only for the individuals having undergone the event by specifying it

The Variance and Confidence Interval of the Kaplan-Meier Estimator

The variance of $(\hat{S}(t))$ estimate is defined by Greenwood's formula:

$$\hat{V}(\hat{S}(t)) = (\hat{S}(t))^2 \sum_{j:t_j \le t} \frac{d_j}{n_j(n_j - d_j)}$$

And when $(\hat{S}(t))$ moving away from value 0 ($np \prec 5$ few events) or 1 ($n(1-p) \prec 5$ few subjects leaving unemployment), we can use the following formula to estimate the confidence interval:

$$IC(\alpha) = \left[\hat{S}(t) \pm z_{\frac{\alpha}{2}} \sqrt{\hat{V}(\hat{S}(t)} \right]$$

This interval is symmetric around $(\hat{S}(t))$, so it provides bounds exceeding 0 or 1 (for values of $(\hat{S}(t))$ which are close to 0 and 1)

While it is preferable to use the Rothman confidence interval, whose limits are always between 0 and 1:

$$IC(\alpha) = \frac{K}{K + (z_{\frac{\alpha}{2}})^2}\left[\hat{S}(t) + \frac{(z_{\frac{\alpha}{2}})^2}{2K} \pm 1{,}96\sqrt{\hat{V}(\hat{S}(t) + \frac{(z_{\frac{\alpha}{2}})^2}{4K^2}}\right]$$

With

$$K = \frac{\hat{S}(t)\left[1 - \hat{S}(t)\right]}{\hat{V}(\hat{S}(t))}$$

Estimates and Results

Non-parametric duration estimation procedures allow us to conduct an evaluation of the risk function directly by accounting for right censoring without incorporating the impact of individual characteristics. The estimator used here is that of Kaplan Meier (1958), which consists of counting for each unit of time, the proportion of young graduates of the four Tunisian universities (Jendouba, Monastir, Gafsa and Gabes) who are unemployed out of the total number of respondents.

This type of estimation does not allow us to explain the hazard, but it does give us some initial information about its shape.

Figure 1 traces the unemployment exit rate calculated with the Kaplan-Meier estimator.

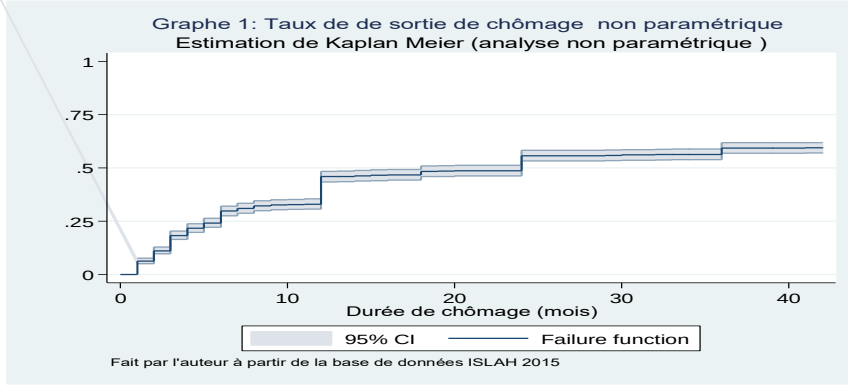

FIGURE 1: Non-Parametric Estimation: Unemployment Exit Rate

Figure 1 shows us that the probability of accessing the first job increases with time, but this increase reveals several critical phases, one around the tenth month of search, the other around the 25th month, we notice that the unemployment exit rates increase less rapidly and then stagnate before increasing a little again.

These thresholds are difficult to interpret at this stage of the analysis because they may be the result of non-linearity in the exit rates as well as the failure to take into account the heterogeneity of the sample.

This difficulty can be partially circumvented by stratifying unemployment durations according

to certain individual characteristics.

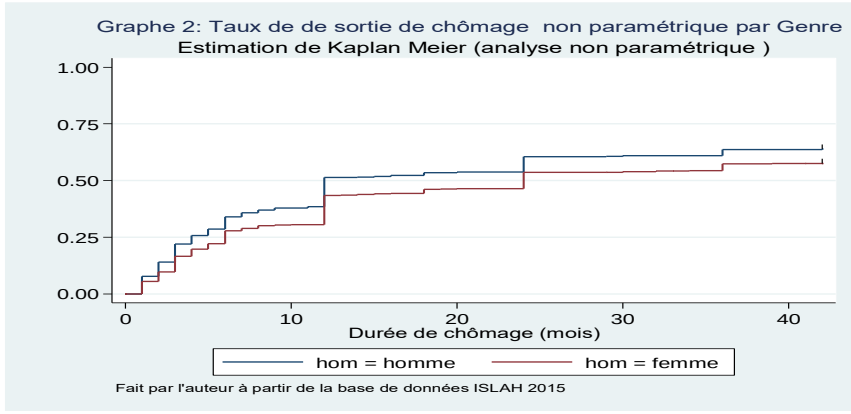

FIGURE II: Kaplan Meier Estimate (By Genre)

Figure 2 presents the non-parametric unemployment exit rate by gender, which shows a notable difference between the gender hazard rate. Indeed, men (average unemployment duration is 12 months) have a higher probability of exiting unemployment than women (average unemployment duration is 24 months) over the whole observed period and this can be explained by the motivation of men to exit unemployment using several job search choices.

The difference observed between these two non-parametric risk curves can be explained by the complete ignorance of explanatory variables other than sex.

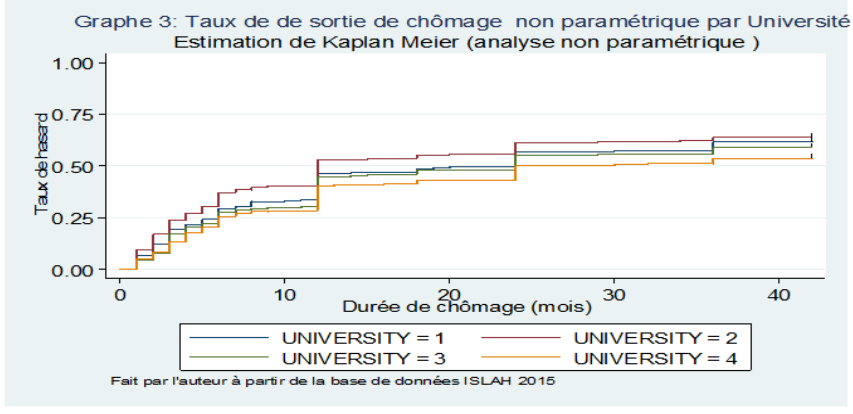

FIGURE 3: Kaplan Meier Estimate (Exit Rate By University)

Graph 3 presents the non-parametric hazard rate by the 4 universities which shows the impact of these universities on the unemployment exit rate. We note that there is a gap between the hazard rates of young graduates of the four Tunisian universities, indeed, graduates of the University of Monastir are the only ones who ensure a higher probability of accessing a job, before ten months of unemployment while graduates of the University of Jendouba take the second place for the exit of the state of unemployment, and finally the graduates of two universities (Gabes and Gafsa) take the same rank in the study of insertion into working life, so we note that these do not allow more rapid exit from the state of unemployment before ten months of unemployment.

This result may be due to the impact of spatial disparity (distance from the university in the center of Tunis) on access to preemployment.

The non-parametric estimation of the durations shows moreover by starifying the chance by specialty and by Stream. Specialty and by Field

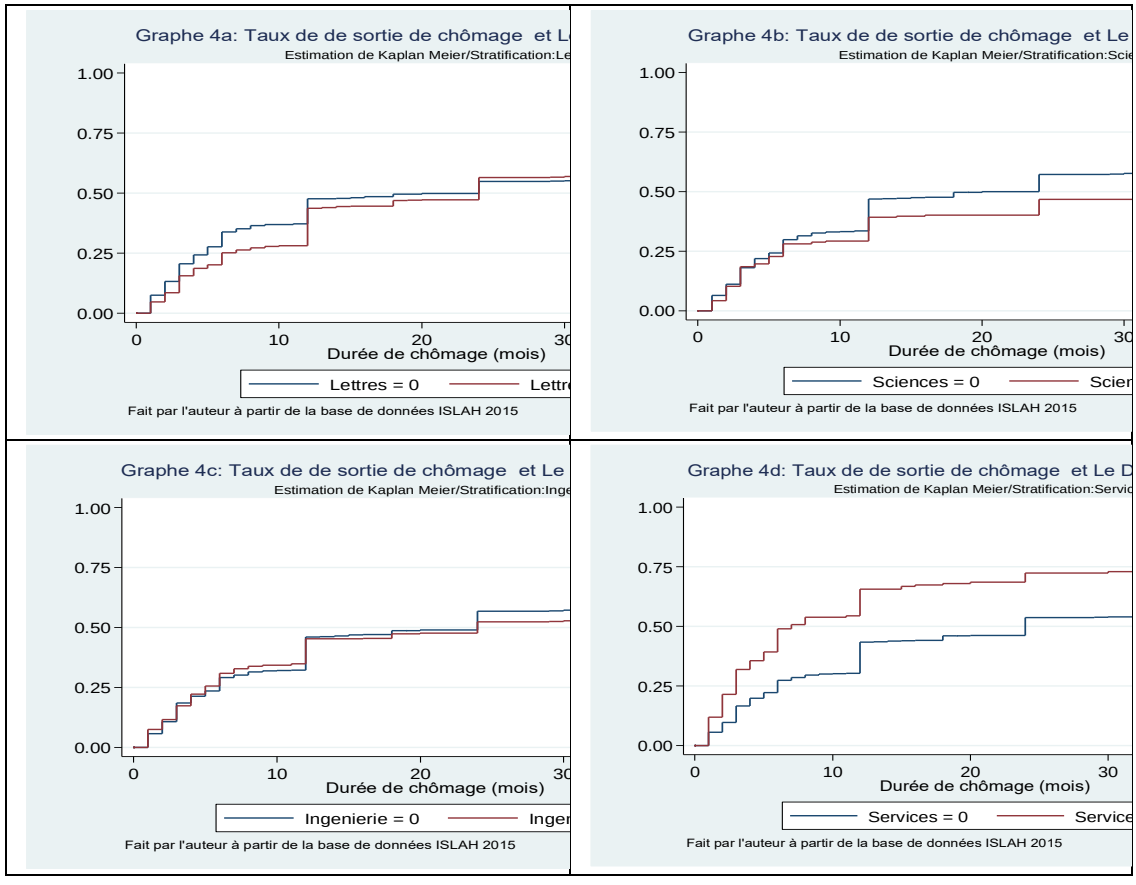

FIGURE 4: Rate of Exits from Unemployment by Specialty

Non-parametric analysis of the time to first job can also be used to study the impact of the institution. We note that poly-disciplinary faculties have a faster access than other faculties, namely legal, economic and social sciences faculties and science faculties.

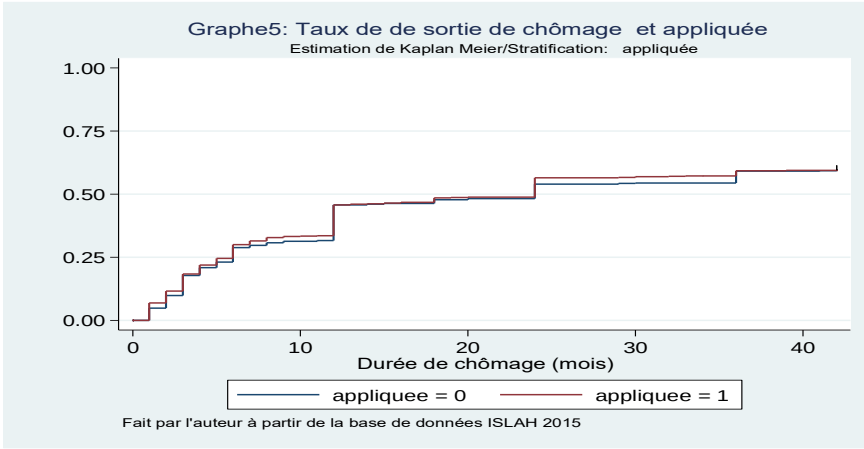

FIGURE 5: Non-Parametric Estimation by Sector

To study the impact of Track for unemployment exit rates, the basic license increases a bit just before the month and then both Track: basic license and applied license provide slightly faster access to employment at all periods.

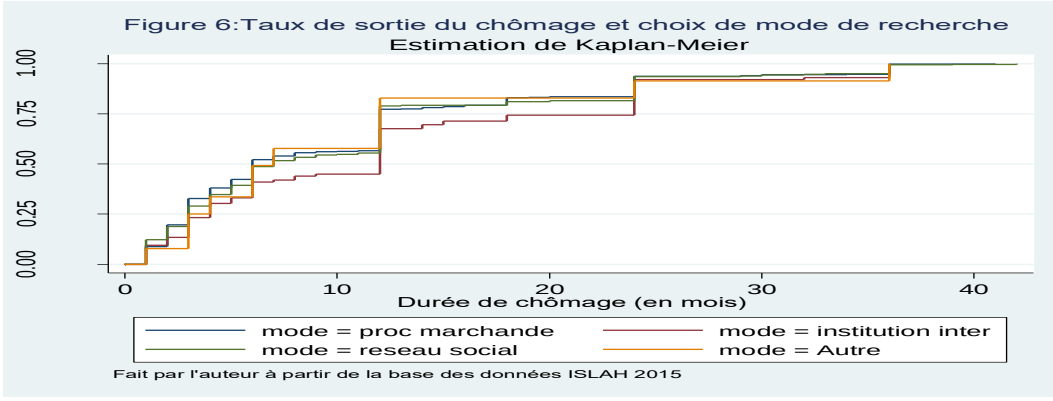

FIGURE 6: Non-Parametric Estimation: Unemployment Exit Rate and Mode Choice

These figures represent non-parametric Kaplan-Meier estimates of the estimated hazard and use of search mode choices to access the first job, concluding that the effect of these job search modes is not very discriminating.

Figure (6a) shows that young graduates from four Tunisian universities, having used market procedures, have a higher rate of exit from unemployment after 12 months of searching. Similarly, figure (6c) underlines the same interpretation as figure (6a) by showing that young graduates choosing the social network allow a slightly faster access to employment has several periods. The network mode and market procedures are considered the most efficient modes for leaving unemployment. While in Figure (6b), institutional intermediaries provide a lower rate of exit from unemployment.

Conclusion

These non-parametric estimates allowed an initial analysis of the duration of access to the first

job. However, they are limited to a brief examination of durations by not controlling for observable heterogeneity among individuals. Indeed, the difference observed between the different curves of the different results of the non-parametric hazard test may be due to the choice of mode, the nature of their selection rules, and the existence of other explanatory variables.

It is therefore necessary to use other more elaborate estimation methods to evaluate the efficiency of the modes.

Non-parametric models employed in this study offer a useful perspective on unemployment durations among young graduates in Tunisia. These models provide a general overview of the time it takes for graduates to find employment and identify some broad trends in the job market. However, they have significant limitations.

The primary drawback is the inability of these models to account for individual heterogeneity. Factors such as personal career choices, the extent and quality of social networks, and specific academic specializations are not incorporated into the analysis. These individual-level variables can significantly influence employment outcomes but remain unexamined in the current study.

Furthermore, the analysis does not delve into the nuances of different economic sectors or regional variations within Tunisia, which could provide more targeted insights for policy formulation. The lack of longitudinal data also limits the ability to track changes in employment patterns over time or in response to specific policy interventions.

To address these limitations, we suggest that more sophisticated methodologies could be employed in future studies. Parametric or semi-parametric models, for instance, could offer a more nuanced evaluation of the factors influencing youth graduate unemployment. These advanced techniques could potentially control for a wider range of variables and provide more robust predictions of employment outcomes.

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