

Hernández-Fernández, Jimena; Marsan, Erik

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Dual Apprenticeships in Mexico: Insights Into the First Employment

Jimena Hernández-Fernández^{1*}, Erick Marsán²

¹*Universidad Iberoamericana, Prolongación Paseo de la Reforma, Santa Fe, Álvaro Obregón,
01376 Mexico City, Mexico*

²*TalentumMX, Cerrada de Camerún, Lomas de Chapultepec, Miguel Hidalgo,
11000, Mexico City, Mexico*

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Abstract

Context: Dual apprenticeships (DA) are a type of Technical and Vocational Education and Training (TVET) that emphasize the development of work skills through collaboration between the education sector and the labour market. DA are believed to facilitate smoother transitions to work for youth by combining vocational training in schools with workplace-based learning. Despite claims of improving youth employability, evidence on DA's effectiveness is limited, especially outside Europe. This study investigates the employability outcomes of graduates from the Mexican adaptation of the DA model.

Approach: The study utilizes a survey conducted with DA graduates in Mexico in 2021 to analyse their likelihood of securing employment post-graduation. A probit model is used to estimate the probability of employment across three scenarios: (1) Securing any type of job, (2) being employed by the company where the DA was completed, and (3) obtaining employment with social security, which serves as a proxy for formal employment. The dependent variables are not mutually exclusive, as overlaps exist between the different employment categories. The sample includes 307 graduates from Coahuila and the State of Mexico, and the analysis controls for individual characteristics and contextual factors.

Findings: The analysis reveals that receiving job-relevant additional training (e.g., language courses) significantly increases the probability of securing both general employment and formal employment with social security. Similarly, longer participation in DA improves em-

*Corresponding author: jimena.hernandez@ibero.mx



ployment chances across all models, though with smaller effects. Gender disparities are evident, as women are less likely to obtain formal employment compared to men. Additionally, graduates from the Electricity and Electronics field have higher employment probabilities than their peers in service-related training areas; while graduates from the Technology and Transportation careers have lower chances of obtaining formal employment than their peers in service-related training areas.

Conclusion: While DA in Mexico shows promising results in employability for graduates, significant areas require attention to ensure equitable and widespread benefits. Policies should focus on increasing access to job-relevant training and extending the duration of apprenticeships to enhance apprentices' opportunities for formal employment. Our findings underscore the importance of local conditions and economic structures in shaping employment opportunities and, ultimately, DA outcomes.

Keywords: Apprenticeship, Education and Training System, Employment Opportunity, Transition From Education and Training to Employment, Vocational Education and Training, VET

1 Introduction

Dual apprenticeships (DA) are a type of Technical and Vocational Education and Training (TVET) that emphasize the development of work skills through collaboration between the education sector and the labour market (Graf et al., 2014). DA offer a combination of vocational training in schools and training and support by professionals in workplaces. This distinguishes DA from other full-time TVET programs, for its strong component of workplace-based learning and training, whereas other TVET models provide only brief periods of work experience (Valiente & Scandurra, 2017). DA is claimed to offer advantages in youth employability through situated learning, skill acquisition, and institutional contact (Ryan, 2012). Specifically, DA is believed to facilitate a smoother transition to work for youth, as employers may use it as a way of screening potential employees (Haasler, 2020; Wolter & Ryan, 2011).

Evidence on the effectiveness of DA in improving youth employment is still limited due to a lack of data (Eichhorst et al., 2015). Nevertheless, evidence from Belgium indicates that DA has a positive effect on early work status (employment and having a permanent contract), but no significant effects were found concerning later labour market outcomes (Neyt et al., 2020). This aligns with several studies that have identified trade-offs between the short-term advantages and long-term disadvantages of vocational education and training (Brunello & Rocco, 2017; Forster et al., 2016; Parey, 2016).

The study of DA's relationship with youth employment has been predominantly Eurocentric (Novella & Pérez-Dávila, 2017). Despite this, the DA model has been transferred to many

other countries, including Brazil, Costa Rica, Chile, India, Nepal, and Mexico (de Amesti et al., 2023; Jansen & Pineda-Herrero, 2019; Novella & Pérez-Dávila, 2017; Pilz, 2017). For instance, in Mexico, research on DA graduates' employability is limited, with relatively few studies on DA's outcomes. Exceptions include only a study on youth employability rates in regions with DA (Zamora-Torres & Thalheim, 2020), as well as a qualitative study on DA graduates' work and educational transitions (Hernández-Fernández et al., 2022).

The objective of this study is to explore apprentices' probability of obtaining a job between four to six months after graduating from the Mexican adaptation of DA. For this purpose, we use a survey conducted with DA graduates in 2021. We use a probit model to measure DA graduates' probability of being employed across three scenarios: Obtaining employment of any kind (including the informal market), working for the company where DA was completed, and securing a position with social security. The scenarios are not mutually exclusive, as the data indicate that the different employment categories can overlap, including cases where individuals secure a job in a DA company without social security.

The article consists of five sections. The first section elaborates on the relationship between DA and employability, drawing on international evidence. The second section describes the Mexican DA adaptation, highlighting its implementation, characteristics and results. The third section presents the methodological strategy, followed by a presentation of the findings. The final section discusses our findings.

2 Dual Apprenticeships and Employability

Technical and Vocational Education and Training (TVET), particularly the German Dual Apprenticeship Model (GDAM), has been associated with Germany's relatively low youth unemployment rates (Haasler, 2020; OECD, 2018). The GDAM combines school-based teaching and company-based training and is alleged to foster smooth youth transitions into employment (Haasler, 2020). The duration of GDAM typically ranges between two and four years, with the company-based component varying between three and four days per week, depending on the theoretical component (Euler, 2023).

Adaptations of the GDAM in Austria, Denmark, Germany, and Switzerland demonstrate that its positive effects are due to several factors: The high degree of formalization in their labour markets, strong involvement of social partners ensuring the relevance of the curricula, government funding allocated to vocational colleges for the school-based component, and firms meeting specific technical criteria for participation, which guarantees relevant training and certification (Eichhorst et al., 2015).

There is a consensus that the positive effects of GDAM cannot be automatically imported to other contexts due to the importance of the economic, cultural, and social systems of the importing country (Euler, 2013, 2023; Euler & Wieland, 2015; Wieland, 2015). Therefore, the

borrowing of DA policies can only be partial and influenced by the national characteristics of the host country (Euler, 2023; Pilz, 2016). DA can only improve youth employment chances when the country's employment system can provide jobs (Pilz, 2017).

While there are no experimental impact evaluations of DA, several studies have measured the labour effects of DA in various countries where it has been implemented (Novella & Pérez-Dávila, 2017). The evidence collected by Novella and Pérez-Dávila (2017) indicates that DA increase the probability of employment. For example, in Brazil, DA increase employment probability by up to 7% (Corseuil et al., 2014). In Austria, Denmark, and Germany, apprentices generally have a higher probability of employment than those with general education until the age of 44, when the trend reverses (Hampf & Woessmann, 2017). Moreover, in Australia, DA has shown positive employment outcomes for young people even during the COVID-19 pandemic (Waugh & Circelli, 2021).

DA has also been found to increase the duration of first employment. For instance, in Germany, the employment duration of apprentices is 1.9 times higher than those with other qualifications (Bellmann et al., 2000). Furthermore, some evidence suggests that DA may have a positive effect on wages. In Brazil, apprentices show an hourly wage increase of 62% after two years and 50% after five years (Corseuil et al., 2014).

The evidence collected by Novella and Pérez-Dávila (2017) also shows that DA may provide advantages when apprentices are compared to graduates of full-time vocational education, unskilled workers, or those with other qualifications, although not when compared to graduates of academic tracks (Novella & Pérez-Dávila, 2017; Riphahn & Zibrowius, 2016). However, the results are positive for male apprentices, while being negative for female apprentices (Novella & Pérez-Dávila, 2017). Conversely, research has shown that the company where apprentices perform their work experience provide differentiated advantages to DA graduates. For example, in Brazil, DA graduates of large or international companies have better employment outcomes than their peers (Bougheas & Georgellis, 2004). Additionally, the positive employment effects are less impactful when comparing countries such as Brazil and Romania with countries like Germany or the United Kingdom (Corseuil et al., 2014; Malamud & Pop-Eleches, 2010; Novella & Pérez-Dávila, 2017).

Interestingly, the available evidence shows that the probability of finding a job is higher immediately after graduation, but the effects decline over time as with evidence of Great Britain, Netherlands and Sweden once established on the labour market there is no unemployment risk difference between DA graduates and their peers from other educational tracks (Korpi et al., 2003). Additionally, evidence from Belgium indicates that DA graduates demonstrate employment advantages after graduation, but only for those who had a more intense period of training at company (Neyt et al., 2020) Therefore, it is relevant to investigate whether in a country such as Mexico, DA can provide apprentices with opportunities to find a job after graduating from the program.

3 Dual Apprenticeships in Mexico

Mexico, like other Latin American countries, has faced high unemployment rates, particularly among youth (OECD, 2024); some argue that one of the reasons is the skills gap among new entrants (Schmees & Láscarez Smith, 2024). Mexico adopted the GDAM, arguing that it could provide students with a pathway for social mobility and rapid insertion into the labour market (Aramburu Cano et al., 2024; Hernández-Fernández et al., In press). Furthermore, the transfer of the GDAM has been massively supported by the German government, as it has been in other countries (Schmees & Láscarez Smith, 2024).

Mexico has now accumulated significant experience with DA, the Mexican adaptation of DA originated from the collaboration between the National College of Vocational Technical Education (CONALEP, by its Spanish acronym) in the State of Mexico and Mercedes-Benz between 1993 and 1998 (Cáceres-Reebs & Schneider, 2013). In the 2000s, the model was piloted on a small scale, and in 2012, the Mexican Model of Dual Training, later renamed the Dual Education System (DES), was established in partnership with some of the most relevant Mexican and German business chambers. In 2015, the Federal Ministry of Education (SEP, by its Spanish acronym) legally introduced DES as a valid educational option in the upper-secondary school education subsystem (Zamora-Torres & Thalheim, 2020).

As DA was initially introduced in State of Mexico's CONALEP, it first expanded within that school modality to other states. Eventually, as the model became an official part of the education system, DA extended to other states and school modalities within the TVET sector. In recent years, student participation in DES has increased by nearly 60% (Hernández-Fernández & Zúñiga Herrera, 2024). However, this growth represents only 2% of the more than four million students enrolled in upper-secondary education in Mexico. The relatively low representation of the model in upper-secondary education is due to the complexity of its operation and the need for a proper link between the educational and productive sectors (Hernández-Fernández & Zúñiga Herrera, 2024).

In Mexico, apprentices begin their upper-secondary education studies at the TVET school and from the third semester onwards can opt to join DA. Apprentices must be at least 16 years old to apply and have written consent from their parents if they are underage. The apprentices start their training at a company but continue to maintain contact with the school to receive theoretical training (García Fuentes & Gutiérrez Huerter O, 2023). Depending on the technical career that the student is undertaking, the duration of the programme may vary. For industrial jobs, studies span two years, and students start their apprenticeship in the third semester. In the case of service careers, DA lasts one year, and apprentices can join either on the third, fourth, or fifth semester. As a result, DA duration varies greatly.

Once in the DA company, apprentices follow a rotation plan where their school curriculum is translated into contents, sequences, activities, responsibilities, and schedules. DA connects the career graduate profile and competencies standards with the activities that the

apprentice will perform and learn at the DA company. Apprentices also attend complementary classes at school to cover subjects that are not taught at the DA company. Additionally, they may be offered further training opportunities at the company such as foreign language lessons. At the end of DA, apprentices receive an academic certificate that validates their upper secondary education with DES and could also obtain external certification through the National Council for Normalisation and Certification of Labour Competencies agency (CONOCER, by its Spanish acronym) In contrast to Germany, where certification is part of DA, in Mexico apprentices have the possibility of undergoing an evaluation that certifies their work skills by CONOCER (Secretaría de Educación Pública, 2022); however evidence show that the external certification is not offered in all training spaces (Hernández-Fernández et al., 2022).

Other, particularity is that while the GDAM contemplates that companies compensate apprentices monetarily and the certification schemes operate with resources from the educational system (Jäger, 2016), the Mexican adaptation lacks regulatory mechanisms to clarify the obligations and responsibilities of companies. Additionally, schools in Mexico operate DA without additional financial resources (Pérez Delgado & Ramírez Reyes, 2022). Research on the Mexican implementation of DA shows that schools have had to formally establish relationships with the productive sector, and companies have had to transform into learning spaces, which has been challenging (Aramburu Cano et al., 2024)

Furthermore, some studies have explored whether DES has helped improve apprentices' entry into their first job. There is evidence that some companies have opened job opportunities for apprentices to be hired at the end of their training (Morales Ramírez, 2014; Zavala Sañudo & Huerta Salomón, 2020). However, to our knowledge, there is no quantitative research showing evidence of Mexican apprentices' transition into their first job. The only exception is a factor analysis conducted between 2013 and 2016, at both national and state level. The findings highlight a positive relationship between DA and labour insertion where a grow in DA implementation correlated with a decrease in youth unemployment and an increase in the number of employed individuals (Zamora-Torres & Thalheim, 2020). Moreover, data from 2021, where the German Technical Cooperation Agency surveyed apprentices, found that 71% perceived an improvement in their employment prospects and 73% felt that what they learned in their training met the requirements of their current job (Subsecretaria de Educación Media Superior & GIZ., 2022).

Recently, a qualitative study investigated whether apprentices who completed DES during the COVID-19 emergency could pursue their labour or educational expectations. The results showed that the socioeconomic profile of graduates acted as a mediating factor, with only apprentices from better socioeconomic backgrounds being able to access work and/or further education. Therefore, the evidence shows that the Mexican DA failed to enhance opportunities for all apprentices during the COVID-19 pandemic (Hernández-Fernández et al., 2022).

4 Methodology

This research is part of a larger project entitled "*Can dual apprenticeships create better and more equitable social and economic outcomes for young people? A comparative study of India and Mexico*". The project aimed to investigate how the Dual Apprenticeship (DA) model has been adopted and implemented and its impact on inequalities in access, learning, and labor market outcomes in Mexico and India (Hernández-Fernández et al., 2022; Maitra et al., 2022). Data collection was conducted simultaneously in both countries between March 2019 and August 2021. For this article, we use data from a follow-up survey conducted four to six months after apprentices' graduation in Mexico. The survey targeted a sample of apprentices from Coahuila and the State of Mexico, which together accounted for 60% of DA enrollments in 2019.

With the support of the operating bodies of DES and the CONALEP we contacted schools to invite the total population of apprentices to participate in the study. Our final sample comprises 307 apprentices, representing a 46% response rate in the State of Mexico (229 respondents) and 43.3% in Coahuila (78 respondents). To account for regional variations in apprentice distribution, we applied weights in the analysis. Our sample consists of recent graduates, 73% of whom were between 17 and 18 years old at the time of the second survey, while 27% were 19 years or older. The sample is 59% male and 41% female, reflecting the gender distribution of apprentices in both states.

4.1 Regression Model

We employ a Probit model to estimate the probability of employment among graduates of the Mexican adaptation of the DA system. Our analysis considers three employment-related dependent variables, each corresponding to a specific survey question: (1) Employment after graduation: "Have you been employed after completing DES?", (2) Employment at the company where the apprenticeship was conducted: "Have you been employed after graduation at the company where you performed DES?", and (3) Employment with social security: "Have you had employment that provided social security after completing DES?", which serves as a proxy for formal employment.

To ensure analytical rigor, we structured the dependent variables to meet three key criteria: (1) They are artificially mutually exclusive, meaning that selecting "yes" for one employment scenario implies not selecting the others within the model; (2) the set of employment alternatives is exhaustive, covering all possible employment outcomes; and (3) the number of alternatives is finite (Moreno Valencia, 2014; Muzam & Tambi, 2023). However, in practice, some employment categories may overlap. For instance, an apprentice may be employed at

the DA company with social security, or they may be employed at the same company without social security.

The Probit model is appropriate for this analysis as it allows us to estimate the probability of employment outcomes while assessing the effects of various independent variables on each employment scenario (Pho & Truong, 2023). The probability of being employed is represented by the following equation where (i) represents the 307 apprentices in the sample:

$$E_i = FE_i + WA_i + DS_i + CE_i + AT_i + TT_i + FA_i + CS_i + e_i \quad (1)$$

The dependent variable (E) which measures employability in three different equations: (Ea) Employed after graduation (Ea = 1 if the individual was employed after graduation, 0 otherwise); (Eb) Employed in a dual company (Eb = 1 if the individual was employed in a dual company, 0 otherwise); (Ec) Employed with social security (Ec = 1 if the individual was employed with social security, 0 otherwise).

The objective of this analysis is to estimate the probability of apprentices securing employment based on key determinant variables, including individual characteristics and contextual factors related to the implementation of DA (as shown in equation 1). The individual explanatory variables included in the model are gender (Female) and age (Working Age). The DA implementation variables considered as explanatory factors include: Whether apprentices received monetary support from the dual company (Dual Scholarship); whether they obtained the DA certification by the time of survey (Certification); and whether they had access to additional training, mostly language courses (Additional Training). We also include the duration of their apprenticeship in the company as part of DES (Training_Time); apprentices' area of study (Formation Area) and the company's production sector (Company Sector).

Finally, e_i represents a vector of exogenous characteristics. These factors are expected to influence the likelihood of securing employment upon graduation from DES¹:

Table 1: Description of Explanatory Variables (own elaboration)

Explanatory variable	Description
Female	Takes the value 1 if the apprentice is female and 0 if male.
Working_Age	Takes the value 1 if the participant is 19 years or older and 0 if 18 years or younger.
Certification	Takes the value 1 if the participant received a formal certification for their apprenticeship in DA and 0 otherwise.
Additional_Training	Takes the value 1 if the apprentice had access to any additional training (e.g., language courses) and 0 otherwise.
Dual_Scholarship	Takes the value 1 if the apprentice received monetary support from the dual company during the program and 0 otherwise.

¹ It is important to note that we did not include a socioeconomic variable in our analysis. This decision was based on the relative homogeneity of participants' socioeconomic backgrounds in DES and the lack of detailed survey questions to effectively measure this aspect.

Training_Time	A continuous variable that takes values from 1 to 36 months, representing the duration of DA training at the company.
Formation_Area	A categorical variable that takes values between 1 and 5, depending on the apprentice's field of study: 1 = Services 2 = Electricity and Electronics 3 = Maintenance and Installation 4 = Production and Processing 5 = Technology and Transportation
Company_Sector	A categorical variable that takes values between 1 and 3, based on the company's productivity sector: 1 = Services Sector 2 = Industrial Sector 3 = Automotive Sector

In an alternative analysis, we present regressions of the same model by region, treating it as a control variable, given that the two regions exhibit intrinsic characteristics that could influence employment outcomes. Coahuila, located in northern Mexico, has a more industrialized economy, while the State of Mexico, situated in the central part of the country adjacent to Mexico City, has an economy more oriented toward services. We controlled for the region through alternative regressions, as its inclusion as an explanatory variable had no significant effect.

Based on the particularities of the DA instrumentation in Mexico, our hypothesis is that being female and being underage at the time of graduation negatively impact the probability of employment. Conversely, receiving a scholarship, obtaining certification, and having additional training during DA are expected to increase the likelihood of securing employment after graduation.

To ensure the robustness of our regression models, we conducted several specification tests. In particular, we applied the McFadden's Adjusted R² to assess the models' goodness of fit².

4.2 Limitations and Scope

There are some limitations that must be acknowledged. First, our study does not compare the employment outcomes of DA apprentices with those of young people who did not participate in a DA program. Second, the study relies on self-reported data from apprentices, which may be subject to response biases. Additionally, the data collection coincided with the COVID-19

² The accuracy rates of the three models were as follows: Ea (Employed after graduation): 63.5%; Eb (Employed in a dual company): 87.3%; Ec (Employed with social security): 76.5%.

pandemic, which may have influenced the employment outcomes observed and limited the ability to isolate the effects of DA from broader economic disruptions.

Furthermore, while our regression models control for several variables, there may be unobserved factors, such as individual motivation and socioeconomic background as well as previous work experience, that may influence employment outcomes but were not captured in our analysis. Notwithstanding our research provides understanding of the DA's employment results and its potential for improving youth employment outcomes in Mexico a country where little is known with regards to DA employment outcomes (Valiente et al., 2020).

5 Dual Apprenticeship and Employability: Empirical Results

The descriptive analysis shows that 42% of DA graduates secured employment after graduation (Ea). Of these, 13% were employed at the DA company (Eb), and 28% obtained jobs with social security (Ec), as shown in Table 2. Interestingly, only 34% of those employed at the DA company had social security, indicating formal employment. Also the descriptive data indicates that male apprentices were more successful in securing employment after graduation, as 63% of employed graduates are men, while only 37% are women. Additionally, among those employed at the DA company, 62% are men and 38% are women. Furthermore, among those employed with social security, 71% are men, whereas only 29% are women.

Moreover, the descriptive analysis indicates that employment rates vary by region, with Coahuila having higher employment rates than the State of Mexico. Specifically, 50% of DA graduates in Coahuila secured employment, compared to 40% in the State of Mexico. Additionally, 18% of the graduates in Coahuila were employed at their dual company compared to 11% in State of Mexico. Also, 44% of graduates in Coahuila reported employment with social security benefits, while only 23% had social security in State of Mexico.

Table 2: Description of Dependent Variables According to Gender and Region (own elaboration)

		Ea	Eb	Ec
		Employed	Employed at dual company	Employed with social security
	Total	42%	13%	28%
Gender	Men	63%	62%	71%
	Women	37%	38%	29%

Regional	State of Mexico	40%	11%	23%
	Men	57%	48%	65%
	Women	43%	52%	35%
	Coahila	50%	18%	44%
	Men	77%	86%	79%
	Women	23%	14%	21%

Table 3 presents the Probit model results. In the first model, which examines employment after graduation (Ea), the most influential variable is Additional Training, with a marginal effect of 0.2919 ($p < 0.01$), indicating that receiving additional training at the company increases the likelihood of employment (29.19 percentage points). Additionally, Training Time has a marginal effect of 0.0112 ($p < 0.01$), suggesting that each additional month in the apprenticeship increases the probability of employment by 1.22 percentage points. Regarding Formation Area, apprentices in Electricity and Electronics exhibit a marginal effect of 0.2304 ($p < 0.05$), meaning that students in this field are more likely to be employed (23.04 percentage points higher) compared to those in careers related to the service industry. With respect to the Company Sector, apprentices in the Industrial Sector show a marginal effect of -0.1633 ($p < 0.05$), indicating that being part of a company in this sector reduces the likelihood of employment (16.33 percentage points less) compared to those in Service Sector companies. No other significant predictors were found in the first employment model.

In the second model, which analyzes employment at the DA company (Eb), Training Time is the only significant predictor, with a marginal effect of 0.0114 ($p < 0.01$), suggesting that each additional month in the apprenticeship increases the probability of employment at the DA company (1.14 percentage points).

In contrast, the third model, which examines employment with social security (Ec), identifies Female, Working_Age, Certification, Additional Training, Training Time, and the Technology and Transportation Formation Area as significant predictors.

The Female variable has a coefficient of -0.1075 ($p < 0.05$), indicating that being female decreases the probability of securing a job with social security benefits (10.75 percentage points less). The Additional Training variable has a marginal effect of 0.2387 with statistical significance ($p < 0.01$), indicating that receiving job-relevant training increases the likelihood of obtaining a job with social security benefits (23.87 percentage points). Similarly, Training Time is a significant predictor in the Ec model, with a marginal effect of 0.0090 ($p < 0.05$), suggesting that each additional month in the program increases the probability of employment with social security by 0.9 percentage points. Finally, the Technology and Transportation Formation Area has a marginal effect of -0.1561 with marginal significance ($p < 0.05$), indicating that apprentices in this field have lower chances (15.61 percentage points less likely) of securing employment with social security compared to those in careers related to the service sector.

Overall, Training Time and Additional Training emerge as the most significant explanatory variables. Although not all variables are statistically significant, their patterns align with those observed in the other two models. Furthermore, the results indicate that being a woman and being underage reduces the likelihood of securing employment with social security.

The analysis reveals that Additional Training and Training Time are the most significant predictors of employment outcomes among DA graduates. The variables, Working Age, Certification, Dual Scholarship were no significant in predicting any of the models. Gender disparities are evident, as women are significantly less likely to obtain formal employment compared to men. In terms of fields of study, graduates from the Electricity and Electronics area have higher employment probabilities, whereas those in Technology and Transportation face disadvantages in securing formal jobs. The industrial sector also presents lower employment rates compared to the service sector. Interestingly, while training time is the only significant factor influencing employment within DA companies, no other variables strongly predict retention in the same company post-graduation.

Table 3: Results of the Probit Regressions (own elaboration)

		Probit Ea (Employment)	Probit Eb (Employment at dual company)	Probit Ec (Employment with social security)
	Female	-0.0352 (0.573)	-0.0022 (0.959)	-0.1075 ** (0.053)
	Working_Age	-0.0913 (0.491)	-0.0091 (0.907)	-0.1560 (0.151)
	Certification	0.0287 (0.624)	0.0377 (0.359)	0.0383 (0.463)
	Additional Training	0.2919 *** (0.009)	-0.0186 (0.790)	0.2387 *** (0.008)
	Dual_scholarship	0.0502 (0.562)	-0.0078 (0.847)	0.0634 (0.228)
	Training Time	0.0122 *** (0.006)	0.0114 *** (0.000)	0.0090 ** (0.020)
Formation Area (Vs Services)	Electricity and Electronics	0.2304 ** (0.036)	0.0226 (0.791)	0.1597 (0.148)
	Maintenance and Installation	0.0573 (0.489)	-0.0278 (0.599)	-0.0589 (0.407)
	Production and Processing	0.0694 (0.429)	0.0103 (0.855)	0.0522 (0.516)
	Technology and Transportation	-0.1033 (0.327)	-0.0386 (0.572)	-0.1561 ** (0.039)

Company Sector (Vs Services)	Industrial	-0.1633 ** (0.019)	-0.0564 (0.238)	-0.0717 (0.247)
	Automotives	-0.1233 (0.283)	-0.0395 (0.590)	0.0478 (0.668)
N		307	307	307
Pseudo R2		0.0613	0.073	0.1025
McFadden's Adj R2:		0.029	0.015	0.024

Note. *p < .1; **p < .05; ***p < .01; standard errors in parentheses. Marginal effects are reported.

Marginal Effects

For the variable Female, all three models show a negative effect on employment probabilities, with the strongest and most significant impact in model Ec (employment with social security). Being 19 or older at the time of graduation, which categorizes an apprentice as being of work-appropriate age, also reduces the probability of employment across all three models. Although this variable lacks statistical significance, it is noteworthy that apprentices of legal working age appear to be penalized for entering DES relatively late.

Conversely, Training Time and Certification positively influence employment probabilities across all three models. The marginal effects of Additional Training during DA increase the probability of securing general employment (Ea) and employment with social security (Ec). However, in the case of employment at a DA company (Eb), Additional Training has a negative but non-significant effect. Similarly, receiving a scholarship shows no statistical significance in any model. However, it has a positive effect in models Ea and Ec (general and formal employment) and a negative effect in model Eb (employment at the DA company).

5.1 Probability Analysis

We analyse the three models' probabilities to visualize on average their specific distributions. Graph 1 shows the predicted probabilities of the three models (Ea, Eb and Ec). The model Ea (employment) is represented with the blue line which is the highest probability distribution, concentrated around 42% of being employed. The red line in Graph 1 features the probability of being employed in a DA company (Eb) with an average probability of 12.7%. The probability of the third model Ec (employment with social security) is represented by the green line with 28% of probability of being employed.

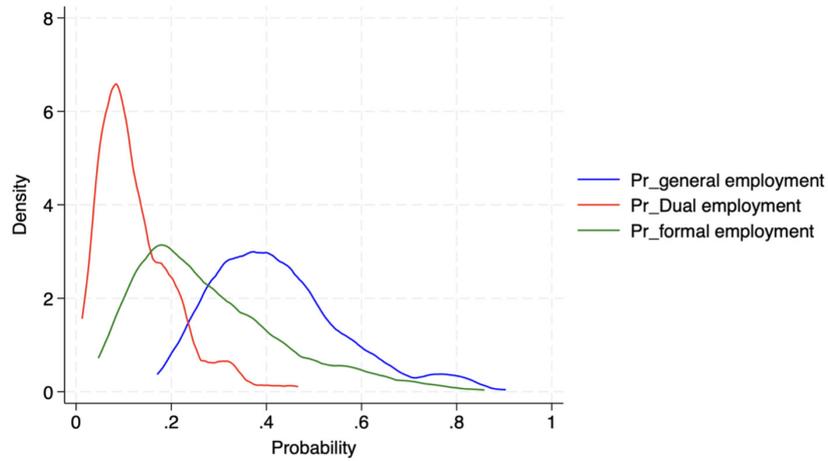


Figure 1: Predicted Probabilities Distribution (own elaboration)

The probability analysis by gender shows that women have lower employment probabilities across all three models, with similar distribution patterns. The differences between men and women are 6.5 percentage points in overall employment probability, 0.7 percentage points in employment at a DA company, and 13.4 percentage points in employment with social security.

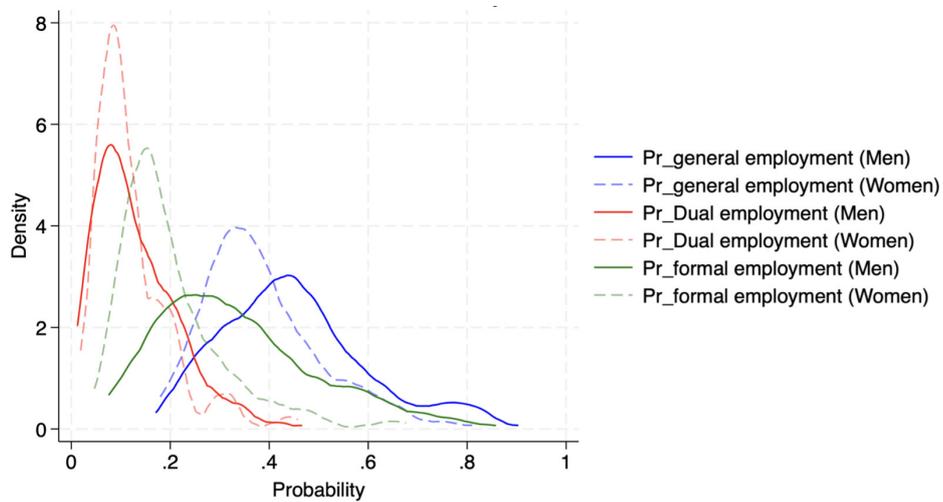


Figure 2: Predicted Probabilities Distributions by Gender (own elaboration)

The probability analysis by region, shows that the probability of being employed in a DA company remains lower than the probabilities of the other two models and with a very similar distribution in both the State of Mexico and Coahuila (5% higher in Coahuila). The probabilities of being employed (Ea) and with Social Security (Ec) are higher in Coahuila than in the State of Mexico. For the model Ea, the probability for Coahuila is 9.9% higher than for the State of Mexico, while for the model Ec (employment with social security) the probability in Coahuila is 19.9% higher than in the State of Mexico.

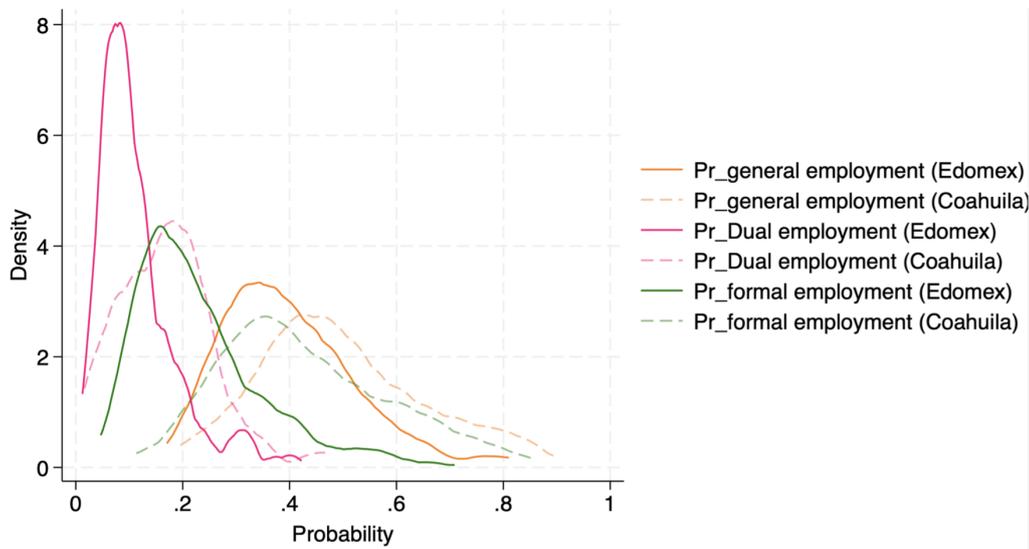


Figure 3: Predicted Probabilities Distribution by Region (own elaboration)

Additional Regressions by Region

The results of additional regressions by region as shown in Table 4 suggest consistency. Training Time and Additional training are the variables with the largest effect. Particularly in the model Ea (employment) for Coahuila, the marginal effect of Additional Training is 0.4143, significant at the 1% level (p-value = 0.005), showing that having additional training increases the probability of employment by 41.43 percentage points. Moreover, in the model Ec for Coahuila, additional training shows a coefficient of 0.3454 and significance at the 5% level (p-value = 0.024), indicating a similar positive impact on employment with social security. Furthermore, the model Ec for State of Mexico shows a positive and marginally significant coefficient of 0.2050 (p-value = 0.049), suggesting that having Additional training in DA increases the probability of employment with social security in 20.50 points.

Another variable that shows significance is Gender in the model for employment with social security in State of Mexico, with a coefficient of -0.1279 and statistical significance at

5% (p-value = 0.030), suggesting that being female is associated with a decrease of 12.79 percentage points in the probability of gaining employment with social security.

Table 4: Results of the Probit Regressions by Region (own elaboration)

	Probit E1 Coahuila	Probit E1 Edomex	Probit E2 Coahuila	Probit E2 Edomex	Probit E3 Coahuila	Probit E3 Edomex	
Female	0.0249 (0.852)	-0.0535 (0.436)	-0.1009 (0.412)	0.0260 (0.569)	-0.0225 (0.865)	-0.1279 ** (0.030)	
Working_Age	(omitted)	0.0679 (0.654)	(omitted)	-0.0676 (0.363)	-0.4924 *** (0.004)	-0.1072 (0.379)	
Certification	-0.0172 (0.876)	0.0534 (0.431)	0.1152 (0.275)	0.0135 (0.754)	-0.0506 (0.629)	0.0637 (0.276)	
Additional Training	0.4143 *** (0.005)	0.2243 (0.105)	0.0333 (0.765)	-0.0269 (0.779)	0.3454 ** (0.024)	0.2050 ** (0.049)	
Dual_scholarship	0.0311 (0.822)	0.0104 (0.870)	0.0430 (0.669)	-0.0173 (0.673)	-0.0078 (0.956)	0.0641 (0.241)	
Training Time	0.0345 *** (0.000)	0.0059 (0.278)	0.0146 * (0.100)	0.0097 *** (0.003)	0.0343 *** (0.000)	0.0018 (0.683)	
Electricity and Electro- nics	0.2764 * (0.091)	0.5212 *** (0.000)	-0.0037 (0.974)	0.1004 (0.551)	0.2632 (0.110)	0.2141 (0.251)	
Maintenance and Installa- tion	0.4736 ** (0.036)	0.0191 (0.836)	(not estima- ble)	-0.0363 (0.505)	0.4165 * (0.075)	-0.1342 * (0.076)	
Formation Area (Vs Services)	Production and Proces- sing	0.3215 ** (0.025)	-0.1131 (0.331)	0.1509 (0.194)	-0.1135 *** (0.008)	0.2597 * (0.066)	-0.1538 * (0.082)
	Technology and Trans- portation	(omitted)	-0.1124 (0.308)	(omitted)	-0.0384 (0.600)	(omitted)	-0.1858 ** (0.015)
Company Area (Vs Services)	Industrial	-0.1841 (0.149)	-0.1206 (0.187)	-0.2054 (0.137)	0.0155 (0.812)	-0.2990 ** (0.017)	0.0559 (0.521)
	Automotives	-0.0702 (0.655)	(omitted)	-0.1649 (0.279)	(omitted)	-0.0852 (0.584)	(omitted)
N	75	229	70	229	78	229	
Pseudo R2	0.2535	0.0757	0.1454	0.0874	0.2554	0.087	

Note. *p < .1; **p < .05; ***p < .01. Marginal effects are reported.

Lastly, Table 4 shows that neither receiving a scholarship nor obtaining certification are significant predictors in any of the models. This implies that these factors do not play a crucial role in determining employment outcomes, regardless of the region. Additionally, the results

indicate regional variation in how different factors influence employment outcomes. In Coahuila, Training Time emerges as the strongest predictor, whereas in the State of Mexico, the results are less consistent. Additionally, gender has a more significant influence in the State of Mexico models.

In the analysis, Formation Area results indicate a positive and significant effect for Electricity and Electronics in the Ea model. Maintenance and Installation and Production and Processing have higher employment probabilities than the Services area in Coahuila, but lower probabilities in the State of Mexico. This pattern is consistent with Coahuila's more industrialized economy compared to the State of Mexico.

6 Conclusion

We explored the relationship between DA participation in Mexico and the employability of its graduates. Data collection took place during the COVID-19 pandemic, a period of economic uncertainty and labour market disruptions. The pandemic likely exacerbated employment difficulties, particularly for young workers, a sector that suffers most from economic contractions (Blustein et al., 2020). While our findings provide key insights into DA graduates' employability, it is possible that employment rates during this period were lower than they would have been in a more stable economic context. The crisis particularly affected formal employment, which may explain why securing jobs with social security was especially challenging for DA graduates. Our study underscores the importance of social protection measures in ensuring job stability, particularly during economic downturns. Future research should explore whether employment outcomes improve as economic conditions recover post-pandemic.

Our descriptive findings indicate that 42% of DA graduates secured employment after graduation. Of these, 13% were employed at the DA company, and 28% obtained jobs with social security. Notably, only 34% of those employed at DA companies had social security, exposing apprentices to economic vulnerability by limiting access to healthcare and pension rights. One of the primary objectives of DA programs is to enhance youth employability (Pilz & Wiemann, 2021) and, in Mexico's implementation, to serve as a mechanism for social improvement (Aramburu Cano et al., 2024). The attainment of formal jobs, as indicated by employment with social security, is a crucial measure of DA's success in providing adequate employment opportunities (Neyt et al., 2020). However, if DA does not consistently lead to formal employment, its effectiveness comes into question.

Our findings identify key determinants of employment and structural challenges that may limit DA's impact. Additional job-relevant training and longer training duration significantly increase the likelihood of employment, particularly formal employment with social security.

Training time is the only significant factor associated with employment within DA companies in our models. A possible explanation is that apprentices who spend more time in the company develop stronger networks and job-specific competencies, making them more attractive candidates for retention (Neyt et al., 2020). Extending DA duration may also facilitate smoother school-to-work transitions, as employers have more time to evaluate potential hires (Haasler, 2020; Wolter & Ryan, 2011).

Despite these positive effects, gender disparities, field-specific employment gaps, and regional variations persist. Although gender was only significant in predicting employment with social security, its lack of significance in predicting general employment suggests a structural labour market problem. DA should actively promote gender equity, as it risks reinforcing existing labour market inequalities rather than addressing them. These findings resonate with previous research indicating that male participants tend to benefit more than female participants in DA programmes (Bonnal et al., 2002; Bougheas & Georgellis, 2004; Novella & Pérez-Dávila, 2017).

Regional variations further underscore the role of local economic structures in shaping employment outcomes. Coahuila, a more industrialised region, displays higher employment rates and greater access to formal jobs than the State of Mexico, where employment outcomes are less favourable. This suggests that DA success depends not only on individual and programme-level factors but also on broader economic conditions (Euler, 2023; Pilz, 2016). These findings reinforce the need for regionally tailored policy approaches to enhance apprentices' labour market integration.

Our analysis also reveals that some fields of study offer better employment prospects than others. Apprentices in Electricity and Electronics have higher employment probabilities, whereas those in Technology and Transportation face greater difficulty securing jobs with social security. This raises concerns about the alignment between training fields and industry demand, suggesting that some apprentices may not be acquiring the skills most valued in the job market. Expanding training programs in Electricity and Electronics could enhance job placement rates for DA graduates while also highlighting the need to revise the alignment of other fields of study with labour market demands.

Overall, our findings underscore the importance of local conditions and economic structures in shaping employment opportunities and, ultimately, DA outcomes. These insights have important policy implications for strengthening DA in Mexico. First, expanding access to additional training and increasing training duration should be prioritised to enhance employment prospects, particularly for securing formal jobs with social security benefits. This aligns with previous evidence stressing the importance of adequate and relevant training environments in facilitating youth employability (Waugh & Circelli, 2021).

Second, addressing gender disparities must be a core objective of DA policies to ensure women have equal opportunities for formal employment. Policies aimed at promoting gen-

der equity and tackling employment barriers that affect women should be prioritised. Third, given the field-specific differences in employment probabilities, training curricula should be better aligned with industry needs, particularly in fields where graduates struggle to secure formal employment. Strengthening partnerships with industries and companies can help ensure that apprenticeships translate into formal jobs.

Finally, further research is needed to assess the long-term career trajectories of DA graduates beyond the pandemic. Longitudinal studies should evaluate job stability and wage progression, while comparative regional studies are crucial for understanding how local economic conditions shape DA outcomes. Additionally, in-depth gender analyses should examine the specific barriers female DA graduates face. Broader investigations into DA's socio-economic impacts, including its role in promoting social mobility, will provide further insights into its effectiveness and future improvements.

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Ethics Statement

This study adhered to all of the research ethics regulations of the participating institutions and the funding organizations. The procedures fulfill the requirements of the IJRVT's ethical statement. The requirement for informed consent was also carefully considered and fulfilled.

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Biographical Notes

Jimena Hernández-Fernández, Dr, is Professor at the Institute for Research on the Development of Education (INIDE) at Universidad Iberoamericana Ciudad de México. She holds a PhD in Education from the University of Sussex, a Master's in Public Administration and Policy, and a BSc in Economics. Her research focuses on the economics of education, the design and evaluation of educational policy, and transitions within education and the labour market. She leads national and international projects on dual apprenticeships and the evaluation of educational programmes. Her academic work explores the relationship between education, work, and equality.

Erick Marsan serves as the Executive Director of TalentumMx, an organization dedicated to reducing inequalities by fostering the development of young people from diverse backgrounds. He has worked on educational initiatives aimed at decreasing high school dropout rates and has contributed to evaluations and research projects related to educational policy. Erick holds a bachelor's degree in Economics from the National Autonomous University of Mexico (UNAM). He is currently pursuing a Master's degree in Data Science and Public Policy at Tec de Monterrey's School of Government and Public Transformation.