

ORIGINAL

The effectiveness of education assistance programs using AI innovation. Case for tackling school dropout in Morocco

La efectividad de los programas de ayuda educativa utilizando innovación en IA. Caso para abordar la deserción escolar en Marruecos

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ABSTRACT

Introduction: since 2008, Morocco's Tayssir program has been a key public initiative aimed at combating school dropout rates, by offering conditional cash transfers to households with school-aged children, particularly targeting rural communities with high poverty rates. This initiative seeks to ensure equitable access to education, regardless of socioeconomic status, and boosted school attendance rates.

Objective: to assess the impact of the Tayssir program on reducing school dropout rates in rural Morocco and to examine the effectiveness of targeting strategies and incentives provided to families.

Methods: the study utilized cross-sectional data from the Household Survey Panel Data. Propensity score matching (PSM) techniques were employed to estimate the program's impact on school dropout rates, comparing beneficiaries with a control group not participating in the program. Various statistical analyses were conducted to explore the characteristics of participants and to validate the logistic model used.

Results: the propensity score matching analysis revealed a statistically significant reduction in school dropout rates among beneficiaries of the Tayssir program. The average treatment effect on the treated (ATET) demonstrated a decrease in dropout rates by approximately 43 % using one-to-one matching, 42,7 % with k-nearest neighbor, and 38,6 % via kernel matching methods. Furthermore, no significant gender differences were observed in the program's impact.

Conclusions: the Tayssir program has significantly contributed to reducing school dropout rates in rural Morocco, ensuring better access to education for children from disadvantaged backgrounds. The program's effectiveness underscores the importance of targeted interventions and conditional cash transfers in promoting educational attainment. Future recommendations include expanding the beneficiary base, refining targeting mechanisms, and establishing a unified social registry to improve program governance.

Keywords: Conditional Cash Transfer; Tayssir Program; School Dropout; Propensity Score Matching.

RESUMEN

Introducción: desde 2008, el programa Tayssir de Marruecos ha sido una iniciativa pública clave destinada a combatir las tasas de deserción escolar, ofreciendo transferencias de efectivo condicionales a hogares con niños en edad escolar, especialmente dirigido a comunidades rurales con altas tasas de pobreza. Esta iniciativa busca garantizar el acceso equitativo a la educación, independientemente del estatus socioeconómico, y ha aumentado las tasas de asistencia escolar.

Objetivo: evaluar el impacto del programa Tayssir en la reducción de las tasas de deserción escolar en las

zonas rurales de Marruecos y examinar la efectividad de las estrategias de focalización y los incentivos proporcionados a las familias.

Métodos: el estudio utilizó datos transversales de la Encuesta de Hogares Panel. Se emplearon técnicas de emparejamiento por puntaje de propensión (PSM) para estimar el impacto del programa en las tasas de deserción escolar, comparando a los beneficiarios con un grupo de control que no participaba en el programa. Se realizaron diversos análisis estadísticos para explorar las características de los participantes y validar el modelo logístico utilizado.

Resultados: el análisis de emparejamiento por puntaje de propensión reveló una reducción estadísticamente significativa en las tasas de deserción escolar entre los beneficiarios del programa Tayssir. El efecto promedio del tratamiento sobre los tratados (ATET) demostró una disminución en las tasas de deserción de aproximadamente el 43 % utilizando el emparejamiento uno a uno, el 42,7 % con el vecino más cercano y el 38,6 % mediante métodos de emparejamiento kernel. Además, no se observaron diferencias significativas de género en el impacto del programa.

Conclusiones: el programa Tayssir ha contribuido significativamente a reducir las tasas de deserción escolar en las zonas rurales de Marruecos, garantizando un mejor acceso a la educación para niños de entornos desfavorecidos. La efectividad del programa subraya la importancia de las intervenciones dirigidas y las transferencias de efectivo condicionales en la promoción del logro educativo. Las recomendaciones futuras incluyen ampliar la base de beneficiarios, refinar los mecanismos de focalización y establecer un registro social unificado para mejorar la gobernanza del programa.

Palabras clave: Transferencia de Efectivo Condicionada; Programa Tayssir; Deserción Escolar; Emparejamiento por Puntaje de Propensión.

INTRODUCTION

Morocco, like most developing countries, suffers from the problem of school dropout. the scourge causes a double loss in terms of financial resources invested by public authorities in the education of children and also a loss in terms of human capital and the weakness of the skills of young people who leave school prematurely. To deal with this, Morocco has launched several programs and initiatives including a conditioned monetary transfer program which aims to encourage households to leave children in school bands.

The authorities' initiative seeks to emulate successful strategies implemented in various countries, particularly in Latin America, with the objective of enhancing human capital. Undoubtedly, indeed, educational dropout constitutes a scourge which handicaps Morocco's human capital and impacts its ranking in human development indicators.

Since its inception in 2008, Morocco's innovative public initiative, known as Tayssir, stands as a pivotal weapon in the battle against school dropout rates. Tayssir, a beacon of hope for the nation's educational landscape, has been instrumental in driving progress towards several crucial objectives.

Foremost among these is the commitment to ensuring that every child, regardless of socioeconomic background, enjoys an unimpeded and equitable path to compulsory education. By targeting vulnerable groups, Tayssir addresses the unique challenges faced by children from economically disadvantaged and impoverished households. In doing so, it strives to bridge the gap between privilege and hardship, fostering a more inclusive educational environment. One of the most remarkable impacts of the Tayssir program has been its resounding success in bolstering school attendance rates. By providing targeted support to families in need, Tayssir has managed to rekindle a sense of purpose and promise among students who may otherwise have been deterred by financial barriers or external pressures. Through the provision of essential resources and incentives, Tayssir has facilitated a resurgence of interest and dedication towards learning, reinvigorating the classroom with a newfound vitality.

Furthermore, the program places a premium on elevating educational attainment levels, recognizing that a thriving society hinges on the empowerment of its youth through knowledge.

By breaking down the barriers that hinder progress, Tayssir opens up a world of opportunities for children who, under different circumstances, might have faced insurmountable odds in their pursuit of education. The primary objective of this article is to critically evaluate the efficacy of the Tayssir conditional cash transfer program in reducing school dropout rates within Morocco. Given the pressing challenge of educational attrition in developing countries, this study aims to assess whether financial incentives directed towards families can significantly influence students' decisions to remain in school. A secondary objective is to scrutinize the targeting mechanism of the Tayssir program, analyzing its precision and effectiveness in reaching the intended beneficiaries—children from economically disadvantaged backgrounds in rural areas. Additionally, by exploring potential gender-specific impacts of the program, the article aims to contribute to the discourse on equitable

educational access, examining whether such interventions can serve as a catalyst for gender parity in education of Morocco.

Through targeted interventions and holistic support systems, the program enables students to not only access learning but also to excel in their academic pursuits. This issue is organized as follows. First section is a theatrical framework in which we offered a brief literature review of the role of the CTTs plan. In section 2, we presented the basic assumption of study and the data used in the estimations. The findings of the specifications test and estimators are given in section 4. In the last section, we discussed the results and concluded.

The structure of the article adheres to a systematic and analytical framework, beginning with the Method section, where we delineate the study's design, data collection processes, and the statistical techniques employed, specifically focusing on propensity score matching to assess the impact of the Tayssir program on school dropout rates. This is followed by the Results section, presenting the findings of our analysis, including the program's effects on enrollment and persistence in education among targeted beneficiaries. Next, the Discussion part interprets the significance of these findings, comparing them with existing literature, and examining the implications for policy and practice within the Moroccan educational context. Finally, the article concludes with the Conclusions section, summarizing the study's key outcomes, its contributions to the field of education policy, and suggesting directions for future research.

METHODS

This section is theoretical in which we presented a brief literature review of conditional cash transfer program and in the end, we exposed the Tayssir plan and its main objectives.

Conditional Cash Transfer programs (CCTs) programs provide financial assistance to indigent households on the condition that they comply with certain criteria. These criteria include for instance attending education sessions, taking nutritional supplements or up-to-date vaccinations.⁽¹⁾

Conditional cash transfer programs are social assistance policies, which invest in human development benefiting the poor families. In fact, at the microeconomic level, CCTs constitute an effective tool in poverty-reduction policy.⁽²⁾

Several studies have been realized to analyze the impact of CTTs programs on health and on student educational outcomes. Evidence from the CCTs plan assumed that these schemes might have reduces severity of poverty among plan beneficiaries.

These programs were launched in the 1990s in Latin America, particularly in Brazil with the Bolsa Escola program, in Mexico with the Progres plan, in Bangladesh with the Food for Education (FFE) plan, in Nicaragua with Red de Proteccion Social program and the Familias en Acción program in Colombia.⁽³⁾

For Doetinchem (2008) ⁽⁴⁾ CCTs programs can reduce poverty by giving financial assistance to indigent population in return for fulfilling specific behavioral conditions. T. Paul (2000) revealed that the Mexican Progres plan affected positively school enrollment particularly among youth in poor families in poor rural communities. ⁽⁵⁾ Using Brazilian data, B. ALAN et al.⁽⁶⁾, (2015) found that the Bolsa Família conditional cash transfer program increased significantly school participation especially among girls aged 6-17 years. Regarding to the Nicaraguan Red de Proteccion Social experiment, Ranjeeta Thomas⁽⁷⁾ (2010) revealed that, using a behavioral model, this social program has positive effects on children's health and education. Does the Moroccan CTTs program act in the same way?

Tayssir which means "facilitation" in Arabic, made direct payments to the head of household of school-aged children (between 6 and 15 years old) in marginal rural communities with a high poverty rate.

According to the High Commission for Planning⁽⁸⁾ (2009), the national literate rate over the person aged more than 10 years old was relatively average in 2009 about 60,3 percent.

Meanwhile the rural primary school rate was still below 45 percent. In order to overcome this issue, the Moroccan government launched a cash transfer program named Tayssir plan. Indeed, Tayssir is a monetary transfer granted to indigent and poor families, residing in rural areas, provided that their children stay in school. It based on a geographic targeting. In fact, it targets children between 6 and 15 years old who reside in municipalities where the poverty rate exceeds 30 % and the dropout rate exceeds 8 %. As well as other criteria to benefit from it, related to the attendance of the child and the number of absence per month (not to exceed 4 maximum). The amount of the monthly allowance varies gradually between 60 MAD (approximately 6,33 USD) and 140 MAD depending on the level of the student (primary or secondary school). The aim is to encourage parents to keep their children enrolled in school. 10 years after the implementation of this public program, education indicators have evolved mainly in rural areas and more specifically for children under 15 years old.⁽⁹⁾

Our data set used in this study was a cross-sectional data, which came from Household Survey Panel Data. Based on the theoretical framework, we expected that the Tayssir program have a significance and negative impact on the school dropout. To determine the causal effect of failure on school dropout, variables linked to individual variables and household characteristics were used namely gender of the individual, area of residence, age of the head of the household, annual expenditure per person, household size...etc.

Let y_k be the outcome of interest (school dropout) for the child $k = 1, 2, \dots, N$. And let Λ_k be the impact of the treatment on the individual (child) k . Λ_k can be defined as the difference between potential outcomes with treatment (y_{k1}) and without treatment (y_{k0}):

$$\Lambda_k = y_{k1} - y_{k0} \quad (1)$$

In fact, this causal effect is difficult to calculate for each individual. To overcome this limitation, we may use the Average Treatment Effect (ATE) ⁽¹⁰⁾ on the population or the Average Treatment

Effect on the Treated (ATET). Mathematically, we can write

$$ATE = E[\Lambda] = E(y_1 - y_0) \quad (2)$$

Where $E(\cdot)$ denotes the expected values.

$$ATET = E[\Lambda_k | T_k = 1] = E(y_1 - y_0 | T_k = 1) \quad (3)$$

Where T_k a dummy variable that referred whether or not the individual belongs to the treatment group.⁽¹²⁾ It is equal to one for treated observations and to zero for control ones.

PSM a common quasi-experimental technique which introduced by Rosenbaum and Rubin (1983).⁽¹³⁾ It is used to estimate the effect of a program or an intervention when we do not have random assignment. Another advantage of PSM is the elimination of sources of bias by finding treated and untreated groups, which have similar characteristics.⁽¹⁴⁾

To match treatment observations to control, we have used a three-stage process:

The first step consisted in explaining the variable Tayssir of assignment to the treatment by the observable characteristics. To do this, we predicted the associated probability of participation in the plan using a logistic (or a probit) regression model.⁽¹⁵⁾

$$\text{Tayssir}_k = Z_k + \delta_k \quad (4)$$

Where δ are the error terms and Z_i a function of enrollee gender, enrollee age, household socioeconomic status and other control characteristics. Secondary, using the estimated parameters from that model, we associated for each individual in our sample a probability score.⁽¹⁶⁾ Lastly, we selected for each individual in the treatment group, at least a non-treated individual with similar characteristics (the same propensity scores).⁽¹⁷⁾

RESULTS

Tables 1 and 2 revealed baseline characteristics of participants by treatment and non-treatment groups. The key independent variable is the school dropout. In fact, the table 2 showed that the rate of dropout is low in the treated group, about 10,4 % compared to 41,68 % in the control group. In addition, according to the table the distribution by gender and by age of the individuals is almost equitable between the two groups. For more detail, see tables below. Furthermore, the percentage of students enrolled in primary and secondary school is higher in the group of treaties compared to the control group. Moreover, the data showed that the majority of the beneficiaries reside in the rural areas. Only 4,14 % of beneficiaries from the urban areas (targeting error).

Table 1. Sample characteristics by treatment group for the qualitative variables

Variables	Modalities	Frequencies (%)	
		Untreated	Treated
sch_drop	Yes	41,68	10,4
	No	58,32	89,6
Primary	Yes	39,99	71,48
	No	60,01	28,52
Secondary	Yes	24,42	24,5
	No	75,58	75,5
Gender	Male	50,25	50,67
	Female	49,75	49,33

residence	Urban	54,69	4,14
	Rural	45,31	95,86
Busy_asset hh	Yes	69,5	80,54
	No	30,5	19,46
retaried hh	Yes	8,4	3,36
	No	91,6	96,64
aged_person_hh	Yes	11,82	8,5
	No	88,18	91,5
Primary_hh	Yes	20,74	22,04
	No	79,26	77,96
secondary_hh	Yes	16,77	10,07
	No	83,23	89,93
college_hh	Yes	10,22	96,64
	No	89,78	3,36

Table 2. Summary characteristics by treatment group for the quantitative variables

	Untreated			Treated		
	sd	cv	mean	sd	cv	mean
age_hh	12,99	0,24	52,13	11,92	0,23	51,22
age_hh 2	1375,8	0,47	2886,72	1361,91	0,49	2765,61
damp	0,61	0,06	9,45	0,5	0,05	9,01
hh_size	2,5	0,41	5,97	4,19	0,55	7,57
hh_size_2	46,68	1,11	41,9	142,95	1,9	74,98

We have restricted our sample to children aged 6 to 30 years. The results for logit model are shown in the table below.

Table 3. Determinants of enrolment in Tayssir program

Variables	Tayssir
Busy_asset_hh	0,180* (0,101)
hh_size	0,152*** (0,028)
hh_size_2	0,00221** (0,000)
log_damp	-0,489*** (0,0788)
rural	2,797*** (0,172)
college_hh	-0,422** (0,203)
secondary_hh	-0,736*** (0,123)
primary_hh	-0,349*** (0,0914)
age_hh	0,0221 (0,0190)
age_hh_2	-0,0003* (0,000)

primary	2,354*** (0,175)
secondary	2,218*** (0,184)
Constant	-3,611*** (0,938)
Observations	16,005
LR chi2(12)	1,632,95
Pseudo R2	0,2368
Log likelihood	-2631,22
Prob > chi2	0,0000

The model was highly significant as indicated by the p-value associated with the F (pvalue=0,0000). Besides, to examine the Suitability of the logistic model, two tests have been adopted Hosmer-Lemeshow test and The AUC criterion.

Hosmer-Lemeshow test: To determine the fit quality of the logistic model to the observations, we have opted for the Hosmer - Lemeshow calibration test.

At the level of 5 percent, the logistic model is valid, correct, well calibrated and compatible with the observations.

AUC criterion and ROC curve: The AUC criterion measures the performance of the logistic model and provides an idea about the ability of the model to classify correctly the observations.

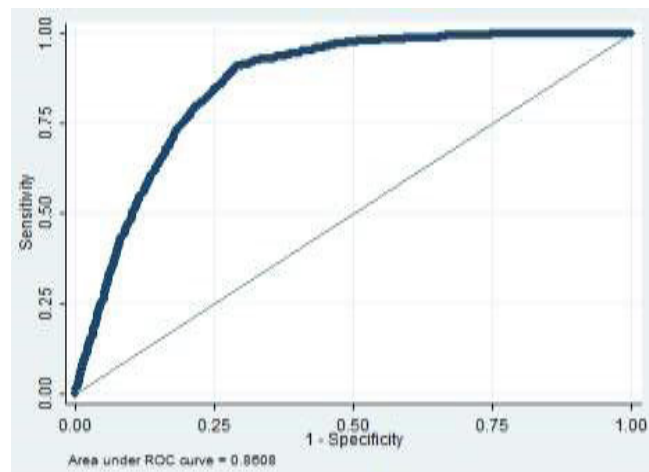


Figure 1. Area under the ROC curve and AUC criterion

Under Stata, we can use the command `lroc` to draw the ROC curve. The AUC criterion is greater than 0,50, which means that the discrimination is acceptable.

To assessment the average treatment impact of Tayssir participation on the treated group, three matching techniques have been adopted. Table 4 below offered the calculations details. Moreover, the table presents the regression findings for Tayssir plan. The significant variables were selected. Hence, the non-significant ones were removed from the final model.

Table 4. Impact of Tayssir program by gender						
		Global model outcome				
	Sample	Treated	Controls	Difference	S.E.	T-stat
One to One	Unmatched	0,104026	0,416716	-0,312689	0,016675	-18,75
	ATET	0,104026	0,534675	-0,430648	0,01956	-22,01
K-nearest neighbour	Unmatched	0,104026	0,416716	-0,312689	0,016675	-18,75
	ATET	0,104026	0,531319	-0,427293	0,020881	-20,46
Kernel	Unmatched	0,104026	0,416716	-0,312689	0,016675	-18,75
	ATET	0,104026	0,489865	-0,385839	0,012681	-30,42

Outcome school dropout if gender = male						
	Sample	Treated	Controls	Difference	S.E.	T-stat
One to One	Unmatched	0,077262	0,422889	-0,345626	0,023415	-14,76
	ATET	0,077262	0,454746	-0,377483	0,026576	-14,2
K-nearest neighbour	Unmatched	0,077262	0,422889	-0,345626	0,0234152	-14,76
	ATET	0,077262	0,443708	-0,366445	0,025692	-14,26
Kernel	Unmatched	0,077262	0,422889	-0,345626	0,0234152	-14,76
	ATET	0,077262	0,468524	-0,391261	0,016192	-24,16
Outcome school dropout if gender = female						
	Sample	Treated	Controls	Difference	S.E.	T-stat
One to One	Unmatched	0,131592	0,410481	-0,278962	0,023749	-11,75
	ATET	0,131592	0,544217	-0,412698	0,028693	-14,38
K-nearest neighbour	Unmatched	0,131592	0,410481	-0,278962	0,023749	-11,75
	ATET	0,131519	0,585034	-0,453514	0,030693	-14,81
Kernel	Unmatched	0,131592	0,410481	-0,278962	0,023749	-11,75
	ATET	0,131592	0,509781	-0,378262	0,0196279	-19,27

DISCUSSION

Using the propensity score matching technique, we were able to match 894 beneficiaries from Tayssir scheme with 768 controls. At this stage, we have used three matching methods namely k-nearest neighbours, one-to-one and kernel matching. We only matched treated and untreated individual who belong to the common support.

As the case for most studies dealing with the impact of CCTs on the educational results of children, and their impact on social indicators in general, our study shows the positive impact of the Tayssir program in reducing school dropout in Morocco.

As expected, all of the propensity score matching methods strongly suggested, after controlling for observed factors such individual age of the head of the household, area of residence, that the Tayssir plan had a statistically significant effect of Tayssir plan on school dropout⁽¹⁸⁾. Table 6 below showed that regardless of the estimation method used, the Tayssir plan kept students in school. Overall, the average effect estimator indicated a decrease the dropout school by about 43,06 %, 42,72 % and 38,58 % on average using one-to-one, k-neighbour, and kernel methods respectively.

CONCLUSION

This research study examined the impact of Tayssir plan on school dropout in the rural of morocco. As a conclusion, we derived three elements from this work.

The first is that the Tayssir plan had helped had to reduce the dropout rate of student beneficiaries and subsequently improved access to school.

Second, being treated by Tayssir plan decreases greatly the probability of leaving school by about 43,06 percent.

The last one, no significant difference was found between the two-treated genders. The program influenced both sexes with the same magnitude and the same way.

- Regarding to the recommendations, we derived three suggestions from this study.
- Broaden the base of beneficiaries while improving the governance of the program,
- Use household targeting instead of geographic targeting,

Creation of a single social registry in order to improve the targeting of social programs, especially for Tayssir plan.

Finally, this paper may help to develop the methodology for assessment the impact of Tayssir on school dropout. We only showed one scenario as an instance in this research. Improvements can be made by searching for the other explanatory variables that could better explain the abundance of school.

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Research: Jouilil Youness, Berrouyne Mustapha.

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