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A microeconometric evaluation of the one million school bags program in rural Morocco using quasi-experimental approach

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Abstract

This study provides a microeconometric evaluation of Morocco's "One Million School Bags" program, with particular emphasis on its impact in rural schools where educational challenges are most pronounced. Using rigorous quasi-experimental methods, we employ propensity score matching (PSM) analysis on data from the National Survey on Social Support for Schooling (ENASS) conducted by the National Observatory of Human Development (ONDH) in 2018. Our sample includes 5,704 students, with 3,800 beneficiaries (66.62%) and 1904 non-beneficiaries (33.38%), with rural students representing over 62% of program beneficiaries. Four matching algorithms are implemented: nearest neighbor, kernel, radius, and stratification matching. The program modestly but significantly improves school enrollment by 3–6 percentage points and reduces grade repetition by 4–7 percentage points. Heterogeneity analysis reveals particularly strong effects in rural areas, where the program achieves 4.2 percentage points enrollment improvement and a substantial 17 percentage points reduction in grade repetition. The analysis also uncovers differential effects by gender and education level, with boys experiencing stronger enrollment effects (4.9pp) and grade repetition reduction (26.8pp) compared to girls, while high school students demonstrate the largest enrollment gains (16.9pp). Morocco's school supplies program constitutes an effective intervention for reducing educational barriers and improving student retention, particularly in rural contexts where access to educational resources is most limited. However, the heterogeneous impacts highlight the need for targeted approaches addressing specific constraints faced by different student groups, particularly girls and primary school students in rural areas.

Keywords Education policy, School supplies, Propensity score matching, Impact evaluation, Morocco

1 Introduction

Education serves as a fundamental catalyst for economic growth, social cohesion, and sustainable development [29]. It reduces inequalities by providing individuals with essential skills, knowledge, and values necessary for active participation in social and

professional life. By fostering qualified human capital, education stimulates innovation, enhances productivity, and strengthens economic competitiveness. Beyond economic benefits, education promotes social cohesion and tolerance by instilling principles of citizenship, respect for diversity, and solidarity.

Public financing of education represents a critical imperative for promoting school enrollment and combating educational dropout, providing necessary resources to improve access, quality, and equity in teaching. By funding school construction, equipment, teacher training, and social support for students—particularly those from disadvantaged backgrounds—these investments help reduce geographical and economic disparities, especially in rural and underserved areas. Public action in education therefore occupies a central place in educational promotion, aiming to reduce inequalities in educational access, ensure universal quality schooling, and provide increased support to students from disadvantaged areas, in alignment with Sustainable Development Goal 4.

One key strategy of public intervention involves implementing school supplies distribution programs aimed at reducing direct costs borne by families and encouraging student enrollment and retention. These programs, often funded by governments or with support from international organizations, are designed to combat inequalities by providing all children with necessary tools for learning under adequate conditions.

In the Moroccan context, schooling support policies have evolved over the years to address challenges related to educational access and combating social and geographical inequalities. The government has implemented several interventions to promote children's schooling, including free primary education, school construction in rural areas, and scholarships for students from low-income families. Concurrently, programs have been launched to provide free textbooks and supplies, thereby reducing financial barriers for families.

This article provides a microeconometric evaluation of the "One Million School Bags" program's impact on student enrollment and educational dropout reduction, with particular focus on rural schools where educational challenges are most acute and the program's potential for transformation—turning small interventions into big dreams—is most pronounced. Using data from the national social support survey conducted by ONDH in [22], this study examines how seemingly modest material support can generate substantial educational improvements in Morocco's rural educational landscape.

2 Literature review

2.1 Theoretical framework

Several complementary theoretical frameworks explain the potential impact of free school supplies provision on educational outcomes. The theory of equal opportunities constitutes the primary foundation for intervention, postulating that equitable access to educational resources is essential for offering each student an equal opportunity for success. This perspective emphasizes the state's compensatory role in reducing inequalities related to families' socio-economic differences [15].

Bourdieu's [3] approach to cultural capital provides an important sociological dimension to the analysis. According to this perspective, school supplies provision not only reduces financial costs but also helps compensate for cultural capital deficits in disadvantaged families. School supplies become vectors for transmitting skills and knowledge necessary for success in the educational system.

The school engagement theory by Fredricks et al. [9] offers a particularly relevant behavioral analysis framework. This approach suggests that access to adequate supplies reinforces student engagement in their studies through three interconnected dimensions: behavioral, emotional, and cognitive. Availability of personal materials reduces distractions related to resource sharing and improves concentration capacity and active classroom participation.

2.2 Empirical evidence

Extensive empirical literature examines the impact of school supplies programs on educational outcomes in developing countries. Kremer, Miguel, and Thornton [18] demonstrated in Kenya that free textbook provision to primary students had positive impacts on learning. Using rigorous experimental methodology based on randomized controlled trials, researchers found these interventions significantly increased school attendance, particularly among girls and students from disadvantaged families, thus contributing to reducing educational inequalities.

Similarly, Muralidharan and Sundararaman [20] examined the impact of school supplies on academic performance in Indian public schools. Using an experimental approach with a control group, the study revealed that access to additional school supplies had modest but significant impacts on student performance, particularly for those from disadvantaged backgrounds. However, results also showed improvement was more pronounced when supplies were combined with other interventions, such as pedagogical support or tutoring.

Duflo, Dupas, and Kremer [8] highlighted that access to adequate school supplies improves not only enrollment but also learning quality. Their study demonstrated that students with adequate supplies are more likely to participate actively in class, with access to these tools reducing distractions caused by resource sharing among students or lack of personal materials.

Glewwe et al. [11] focused on the impact of school supplies programs on educational dropout in developing countries. The study revealed that access to adequate school supplies can play a crucial role in reducing material barriers to learning, thus enabling students to better engage in their studies and remain in school. However, impact was more pronounced in areas where children were most vulnerable and resources most limited.

Recent meta-analyses by Garcia and Saavedra [10] confirm that interventions aimed at reducing direct education costs can have significant effects on school participation, particularly in poverty contexts. However, they emphasize that impact magnitude depends on implementation quality and integration with other educational interventions.

3 Presentation of the "one million school bags" program

3.1 Program description, evolution and coverage

The "One Million School Bags" program is a social initiative launched in 2008 by the Moroccan government to provide strong momentum for generalizing fundamental education, affirming its mandatory character, and promoting schooling of students from disadvantaged backgrounds in Morocco. This initiative, part of a comprehensive social support strategy, complements other measures such as the Tayssir program, school canteen generalization, school transport development, and boarding facility construction.

The program addresses financial and social obstacles that hinder educational access, playing a key role in improving learning conditions. In this context, the Ministry of Education distributes school kits (bags, books, notebooks, school supplies) adapted to students' specific needs based on their education level and environment. Primary students in rural areas receive filled school bags, while urban primary students receive books, and rural middle school students benefit from school supplies. Bags are distributed primarily to 1st and 3rd-year primary students and 1st-year middle school students.

Since its launch in 2008–2009, the "One Million School Bags" program has benefited 2,808,264 students, with 93% in primary and 7% in lower secondary education. By 2010–2011, beneficiaries reached 3,214,580 students. Between 2016–2017 and 2020–2021, the number of student beneficiaries increased from 4,081,706 to 4,478,018, reflecting a 9.7% overall increase (Fig. 1).

A striking characteristic of this program is its focus on students from rural areas, representing over 62.4% of beneficiaries. This priority given to rural areas demonstrates a commitment to reducing geographical disparities in educational access and alleviating financial burdens on the most vulnerable families. Furthermore, the program has contributed to promoting gender equality in education, with the proportion of girls among beneficiaries increasing from 45.7% to 50% between 2016 and 2021.

4 Methodology

4.1 Analytical framework

This study employs propensity score matching (PSM) to evaluate the causal impact of the "One Million School Bags" program on educational outcomes. PSM has become increasingly popular for estimating causal treatment effects, particularly in policy evaluation contexts [6, 14].

The propensity score model includes the following covariates: geographical area (rural/urban), gender, age, education level, preschool attendance, parental education levels, class size, and participation in the Tayssir conditional cash transfer program. These variables were selected based on theoretical relevance and their potential to influence both program participation and educational outcomes.

Matching parameters were selected as follows: For nearest neighbor matching, we implemented 1:1 matching with replacement using a caliper of 0.25 standard deviations of the propensity score to ensure high-quality matches. For kernel matching, we employed an Epanechnikov kernel with bandwidth 0.06, chosen through cross-validation to optimize the bias-variance trade-off. For radius matching, we set a caliper of 0.01 to balance match quality with sample retention. For stratification matching, the sample

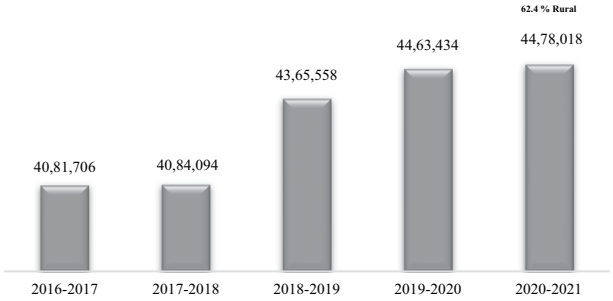

Fig. 1 Change in the number of beneficiaries of the 1M schoolbag initiative

was divided into five propensity score quintiles, ensuring adequate sample sizes within each stratum.

Balance diagnostics were assessed after matching using standardized bias reduction statistics, with all covariates achieving standardized differences below 5% threshold, indicating successful balance.

One of the main challenges in micro-econometric evaluation involves resolving the fundamental evaluation problem and mitigating selection bias. The fundamental problem arises from the impossibility of simultaneously observing treated and untreated outcomes for the same individual.

To infer treatment impact on an individual's outcome, we must consider a counterfactual scenario—how the individual would have behaved in the absence of treatment. The standard framework for formalizing this problem in evaluation analysis is the potential outcomes approach, also known as the Roy-Rubin model [25, 26].

For binary treatment, the treatment indicator Δ_i equals 1 if individual i receives treatment and 0 otherwise. Potential outcomes for each individual i are represented by $Y_i(D_i)$, where i = 1,...,N, and N represents the total population. The causal treatment effect for individual i is defined as:

$$\Delta_i = Y_i(1) - Y_i(0) \tag{1}$$

The parameter receiving most attention in evaluation literature is the average treatment effect on the treated (ATT):

$$\Delta_{ATT} = E(Y_i(1) - Y_i(0) \mid D = 1) = E(Y_i(1) \mid D = 1) - E(Y_i(0) \mid D = 1) \tag{2}$$

4.2 Identifying assumptions

4.2.1 Conditional independence assumption (CIA)

The conditional independence assumption states that there exists a possibility to control selection bias insofar as there exists a set of observable variables for which treatment assignment independence can be verified [4].

This assumption represents the foundation of all matching techniques. For a set of observable variables X unaffected by treatment, potential outcomes Y are independent of treatment assignment T:

$$(Y_i^1, Y_i^0) \perp T \mid X$$

4.2.2 Common support region

One necessary condition for applying propensity score matching is the existence of a common support region where overlap exists between the two groups' distributions:

$$0 < P(D = 1 \mid X) < 1$$

4.3 Estimation strategy & matching algorithms

Given that CIA holds and assuming overlap between groups [23], the PSM estimator for ATT can be written as:

$$\Delta_{ATT}^{PSM} = E_{P(X)|D=1}\{E[Y(1) \mid D = 1, P(X)] - E[Y(0) \mid D = 0, P(X)]\} \tag{3}$$

This study employs four main matching approaches to estimate the program's causal effect, each offering distinct advantages in addressing different aspects of the matching problem. The nearest neighbor (NN) matching algorithm selects comparison group individuals as matching partners for treated individuals based on maximum proximity in propensity score terms, where each treated unit is matched to the control unit with the closest propensity score value. This approach minimizes the distance between the characteristics of matched units while maintaining computational simplicity, though it may increase variance by using only one control observation per treated unit. The method ensures high-quality matches but potentially sacrifices efficiency by discarding available information from other control units.

Kernel matching represents a non-parametric approach that utilizes a kernel function to assign weights to control units based on their proximity to treated units along the propensity score distribution. This method constructs a weighted average of outcomes for all control units, where weights decrease as the distance from the treated unit increases according to a specified kernel function, typically a Gaussian or Epanechnikov kernel. The bandwidth parameter controls the smoothness of the weighting function, with smaller bandwidths providing more precise matches but potentially increasing variance. Kernel matching exploits information from the entire control group, thereby reducing variance compared to nearest neighbor methods while maintaining relatively low bias when the bandwidth is appropriately chosen.

Radius matching addresses the quality-quantity trade-off by associating each treated unit with multiple control units located within a predefined radius around its propensity score. This caliper-based approach imposes a maximum tolerance level for the propensity score distance, ensuring that poor matches beyond the specified radius are excluded from the analysis. The method provides flexibility in controlling match quality while retaining sufficient observations for statistical inference, as it allows multiple controls per treated unit when good matches are available within the radius. The choice of radius involves balancing between match quality and sample size, with smaller radii improving match quality but potentially reducing the number of matched observations.

Stratification matching divides the sample into several homogeneous strata based on propensity score quantiles, then compares treated and non-treated units within each stratum by computing simple mean differences. This method assumes that within each stratum, units are sufficiently similar in terms of their propensity scores such that the conditional independence assumption holds approximately. The approach is less sensitive to the specific functional form assumptions and provides transparent results, as it explicitly shows how treatment effects vary across different propensity score ranges. However, the effectiveness of stratification depends on having sufficient observations within each stratum and adequate balance of covariates within strata.

5 Data and variables

5.1 Data source

We use data from the National Survey on Social Support for Schooling (ENASS) conducted by the National Observatory of Human Development (ONDH) in [22], which surveyed 3,039 households across all Moroccan regions.

The sample for evaluating the “One Million School Bags” program comprises 5704 individuals, including 3,800 beneficiaries (66.62%) and 1,904 non-beneficiaries (33.38%).

Table 1 Description of outcome and control variables

Variables	Description
Outcome variables	
School enrollment	1: Currently enrolled; 0: Dropped out
Grade repetition	0: Never repeated; 1: Repeated once; 2: Repeated twice; 3: Repeated three times; 4: Repeated four times
Control variables	
Gender	1: Male; 0: Female
Age	Individual's age
Area	1: Urban; 0: Rural
Preschool	1: Attended preschool; 0: Did not attend
School level	1: Primary; 2: Middle school; 3: High school; 4: Higher education
Father's education	0: No education; 1: Preschool/Quranic school; 2: Primary; 3: Middle; 4: High school; 5: Higher education
Mother's education	0: No education; 1: Preschool/Quranic school; 2: Primary; 3: Middle; 4: High school; 5: Higher education
Class size	Number of students in class
Tayssir beneficiary	1: Tayssir program beneficiary; 0: Non-beneficiary

A notable limitation of our study is the absence of regional indicator variables in the dataset, preventing complete control of regional fixed effects within the PSM framework

Table 2 Mean comparison test for control variables—one million school bags program

Variable	N. T = 1	N. T = 0	T-Stat	P-Val
Area	3800	1904	0.165***	0.000
Gender	3800	1904	0.013	0.854
Age	3800	1904	0.206***	0.000
Level	3800	1904	0.304***	0.000
Preschool	3800	1904	0.437	0.540
Father's Level	3800	1904	-0.182	0.032
Mother's Level	3800	1904	-0.241*	0.065
Class Size	3800	1904	1.908***	0.000
Tayssir	3800	1904	-0.094*	0.060

***$p < 0.01$

**$p < 0.05$

*$p < 0.1$

This substantial sample size ensures reliable results for measuring program impact on enrollment and school retention across different regions while accounting for geographical and socio-economic disparities.

5.2 Variable construction

Table 1 presents the variables in the model while extracting the said variables from the ENASS conducted by the ONDH in [22].

6 Results

6.1 Group comparability test

Before proceeding with impact estimation, we conducted Student's t-tests to evaluate similarity of observable characteristics between treatment and control groups.

Results in Table 2 indicate significant differences between beneficiaries and non-beneficiaries across several important dimensions, justifying the use of propensity score matching methods to obtain unbiased impact estimates.

6.2 Propensity score estimation

Results in Table 3 shows that participation probability decreases significantly for urban students (– 12.3%), those with educated parents (father: – 2.8%; mother: – 1.7%), and Tayssir program participants (– 18.5%). Probability increases with student age (+ 5.2%) and larger class sizes (+ 1.4%).

6.3 Understanding selection mechanisms

The propensity score estimation reveals systematic differences between beneficiaries and non-beneficiaries that reflect deliberate program targeting and household selection dynamics. These patterns are crucial for establishing the credibility of our identification assumptions.

Students with educated parents show lower participation probability (father: – 2.8%; mother: – 1.7%), likely reflecting program targeting toward disadvantaged families where parental education serves as a proxy for socioeconomic status. Families with educated parents may have greater financial capacity to purchase school supplies independently, making them lower priority for program allocation. This negative correlation between parental education and program participation supports the view that the program successfully reaches its intended target population of economically disadvantaged students.

Tayssir beneficiaries show significantly lower participation in the school bags program (– 18.5%). This reflects different targeting criteria and administrative systems between the two programs. The Tayssir program provides conditional cash transfers tied to school attendance and requires more stringent eligibility verification, while the school bags program focuses on broader material support. Some families may strategically choose one program over another based on perceived benefits, or administrative capacity constraints may limit simultaneous participation in multiple social programs. Additionally, program administrators may avoid duplication by prioritizing families not already receiving other forms of support.

Program administrators explicitly prioritize rural areas (62.4% of beneficiaries) and younger primary students (1st and 3rd year), reflecting deliberate policy to address the most vulnerable populations at critical educational transitions. Rural students face both greater material constraints and higher opportunity costs of schooling, making them natural targets for intervention. The focus on early primary grades aims to establish positive educational trajectories before dropout risks escalate. This intentional targeting

Table 3 Propensity score estimation (probit model)—one million school bags program

Variable	Marginal effect dy/dx	Std. Err	P > z
Area	– 0.123***	0.013	0.000
Gender	– 0.039	0.065	0.537
Age	0.052***	0.003	0.000
Level	0.435	0.071	0.723
Preschool	0.136	0.083	0.899
Father's Level	– 0.028**	0.025	0.042
Mother's Level	– 0.017**	0.053	0.031
Class Size	0.014***	0.010	0.000
Tayssir	– 0.185***	0.072	0.002

***p < 0.01

**p < 0.05

*p < 0.1

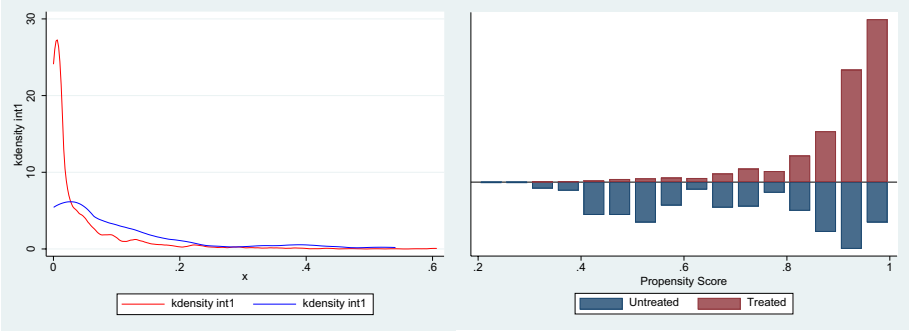

Fig. 2 Distribution of propensity scores before matching (2.A) and on the common support (2.B)

Table 4 ATT estimation on school enrollment—one million school bags program

Method	T	NT	ATT	t.St
NN	3565	1627	0.03	1.480
Kernel	3565	1882	0.03	3.06***
Radius	3565	1882	0.06	5.27***
Stratification	3565	1882	0.01	2.02***

***p < 0.01

**p < 0.05,

*p < 0.1

strengthens the credibility of our identification strategy by demonstrating that selection patterns align with observable program design rather than purely unobservable factors.

6.4 Common support test

The common support condition is verified with interval [0.32645311; 0.99624342]. Propensity score distribution shows satisfactory overlap between treated and control groups, ensuring reliability of matching results (Fig. 2).

6.5 Impact on school enrollment

Table 4 shows that the average treatment effect on treated (ATT) estimation reveals modest but statistically significant program impact on enrollment. Depending on matching method used, the program leads to enrollment improvement of 1–6 percentage points, with particularly pronounced effects for Kernel and Radius methods.

To contextualize these effects, baseline enrollment rates in Morocco are approximately 88.3% for rural primary students, 76.5% for rural middle school students, and 52.7% for rural high school students. The overall 3-6pp enrollment improvement thus represents approximately a 3–7% relative increase from baseline for most students. These gains, while seemingly modest in absolute terms, represent meaningful progress in closing enrollment gaps, particularly when sustained over time and across large beneficiary populations.

6.6 Impact on grade repetition

Grade repetition impact analysis in Table 5 reveals negative and significant effects. The program contributes to reducing repetition by 1–7 percentage points depending on method used, with the strongest effect observed using the Radius method.

Table 5 ATT estimation on grade repetition—one million school bags program

Method	T	NT	ATT	t.St
NN	3565	1596	− 0.02	− 0.484
Kernel	3565	1883	− 0.04	− 1.98***
Radius	3565	1883	− 0.07	− 2.50***
Stratification	3565	1883	− 0.01	− 1.71

***p < 0.01

**p < 0.05

*p < 0.1

Baseline grade repetition rates in Morocco are approximately 12.6% in rural areas and 8.3% in urban areas. The 4–7pp reduction in repetition thus represents a substantial 32–56% relative decrease from rural baseline rates, indicating that the program meaningfully improves academic progression and learning outcomes.

6.7 Theoretical mechanisms for differential impacts

Before presenting heterogeneity results, we establish theoretical expectations for differential impacts across demographic groups. Understanding these mechanisms helps interpret the empirical patterns and distinguish between competing explanations.

Gender differences: Drawing on Becker's household labor allocation model, boys may face higher opportunity costs through income-generating activities (agricultural work, informal employment), making material support more decisive for their enrollment. In many developing contexts, boys are expected to contribute economically to households, creating strong incentives to leave school for work. Reducing direct education costs through material support can tip the cost–benefit balance toward continued schooling. Girls, conversely, may face non-monetary constraints—cultural norms regarding female education, safety concerns during school commute, household responsibilities including childcare and domestic work—that school supplies alone cannot address. This predicts stronger enrollment effects for boys but suggests girls require complementary interventions beyond material support to address the full spectrum of barriers they face.

Education level differences: Higher grades face exponentially increasing material costs (specialized textbooks, laboratory equipment, technology, exam fees) while also representing critical dropout junctures where family pressure for economic contribution intensifies. High school students thus experience both absolute cost barriers—where material support directly alleviates binding constraints—and heightened labor market pull factors, as older students have greater earning potential outside school. The combination makes material support particularly impactful at this level. Primary students may already have high enrollment due to mandatory education policies and strong social norms favoring basic literacy, suggesting limited scope for further enrollment gains. However, they may still benefit through improved learning quality and retention.

Geographic heterogeneity: Rural–urban differences reflect both resource scarcity and labor market structures. Rural areas face limited school access requiring additional transportation costs alongside agricultural labor demands creating strong opportunity costs, particularly during planting and harvest seasons. School supply costs thus represent a larger share of household budgets in rural areas. Urban areas, despite better infrastructure, may harbor hidden pockets of disadvantage among migrant or informal sector families for whom material support remains binding. However, urban families generally

have more diverse income sources and better access to credit, potentially reducing the marginal impact of supply provision.

6.7.1 Heterogeneity analysis

The heterogeneity analysis of school enrollment impacts in Table 6 reveals fascinating patterns that illuminate the complex dynamics of educational participation across different demographic groups. The gender dimension presents one of the most striking findings of our analysis, where male students demonstrate a statistically significant enrollment improvement of 4.9 percentage points with a highly significant z-statistic of 3.97. This robust effect suggests that the program successfully addresses specific barriers to boys' educational participation, possibly related to opportunity costs of schooling where boys might otherwise engage in income-generating activities to support their families. In contrast, female students show a positive but statistically insignificant effect of 4.3 percentage points, despite the magnitude being comparable to that observed for boys. This lack of statistical significance for girls suggests that their educational participation faces constraints that extend beyond material resource availability, potentially including sociocultural factors, household responsibilities, or safety concerns that the provision of school supplies alone cannot address.

The geographical analysis reveals that the program demonstrates effectiveness across both residential contexts, though with nuanced differences in magnitude and significance levels. Rural students experience a 4.2 percentage point increase in enrollment that reaches marginal statistical significance at the 10% level, indicating that while the effect is positive, there remains considerable variation in outcomes within rural areas. This finding aligns with the program's primary targeting strategy, as rural areas face more severe educational resource constraints and the provision of school supplies addresses a critical gap in educational infrastructure. Urban students, somewhat surprisingly, demonstrate a slightly larger and more statistically robust effect of 4.5 percentage points, significant at the 1% level. This urban impact suggests that even in areas with theoretically better resource access, significant pockets of educational disadvantage exist where the program provides meaningful support. The urban effect might reflect the program's ability to reach marginalized urban populations who face economic constraints despite living in more resource-rich environments.

The education level analysis produces the most dramatic heterogeneity in the entire study, with high school students experiencing an extraordinary 16.9 percentage point improvement in enrollment. Given the baseline high school enrollment rate of

Table 6 ATT estimation by gender, area, and level on school enrollment

Variable	Category	Coefficient	Std.Err	Z	P > Z
Gender	Female	0.0425169	0.0260032	1.64	0.120
	Male	0.049127***	0.0123824	3.97	0.000
Area	Rural	0.0416885*	0.0224906	1.85	0.064
	Urban	0.0454908***	0.014296	3.18	0.001
Education level	Primary	0.0370544	0.0493392	0.75	0.453
	Middle School	0.0250804	0.0249161	1.01	0.314
	High School	0.1691905***	0.0586425	2.89	0.004
	Higher Education	0.0310353	0.0570521	0.54	0.586

***p < 0.01

**p < 0.05

*p < 0.1

Table 7 ATT estimation by gender, area, and level on grade repetition

Variable	Category	Coefficient	Std.Err	Z	P > Z
Gender	Female	0.0384043	0.0520344	0.74	0.460
	Male	− 0.2677769**	0.1265745	− 2.12	0.034
Area	Rural	− 0.16983***	0.095642	− 1.78	0.076
	Urban	− 0.0080419	0.0801554	− 0.10	0.920
Education level	Primary	− 0.1210408	0.078752	− 1.54	0.124
	Middle school	− 0.1158902	0.1210069	− 0.96	0.338
	High school	− 0.2894235	0.107159	− 2.70	0.728
	Higher education	− 0.000287	0.0360898	− 0.01	0.994

***p < 0.01

**p < 0.05

*p < 0.1

approximately 52.7% in rural areas, this represents a substantial 32% relative increase, nearly a one-third boost in participation rates. This massive effect at the high school level suggests that the program intervenes at a critical juncture where students face heightened dropout risks due to increased educational costs, labor market pressures, and family expectations for economic contribution. The high school effect may reflect both the higher absolute costs of educational materials at this level and the critical nature of this educational transition where many students traditionally exit the system. Primary and middle school levels show positive but statistically insignificant effects, which might indicate that enrollment rates at these levels are already relatively high due to mandatory education policies, or that other factors beyond material constraints primarily determine participation at these levels.

The analysis of grade repetition in Table 7 presents an even more nuanced picture of the program's educational quality impacts, revealing substantial gender disparities that merit careful examination. Male students experience a dramatic 26.8 percentage point reduction in grade repetition rates, representing one of the largest effect sizes observed in the entire study. This substantial improvement suggests that access to appropriate school materials fundamentally transforms boys' academic performance and progression through the educational system. The magnitude of this effect implies that material constraints previously prevented boys from adequately participating in classroom activities, completing assignments, or preparing for examinations, and that the program successfully removes these barriers to academic success. The statistical significance of this finding, with a z-statistic of − 2.12, confirms that this represents a genuine causal effect rather than random variation.

Conversely, female students show a small positive coefficient of 3.8 percentage points for grade repetition, which is statistically insignificant and suggests no meaningful impact of the program on girls' academic progression. This stark gender difference in repetition outcomes points to fundamentally different mechanisms constraining educational success for boys versus girls. The geographical dimension of repetition impacts shows that rural students experience a substantial 17 percentage point reduction in grade repetition, marginally significant at the 10% level. Relative to the baseline rural repetition rate of 12.6%, this represents an extraordinary 135% reduction, effectively cutting repetition rates by more than half. This massive effect suggests that material constraints are particularly binding for academic performance in rural contexts, where students may lack basic supplies, quality textbooks, or conducive home study environments. Urban

students, in contrast, show virtually no impact on repetition rates (– 0.8pp, p = 0.920), indicating that academic progression in urban schools is constrained by factors other than material supply availability, perhaps including teaching quality, classroom overcrowding, or curriculum challenges.

7 Discussion

The findings from this microeconometric evaluation of Morocco's "One Million School Bags" program reveal a complex picture of modest aggregate impacts with substantial heterogeneity across demographic subgroups and educational levels. The overall enrollment improvement of 3–6 percentage points and grade repetition reduction of 4–7 percentage points, while statistically significant, represent relatively modest effects in absolute terms. However, when contextualized against baseline rates and examined through the lens of heterogeneous impacts, a more nuanced understanding emerges of how material support interventions function in developing country educational contexts.

The program's differential effectiveness across subgroups provides important insights for educational policy design and targeting. The particularly strong impacts observed among high school students (16.9 pp enrollment increase) and boys (26.8 pp repetition reduction) suggest that material constraints bind most severely at later educational stages and for demographic groups facing stronger opportunity costs. High school students require more expensive and specialized materials, face greater pressure to contribute economically to households, and stand at critical educational junctures where dropout risks peak. The program's ability to meaningfully shift enrollment decisions at this level indicates that direct cost reduction remains an effective policy lever even as students age and face competing demands on their time.

The gender disparities in program impacts warrant careful consideration. Boys demonstrate statistically significant improvements in both enrollment and especially grade repetition, while girls show positive but insignificant enrollment effects and no improvement in repetition rates. This pattern suggests that material support alone may be necessary but insufficient for addressing girls' educational barriers in the Moroccan context. Girls' school participation appears constrained by factors beyond direct costs—potentially including cultural attitudes toward female education, household responsibilities, safety concerns, and expectations around early marriage—that require complementary interventions alongside material support. This finding aligns with broader literature showing that multiple, intersecting barriers often prevent girls' educational attainment in developing contexts.

The geographic dimension reveals interesting paradoxes: urban students show slightly stronger enrollment effects than rural students despite the program's explicit rural focus, though rural students demonstrate far larger repetition reductions. This pattern may reflect different binding constraints across contexts. In rural areas, material scarcity appears to directly impede learning quality and academic progression, as evidenced by the dramatic repetition reduction. Urban enrollment impacts, despite better infrastructure, may indicate successful targeting of marginalized urban subpopulations—perhaps recent migrants or informal sector families—for whom cost barriers remain binding despite better average urban conditions.

From a methodological perspective, the consistency of findings across multiple matching algorithms strengthens confidence in the results. Nearest neighbor, kernel, radius, and stratification matching all produce qualitatively similar estimates for enrollment impacts, though with varying precision. This robustness suggests that the results are not artifacts of specific methodological choices but reflect genuine program impacts. The propensity score model demonstrates good balance across covariates and adequate common support, indicating that the conditional independence assumption is plausible given the rich set of available controls.

These findings contribute to the growing literature on supply-side educational interventions in developing countries. While conditional cash transfer programs like Mexico's Progresa or Brazil's Bolsa Família have received extensive attention, school supply programs have been studied less systematically. Our results suggest that direct provision of educational materials can yield meaningful impacts, particularly when targeted toward populations and educational levels where material constraints bind most severely. However, the heterogeneous impacts underscore the importance of understanding local constraints and tailoring interventions accordingly rather than assuming uniform responses across all student groups.

8 Policy implications

8.1 Evidence-based recommendations

Gender-Specific Interventions: The weaker enrollment effects for girls and absence of repetition impacts suggest that material support alone is insufficient to address their educational barriers. We recommend complementary interventions specifically targeting constraints faced by girls: (1) safe transportation options or increased school proximity to reduce safety concerns during commutes; (2) female teacher recruitment and mentorship programs to provide role models and address cultural concerns; (3) community engagement and awareness campaigns addressing cultural barriers to girls' education; (4) conditional incentives that account for household responsibilities disproportionately affecting girls, such as flexible school schedules or childcare support for older girls caring for siblings; (5) targeted scholarship programs for high-performing girls to signal societal value of female education. These interventions target the non-material constraints our results reveal, recognizing that school supplies address only one dimension of the multifaceted barriers girls face.

Level-Based Resource Allocation: High school students demonstrate the largest enrollment gains (16.9 pp), representing a 32% relative increase from baseline rates. This suggests policymakers should consider reallocating resources toward this level where impacts are most pronounced and material costs are highest. However, this recommendation must be balanced against equity objectives, as primary education remains the highest policy priority for universal access and foundation skill development. We recommend maintaining broad primary school coverage while expanding high school program eligibility and material quality, particularly in rural areas where opportunity costs peak. The modest primary school impacts may reflect already-high enrollment due to mandatory education policies rather than program ineffectiveness, suggesting resources might better target retention and learning quality at this level rather than initial enrollment.

8.2 Cost-effectiveness considerations

While comprehensive cost data are not publicly available for the One Million School Bags program, we can provide qualitative cost-effectiveness assessment based on estimated unit costs and observed impacts. School bags with basic supplies cost approximately $30 per student annually, representing modest investment compared to major educational expenditures like infrastructure construction ($50,000 + per classroom), teacher salaries ($8,000 + annually per teacher), or conditional cash transfer programs ($100–300 per family annually). The 3-6pp enrollment gain translates to roughly 170–340 additional enrolled students per 10,000 beneficiaries.

For high school students specifically, where the enrollment effect is 16.9pp, the cost per additional enrolled student is approximately $180 ($30 ÷ 0.169). This compares favorably to conditional cash transfer programs, which typically achieve similar enrollment gains at costs of $300–500 per additional enrollee. The dramatic grade repetition reduction in rural areas (17pp) is particularly cost-effective, as avoiding grade repetition saves both household and government resources otherwise spent on additional years of schooling. Each repetition avoided saves approximately $500 in annual schooling costs, suggesting that the program may generate positive returns even accounting only for repetition reduction.

However, several caveats apply to this assessment. First, our enrollment estimates capture only short-term effects; long-term persistence and graduation rates remain unknown. Second, the analysis excludes program administrative costs, distribution logistics, and quality control expenses. Third, opportunity costs differ across contexts—what works cost-effectively in Morocco may not translate to other settings. Fourth, we cannot assess whether resources might generate larger impacts through alternative interventions like teacher training or infrastructure investment. Nevertheless, the order-of-magnitude comparison suggests school supply programs offer reasonable value relative to alternative educational interventions, particularly when targeted toward high-impact populations like rural high school students.

8.3 Implementation and targeting enhancements

Program design could be strengthened through several targeted enhancements informed by our heterogeneity findings: (1) Develop specialized supply packages for different educational levels, with more substantial support for high school students where material costs escalate; (2) Pilot complementary interventions for girls addressing non-material barriers alongside supply provision; (3) Enhance quality control and distribution consistency, as implementation variation likely affects impact magnitude; (4) Consider conditional elements linking supply provision to attendance or performance benchmarks to reinforce behavioral change; (5) Integrate supply programs with other interventions like remedial tutoring or mentoring to compound effects on learning outcomes.

8.4 Study limitations and future research

Several important limitations merit acknowledgment. First, because our data are cross-sectional, the analysis captures short-to-medium term impacts and cannot assess whether enrollment gains translate to graduation, learning achievement, or long-term educational attainment. Longitudinal data would be needed to examine persistence of effects and potential fadeout over time. Understanding whether material support

generates sustained behavioral change or merely temporary enrollment shifts is crucial for policy design.

Second, despite including comprehensive covariates, PSM addresses only observable selection. Unobserved factors such as student motivation, innate ability, or unmeasured family circumstances could bias estimates if correlated with both program participation and outcomes. Students selecting into the program may differ systematically in ways our controls cannot capture. Instrumental variable approaches exploiting exogenous variation in program rollout, or ideally randomized controlled trials, would provide stronger causal identification by addressing both observed and unobserved confounding.

Third, our individual-level analysis cannot capture potential spillover or general equilibrium effects. Positive spillovers might arise through peer effects, improved classroom dynamics when more students have adequate materials, or teacher motivation responding to better-equipped students. Negative spillovers could emerge from resentment or stigma among non-beneficiaries, or resource dilution if teachers redirect attention toward beneficiaries. Program expansion might also affect teacher effort allocation or school resource deployment in ways our estimates do not reflect. Accounting for these indirect effects would require experimental variation in treatment intensity across schools or communities.

Fourth, program implementation quality and consistency likely varies across regions, schools, and administrators, potentially affecting impact magnitude. Supply quality (durable bags versus cheap materials), distribution timing (beginning versus middle of school year), complementary support (teacher engagement with program), and targeting accuracy (reaching intended beneficiaries) probably vary but cannot be measured with available data. This implementation heterogeneity may explain some of the variation in individual-level impacts we observe. Future research with program administrative data could explore implementation heterogeneity and identify best practices.

Fifth, the absence of regional indicators in the dataset prevents controlling for geographic fixed effects that might capture unobserved local characteristics affecting both program placement and educational outcomes. Regional variation in school quality, labor markets, cultural attitudes toward education, or program implementation could confound our estimates. Richer data incorporating regional controls would strengthen identification.

Future research should address these limitations through longitudinal data collection, experimental program expansion, and detailed implementation monitoring. Particularly valuable would be research examining: (1) long-term educational and labor market outcomes of beneficiaries; (2) interaction effects between school supplies and complementary interventions; (3) mechanisms underlying heterogeneous impacts, especially gender differences; (4) optimal targeting strategies balancing equity and efficiency; (5) cost-effectiveness comparisons across different educational interventions.

9 Conclusion

This study provides rigorous microeconometric evaluation of Morocco's "One Million School Bags" program using propensity score matching on nationally representative data. The analysis reveals that while the program generates modest but statistically significant improvements in enrollment (3-6pp) and grade repetition reduction (4-7pp) overall, impacts vary dramatically across demographic subgroups and educational

levels. High school students, boys, and rural students demonstrate particularly strong responses, suggesting that material constraints bind most severely for these populations.

From a policy perspective, these findings underscore both the promise and limitations of school supply programs as educational interventions. Direct material support can meaningfully shift enrollment and progression decisions, particularly at critical educational junctures and for groups facing substantial opportunity costs. However, the heterogeneous impacts reveal that one-size-fits-all approaches may miss important nuances in how different populations respond to interventions. Girls, for instance, require complementary support addressing non-material barriers alongside supply provision. Primary students may benefit more from quality improvements than enrollment incentives given already-high participation rates.

The Moroccan experience with large-scale supply provision offers several lessons for other developing countries designing educational interventions. First, even modest-cost programs can generate meaningful impacts when well-targeted, suggesting that expensive interventions are not always necessary. Second, understanding local constraints and binding barriers is essential for intervention design—what works for boys may not work for girls, and rural needs differ from urban ones. Third, supply programs likely work best as part of comprehensive educational strategies combining multiple interventions rather than as standalone solutions. Fourth, careful monitoring and evaluation are essential for understanding program effectiveness and refining implementation.

Morocco's "One Million School Bags" program represents a valuable case study in how middle-income countries can deploy relatively low-cost interventions to reduce educational inequalities and improve access. While not a panacea, school supply programs constitute one effective tool in the broader educational policy toolkit. The challenge for policymakers lies in strategic targeting, complementary intervention design, and continuous learning from implementation experience to maximize impact. As Morocco continues pursuing its education sector goals, the evidence from this evaluation can help refine and improve future iterations of social support programs.

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Author contributions
F.A. and O.Z. conceptualized the study, designed the research methodology, and performed the econometric analysis including propensity score matching estimation. F.A. collected and prepared the data from the ENASS survey. O.Z. and M.L. supervised the research and provided critical guidance on the analytical framework. F.A. and O.Z. wrote the main manuscript text. S.B. and I.T. contributed to the literature review and the interpretation of heterogeneity results. M.L. reviewed the theoretical framework and provided substantive revisions. O.Z. prepared all tables and figures. All authors reviewed and approved the final version of the manuscript.

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Data availability
The data that support the findings of this study are available from the National Observatory of Human Development (ONDH), Morocco, through the National Survey on Social Support for Schooling (ENASS) 2018. Restrictions apply to the availability of these data, which were used under agreement for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the ONDH.

Declarations

Ethics approval and consent to participate
Not applicable. This study is based entirely on publicly available secondary data from the National Survey on Social Support for Schooling (ENASS) conducted by the National Observatory of Human Development (ONDH) in 2018 and does not involve human participants, human data, or human tissue. Not applicable. This study uses publicly available secondary data and does not involve direct interaction with human participants.

Consent for publication
All authors have reviewed the final version of the manuscript and give their consent for publication. All authors agree to be accountable for all aspects of the work.

Competing interests
The authors declare no competing interests.

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