Is Early Childhood Care and Education a Good Investment for Egypt? Estimates of Educational Impacts, Costs, and Benefits

MPP Professional Paper

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1. Introduction

The Egyptian government is making a major investment in early childhood education through an expansion in access to kindergarten. Providing kindergarten to only 30% of Egyptian children by 2015 is estimated to cost the country $103 million (UNDP, 2008). There is a body of supportive international evidence indicating that kindergarten, as a form of early childhood education, is a worthwhile investment. Early childhood education can have a positive impact on cognition, behavior, health, and educational attainment. While early educational interventions *can* have important effects, there is also a great deal of heterogeneity in program impacts (Nores & Barnett, 2010). The quality of early childhood interventions and the country-specific context in which they are applied can cause enormous variation in program effects.

In the context of Egypt, there is a serious dearth of evidence on the impact of early childhood care and education (ECCE). A World Bank report notes that there are no studies of the impact of preschool in the Egyptian context, and instead conducts a cost/benefit analysis for Egypt on the basis of evidence from places such as Chicago, India, and Bolivia (Janssens, Van Der Gaag, & Tanaka, 2001). Such an analysis does not properly account for the context of the Egyptian ECCE system, or the Egyptian educational and economic context. This paper seeks to rectify the absence of evidence by estimating the impact of early childhood care and education in the context of Egypt, with a focus on educational outcomes.

This study identifies the effect of ECCE through a within-family estimate of ECCE effects. The data used is Egypt's first representative survey to include a question about ECCE attendance. The data cover a sample of youth who would have been of preschool age in 1984-2004. Appropriate econometric techniques, such as estimating the impact of ECCE within-family, can generate accurate ECCE effects from this cross-sectional survey. As an alternative to exploiting within-family variation in ECCE to account for unobservable family characteristics, propensity score matching is also used to address selection. Together, this range of techniques indicates a robust range of ECCE's impact on educational outcomes.

The results of these different methods show an early childhood care and education impact that is both statistically significant and sizeable in practical terms. This ECCE impact occurs across a number of different and important educational outcomes. Years of school attained, primary and preparatory drop out, primary and preparatory repetition, test scores at the primary and preparatory levels, and tracking into general secondary and therefore higher education *all* demonstrate a consistently significant and meaningful improvement due to ECCE. Due to these many and sizeable effects, the analysis also suggests that the benefits of ECCE exceed the costs, even when estimating only the private wage returns due to additional educational attainment. This finding is, however, sensitive to the assumptions underlying the cost-benefit analysis. Overall, the Egyptian government's plans to invest in ECCE would improve educational outcomes to the extent that ECCE's educational effects alone are sufficient to fully pay off this investment.

Section 2 reviews the literature. Section 3 discusses the data. Section 4 provides background on Egypt and its educational system. Section 5 presents the methodology. Section 6 presents the findings for the effects of ECCE on educational outcomes. Section 7 provides a cost-benefit analysis. Section 8 provides a sensitivity analysis for these findings. Section 9 discusses the policy implications of the findings, their limitations, and suggests directions for future research. Section 10 concludes.

2. Literature Review

The international literature on early childhood development (ECD) and specifically early childhood care and education (ECCE) shows both the potential and heterogeneity of program and policy impacts (Nores & Barnett, 2010). Evidence from the U.S. indicates the highest returns are generated by high-quality programs targeted towards disadvantaged youth (Temple & Reynolds, 2007). Early childhood is the focus of many human development interventions and policies because early childhood is both when persistent development gaps and deficits occur, and consequently also when interventions to rectify disadvantage yield benefits that justify their costs (Heckman et al., 2006). Childcare, education, nutrition, and healthcare are the primary types of early childhood interventions and show a broad variety of health, cognitive, behavioral, and educational gains (Nores &

Barnett, 2010). Which intervention or combination of interventions is the best investment remains a subject of debate and analysis (Nores & Barnett, 2010).

A great deal of the debate focuses on evidence from the United States. Even in a report discussing the promise of early childhood development in Latin America and the Caribbean, the first evidence presented on ECD/ECCE program effectiveness is from the United States. The Abecedarian Program, the Chicago Child Parent Program, and the Perry Preschool Program are all cited as providing "impressive" results and the best-studied evidence (Vegas & Santibanez, 2010; Heckman, Moon, Pinto, Savelyev, & Yavitz, 2010). These programs provided evidence for positive economic returns to quality preschool investments, returns that exceeded most other educational interventions (Temple & Reynolds, 2007).

Evidence from the United States showing the impact of preschool has been reinforced by solid international evidence, both randomized trials and natural experiments. Programs and public preschool expansions everywhere from Uruguay (Berlinksi, Galiani, & Manacorda, 2008) to Bangladesh (Aboud, 2006) show the potential of preschool to improve educational outcomes. Early childhood education is considered an important cornerstone of meeting the goal of Education for All and the Millennium Development Goals, as well as an important part of development and poverty reduction (UNESCO, 2006).

However, not all ECCE programs are equal and not all have shown significant or positive impacts. Negative, insignificant, and small impacts, as well as positive, significant, and large impacts are visible in a meta-analysis of international high-quality ECD evidence (Nores & Barnett, 2010). In ECCE, teacher quality and high quality programs are important components to high quality outcomes (Early et al. 2007). Much of the evidence showing a large impact for ECCE comes from high quality programs (Temple & Reynolds, 2007; Vegas & Santibanez, 2010). In Bangladesh, a revised higher quality preschool program was found to have an important and significant improvement over existing regular preschool on a number of cognitive and social outcomes (Moore, Akhter, & Aboud, 2008). International evidence also suggests that disadvantaged children may particularly benefit from ECCE

programs (UNESCO 2006), but this evidence is not conclusive (Nores & Barnett, 2010). Complicating assessment of ECCE is that some program impacts from the expansion of ECCE are often unobserved. For instance, evidence from Israel indicates that free public preschool increased Arab mothers' labor force participation (Schlosser, 2005).

The Egyptian government is focused on expanding ECCE in the form of kindergarten as an important intervention towards the goal of improving educational outcomes. The push for ECCE is based on the generally positive international evidence. However, the government (Todd, 2010) and World Bank (Janssens, Van Der Gaag, & Tanaka, 2001) both cite a shortage of evidence based in the Egyptian context. Current estimates of the impact of ECCE in Egypt are based on simulations (Naudeau, Kataoka, Valerio, Neuman, & Elder, 2010; Janssens, Van Der Gaag, & Tanaka, 2001) using international impacts. These estimates do not fully account for the context of the Egyptian ECCE system, or the Egyptian educational and economic context.

3. Data

A recent survey, the 2009 Survey of Young People in Egypt (SYPE), provides an opportunity to marshal evidence on ECCE impact in Egypt. The survey covers a nationally representative sample of 15,029 youth with household and individual data on the youth. Within households, one youth 10-14, one male and one female 15-21, and one male and one female 22-29 were sampled. The questionnaire includes over a hundred questions on education, as well as numerous demographic, employment, health, and other questions. A retrospective question on nursery or kindergarten attendance is included in the education section (Population Council, 2010).

4. Egypt—Background & Education System

Egypt is a middle-income country with a population of 79.9 million (CAPMAS, 2011), including a large youth population (UNDP, 2010). This youth population presents both a sizeable challenge, in terms of delivering education and expanding employment, and an enormous opportunity to advance the development of Egypt and the wellbeing of its citizens. Substantial strides have been made in educating Egypt's youth. The right to a free

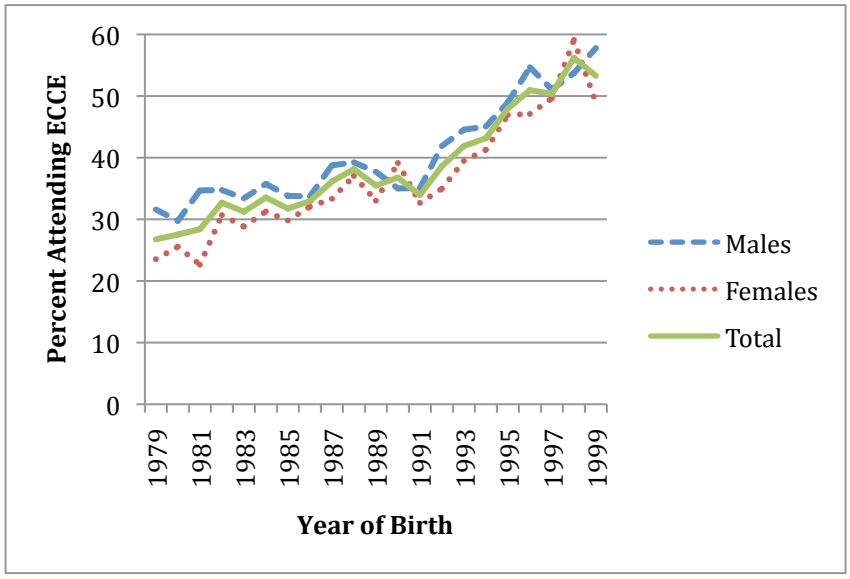
public education is enshrined in Egypt's constitution (Population Council, 2010) and Egypt is approaching universal primary enrollment (UNDP, 2008).

Primary (5 or 6 years) [1] and preparatory (3 years) of schooling are compulsory, with entry at age six (Population Council, 2010). General (University track) or technical (generally terminal) secondary may follow preparatory. General secondary students almost always proceed to University, with a few technical secondary students entering university, and a mix of technical and general secondary students attends two-year Post-Secondary Institutes. The education system is largely public, with some private and religious schools as well (Population Council, 2010).

The ECCE system in Egypt can be divided into two types: kindergartens and nurseries. Kindergartens are one or two years of pre-primary classes for children 4-6, with formal curricula and teachers; they fall under the oversight of the Ministry of Education. Half are government run, and the remainder privately run by NGOs, religious schools, workplaces, or private individuals. The nursery system also has a public component, under the oversight of the Ministry of Social Solidarity, but this accounts for less than a third of nursery services. Over two thirds of nursery services are NGO provided, and some by the private sector. While nurseries are supposed to be for children under the age of four, due to a lack of kindergarten space, up to 40% of nursery children are estimated to be 4-6. Enrollment fees can be a barrier for both kindergarten and nurseries. Quality of both teachers and facilities is extremely mixed, and likely to continue to be so, as expansion of ECCE rests on both private and public growth (UNDP, 2008).

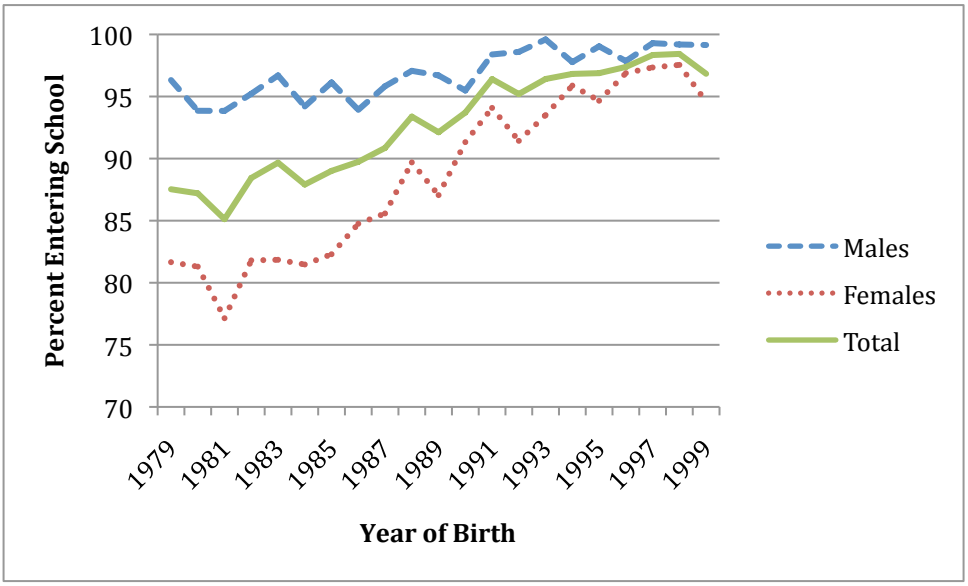
[1] In 1988, for budgetary reasons, primary school was reduced from six years to five. Youth who completed six years of primary prior to 1988 would be older than the SYPE sample. In the 2004/2005 school year, the sixth year of primary was restored to the schooling system. Therefore, youth fifteen/sixteen and younger would attend six years of primary schooling. (Shahine, 2003). In this analysis, primary school always counts as five years of school, so as to not bias calculations.

Figure 1 ECCE attendance by gender and birth cohort



Two Egyptian educational trends are particularly relevant to a retrospective examination of ECCE's impact. These are an expansion in both ECCE and an expansion in the overall educational system. Figure 1 shows the trend in ECCE attendance by birth cohort and gender. Although less than 30% of the oldest youth attended ECCE, more than 50% of the youngest youth have done so, and there has generally been a trend of increasing ECCE attendance with more recent birth cohorts. There has also been, especially in earlier birth cohorts, a substantial gender gap in ECCE attendance. Males are more likely to attend ECCE than females. Figure 2 shows a related and simultaneous trend, the general expansion of school attendance. While less than 90% of youth in the oldest birth cohorts even entered school, more than 95% of older birth cohorts did so; likewise the years and level of schooling attained by youth have similarly increased over time. School entry also shows a gender gap, and one that is larger than the ECCE gap. Females born in 1979-1985 entered school at rates around 81%, while males were much closer to 95%. The gender gap has substantially diminished, with school entry improving especially for females even while males also entered at slightly higher rates. In more recent years, Egypt has neared universal school entry (UNDP, 2008).

Figure 2 School entry by gender and birth cohort



Although access to education has expanded, quality and access issues in the education system persist. These could confound the impact of ECCE. The relatively simultaneous expansion of both ECCE and overall education can also complicate an identification of ECCE impact, especially when compounded by educational differences on dimensions such as gender. Additionally, the impact of early educational interventions can decay over time when not supported by additional quality education (Currie & Thomas, 1995). Frequent grade repetition and an emphasis on rote learning in the Egyptian educational system (Population Council, 2010) indicate that Egypt may be poorly positioned to maximize any ECCE gains.

5. Methodology

There is an absence of experimental or longitudinal data addressing ECCE in Egypt; to the best of this author's knowledge, the SYPE is the first representative survey to collect ECCE attendance data in Egypt. Although it is cross-sectional and non-experimental, the SYPE data and its features can be used, with appropriate econometric techniques, to generate an estimate of the impact ECCE currently has in Egypt, and shed light on the merits of expansion policies.

Within-family or family fixed effects, essentially sibling comparisons, are one method that can help address selection into ECCE. Since many of the unobservables that affect both selection into ECCE and educational outcomes are at the parent/household level, by comparing siblings within a household where one received ECCE and one did not, the impact of ECCE can be estimated with greatly diminished, if not eliminated, selection bias. This technique has been used to estimate the impact of Head Start in the U.S. (Currie & Thomas, 1995) as well as preschool expansion in Uruguay (Berlinksi, Galiani, & Manacorda, 2008). Family fixed effects models generally estimate equations of the form:

$$Y_{ij} = \beta_0 + \beta_1 X_{ij} + \alpha_j + \varepsilon_{ij}$$

Where the outcome, Y, for individual i in family j is a function of individual characteristics X_{ij} such as ECCE that vary by an individual within a family, as well as a family fixed effect, α_j that reflects variability across families, and ε_{ij} representing the random variability of individuals within families.

Preferential treatment of some children, or changes, especially income changes, between children's ECCE and school years can still bias results towards a positive ECCE effect. The possibility that parents select their more-able children into ECCE is particularly problematic. However, findings can also be tested for some cases of parental preference for certain children. For example, the data can be examined for preferential treatment of eldest children, or male children, and controls for any detected biases can be included in modeling.

Counter-balancing the problem of potential preferential treatment biasing within-family ECCE effect estimates upward is the possibility of two types of sibling spillovers. What one child learns may spill over to other siblings and bias estimates of ECCE effects downward within families. This is likely to occur when older siblings receive ECCE and their knowledge supports and spills over to younger siblings. There is suggestive evidence of a positive but small sibling spillover effect in Head Start in the United States (Graces,

Thomas, & Currie, 2000). Older to younger spillovers from ECCE when the older sibling is treated and the younger is not are fairly intuitive, while the opposite seems less likely. However, a younger sibling attending ECCE may in fact have positive spillovers to educational outcomes for an older (usually female) sibling regardless of their ECCE status. Data from Kenya indicate a strong substitution between ECCE and older-sibling (female) child care and concomitant school exit (Lokshin, Glinskaya, & Garcia, 2000). A younger sibling attending ECCE can therefore drive up educational attainment for older female siblings. With both older to younger and younger to older female spillovers possible, within-family effects may be an underestimate of actual ECCE program effects.

An alternative technique for correcting selection into ECCE is propensity score matching. This technique utilizes the entire survey sample, and matches on observable pre-treatment features to compare those who received ECCE with those who did not but are otherwise similar in their propensity to receive ECCE. Given observational data, this technique is recognized as an effective method for reducing bias in estimating treatment effects (Becker & Ichino, 2002). Although this approach corrects for selection on observables, to posit that ALL selection has been corrected, it has to be assumed that selection occurs exclusively on observables.

As well as confronting an econometric challenge with selection into ECCE, there is a challenge with the data in terms of right-censoring on educational outcomes due to respondents who are current students. Counting current years of education as final when a student has not yet left school will bias results. Focusing on students, such as 18-29 year-olds, who have achieved their final level of schooling is an alternative. However, given changing trends in educational outcomes over time, this is less than desirable. This will also not work for family fixed effects, as there is not a sufficiently large set of 18-29 year-olds who attended ECCE with another 18-29 year-old sibling in their household who did not attend ECCE.

Additionally, years of school is more properly understood as a time-to-event type of outcome where ECCE may have different effects on different years. Time to event is the

time between school entry and drop out/graduation. Because the survey covers 10-29 year-olds, it is essentially a collection of entry cohorts, which are ideal for time-to-event analysis. A hazard function, $\lambda(t)$ can be used to model the probability of school exit between time t and $t+\Delta t$ conditional on survival until time t or later:

$$\lambda(t) = Pr(t \leq T < t+\Delta t \mid T \geq t)$$

Where T is time of failure (Cleves, Gould, Gutierrez, & Marchenko, 2008). The hazard function and corresponding survival function can then be estimated to model the risk of leaving school and how different characteristics, such as ECCE, alter this risk. This can be transformed into changes in the mean years of school by summing and comparing the survival functions with and without ECCE.

For the outcome of years of schooling a Cox proportional hazard model with time interactions is used, which does not require a parametric form of the hazard function to be specified. Because years of school has hard breaks at the end of levels, the absence of a parametric form is a distinctly desirable feature; accelerated failure time or other models which specify an underlying parametric distribution of the hazard function will be inaccurate. While a Cox proportional hazard model is not the typical model for years of schooling, a variety of different studies have used this model, such as an investigation of the impact of remittances on years of schooling in El Salvador (Edwards & Ureta, 2003) or a study of the impact of wealth on the demand for and duration of schooling in Vietnam (Glewwe & Jacoby, 2004).

The Cox proportional hazards model assumes the underlying hazard to be (Cleves, Gould, Gutierrez, & Marchenko, 2008):

$$h(t)=h_0(t) \exp(\beta_1 x_1 + \ldots + \beta_k x_k)$$

The Cox proportional hazard model does have one potential major drawback, the assumption of proportionality, that the relative risk of a variable is not a function of time. If this assumption is violated, risk estimates may be inaccurate. Including time-dependent covariates in the model can solve this problem (Concato, Feinstein, & Holford, 1993). Time interactions allow the effect of ECCE to vary over time, as fade-out of an ECCE effect is an important possibility.

Time interactions can be added into a hazard model as (StataCorp LP, 2009):

$$h(t) = h_0(t) \exp[\{\beta_1 + \gamma_1 g(t)\}x_1]$$

Where $\beta_1 + \gamma_1 g(t)$ is a (potentially) time-varying coefficient on the covariate x_1 for a specified function of time g(t). Modeled here with a single covariate for simplicity, this approach can be used with multiple covariates. The functional form of time can also be quite flexible, changing from time unit to time unit (Cleves, Gould, Gutierrez, & Marchenko, 2008).

The proportional hazards model assumes that the hazard function and time are continuous and no tied events should occur (Therneau & Grambsch, 2000). However, as is often the case, the SYPE data record schooling time discretely, in years. While underlying drop out may be continuous, if graduation is the method of school exit, it is genuinely simultaneous. Ties present a computational challenge to calculating the hazard function without bias (Hertz-Picciotto & Rockhill, 1997). The proportional hazards model with the exact partial method for calculating ties is ideal in this case, as this approach treats time as discrete (Therneau & Grambsch, 2000).[2]

The Cox proportional hazard model also has the desirable feature of being able to simulate fixed effects. By generating separate strata for individuals with repeated events,

[2] The Cox proportional hazard model using the exact partial method for ties is equivalent to computing conditional logistic regressions where the groups are the risk set (individuals not yet censored or failed) and the outcome is failure (drop out or graduation) in that time period (StataCorp 2009).

fixed-effects on an individual level can be implemented (Allison & Christakis, 2007). This same methodology can be extended to multiple observations from within another type of fixed effect, such as family fixed effects (Ridder & Tunali, 1999). Using strata to account for group effects allows the baseline hazards to be different for each family (Cleves, Gould, Gutierrez, & Marchenko, 2008). The hazard at time t for a subject in family j is (StataCorp LP, 2009):

$$h(t)=h_{0j}(t)\exp(\beta_1 x_1 + \ldots + \beta_k x_k)$$

While the baseline hazards may vary by family, the estimated coefficients on covariates are constrained to be equal.

For other outcomes, such as test scores, repetition, and secondary tracking, time-to-event approaches are not relevant and more traditional estimation approaches can be used.

6. Findings

6.1 Descriptives

Attending ECCE is not randomly distributed through the Egyptian youth population (Table 1). A total of 39.3% of youth in the SYPE reported attending ECCE. Youths' background shows a strong relationship with ECCE attendance. Males are slightly more likely to have attended ECCE than females (41.1% versus 37.4%). Younger youth, especially the 10-14 age group, are much more likely to have attended ECCE than older youth, especially the oldest youth (51.1% of 10-14 year olds versus 29.8% of 25-29 year olds).

Family background, in terms of wealth and parents' education, has a close relationship with ECCE. Youth in the highest wealth quintile are more than four times more likely to have attended ECCE than youth in the lowest quintile. Although there is an overall increase with wealth, the jump in ECCE attendance is particularly sharp in the fourth and

highest quintiles. This is consistent with issues of financial access determining ECCE utilization, as other authors have suggested is the case in Egypt (UNDP, 2008). Parents' education is also closely tied with ECCE. More-educated parents, especially highly (post-secondary institute, university, or above) educated parents are associated with ECCE.

Geography is closely related to youths' attendance to ECCE. More than two thirds (69.5%) of youth in urban governorates attended ECCE and more than half in urban Lower Egypt (56.1%). These are also the more privileged areas of Egypt in terms of education and wealth. Rural Upper Egypt, generally identified as the poorest region in Egypt, also has the lowest ECCE attendance at 16.6%. Rural areas generally have low ECCE attendance, at 25.9%. This is even worse than slum areas, at 48.5%, and less than half that of urban areas, at 61.3%.

Overall, given the emphasis in much of the international and Egyptian ECCE literature on ECCE as particularly important for the most disadvantaged children, the current distribution of ECCE appears disconnected from the greatest need and returns for ECCE. The distribution of ECCE also clearly indicates that ECCE is not randomly assigned in the population, but associated with socio-demographic background factors that are also likely to affect educational and life outcomes; the effects of ECCE on these outcomes will be difficult to disentangle.

Table 1 Percentage of youth attending ECCE by background characteristics

Percentage Attending ECCE	
Gender	
Males	41.1
Females	37.4
Age Group	
10-14	51.1
15-17	39.5
18-24	34.8
25-29	29.8
Wealth Quintile	
Lowest	16.2
Second	23.0
Third	32.8
Fourth	51.9
Highest	77.8
Father's Education	
Illiterate	22.6
Primary	37.6
Preparatory	45.8
Vocational Secondary	57.5
General Secondary	55.7
Post-secondary Institute	70.2
University & Above	76.2
Father's Education Missing	29.2
Mother's Education	
Illiterate	25.0
Primary	42.8
Preparatory	53.1
Vocational Secondary	66.1
General Secondary	74.6
Post-secondary Institute	84.8
University & Above	86.0
Mother's Education Missing	26.4
Region	
Urban Governorates	69.5
Urban Lower Egypt	56.1
Rural Lower Egypt	34.0
Urban Upper Egypt	32.5
Rural Upper Egypt	16.6
Frontier Governorates	31.6
Residence	
Urban	61.3
Rural	25.9
Slum	48.5
Total	39.3

6.2 Outcome: Years of School

ECCE is theorized to deliver educational, economic, and social benefits through a number of different cognitive and behavioral avenues. Given the nature of the data available, not all of these benefits can be measured. However, most of them are mediated through educational outcomes, on which data is available; one of the strengths of the SYPE is a very detailed education section. By focusing solely on educational outcome differences, outcomes related to other private or public benefits remain unmeasured, and the resulting cost-benefit analysis can be considered quite conservative.

Table 2 displays the results of OLS regressions for the impact of ECCE on years of school[3] without any covariates. Specification 1a is a regression on ECCE alone for all youth age 10-29. With no background characteristics, ECCE attendance predicts 1.277 more years of schooling. However, many youth, especially in the 10-17-age range, are still in school, and therefore this variable is censored and biases the estimate. Specification 1b restricts the ECCE/years of school relationship to youth 18-29. Although some may be current students at the university level, still biasing the relationship slightly downward, ECCE is associated with 3.336 additional years of schooling. However, as was obvious from the descriptive statistics, ECCE is distributed in conjunction with other characteristics that are likely to confer educational advantage. Although 18-29 year olds who attended ECCE may have attained 3.336 years of additional schooling, causality is unclear.

[3] Years of school was top-coded so that maximum attainment was 19 years (5 years beyond university)

Table 2 Years of School—OLS with no covariates

	Years of School	Years of School
	Spec. 1a ECCE only, all ages 10-29	Spec. 1b ECCE only, ages 18-29
ECCE	1.277*** (0.068)	3.336*** (0.097)
Constant	7.321*** (0.043)	8.374*** (0.056)
R-Squared	0.023	0.122
N	15025	8486

* p<0.05, ** p<0.01, *** p<0.001
Standard errors in parentheses

Specification 2a (Table 3) adds family and individual background characteristics. Specification 2a restricts the sample to 18-29 year olds, and finds a 1.791-year increase in years of school associated with ECCE. Another important issue that may be biasing results is ever-entry into school. Very few (N=21) respondents who have never been to school at all (N=1,167) report attending ECCE. Although parents' decision to send their children to ECCE occurs chronologically before formal school entry, conceptually the decision is a function of the unobserved intention to educate children. Comparing children with no schooling and almost always no ECCE to those with any amount of schooling and on average some ECCE might falsely attribute to ECCE the decision to educate children at all, and seriously bias the coefficient on ECCE.

Some international literature ascribes to ECCE the effect of increased entry into primary school (Arnold, Bartlett, Gowani, & Rehana, 2007; UNESCO, 2006). Despite illustrating that higher numbers of ECCE attendees enter primary, they do not convincingly disprove joint selection into both ECCE and schooling. Additionally, in the context of Egypt, never-entry is becoming a less frequent problem, with less than 5% of the youngest SYPE respondents never entering school. Those that are still failing to enter have the most disadvantaged backgrounds, and likely the least access to ECCE. Also, their stated reasons

for not entering school, such as unaffordability, health, parental opposition, or the need to work (Population Council, 2010) are not tractable with ECCE. Including never attending youth as members of the comparison group ascribes to ECCE some of the impact of parents' decision to send their children at all.

Specification 2b attempts to correct this issue by limiting the regression to 18-29 year olds who ever attended school. The coefficient on ECCE drops from the 1.791 of Specification 2a to 1.090 additional years of school as a result of ECCE. The relationship between ever entry and ECCE was leading to an approximately 0.7 year over-estimation of the impact of ECCE, a substantial bias.

Table 3 OLS Years of School With Covariates

	Years of School	Years of School
	Spec. 2a Restricted to 18-29	Spec. 2b Restricted to 18-29 EVER ENTERED
ECCE	1.791***	1.090***
	(0.103)	(0.082)
Female	-0.562***	0.259***
	(0.088)	(0.073)
Father Primary	0.388**	0.321**
	(0.145)	(0.119)
Preparatory	0.262	0.440*
	(0.227)	(0.184)
General Secondary	1.197*	1.042*
	(0.540)	(0.427)
Vocational Secondary	0.997***	0.951***
	(0.195)	(0.156)
Post-secondary Inst	1.216**	1.177***
	(0.410)	(0.324)
University & above	0.827**	0.969***
	(0.253)	(0.201)
Missing	-0.132	0.124
	(0.139)	(0.116)
Mother Primary	0.410**	0.127
	(0.134)	(0.108)
Preparatory	0.494*	0.329
	(0.251)	(0.200)

	Years of School	Years of School
	Spec. 2a Restricted to 18-29	Spec. 2b Restricted to 18-29 EVER ENTERED
General Secondary	0.693	0.678
	(0.525)	(0.414)
Vocational Secondary	0.542**	0.598***
	(0.205)	(0.163)
Post-secondary Inst	0.356	0.654
	(0.521)	(0.411)
University & above	0.612*	0.700**
	(0.300)	(0.238)
Missing	-0.955***	-0.835***
	(0.134)	(0.113)
Wealth Quintile Second	1.363***	0.563***
	(0.132)	(0.117)
Third	2.471***	1.198***
	(0.133)	(0.115)
Fourth	3.701***	2.189***
	(0.145)	(0.123)
Highest	5.117***	3.586***
	(0.177)	(0.148)
Constant	5.731***	7.280***
	(0.323)	(0.271)
R-squared	0.319	0.272
N	8486	7522

* p<0.05, ** p<0.01, *** p<0.001
Standard Errors in Parentheses
Reference Case: male, father illiterate, mother illiterate, lowest wealth quintile. Birth Cohort (1979 reference), governorate of birth[4] (Cairo reference) and rural dummy are also included

Although the regressions limited to 18-29 year olds diminish the censoring generated by current students in the sample, they do not do so completely. Nor do they tell us *when* the additional schooling is occurring. Especially in later estimating costs and benefits it is important to know when costs and benefits occur. To investigate this question, survival analysis or time-to-event methods are more appropriate. First, Kaplan-Meier survival functions are computed. Figure 3 presents the Kaplan-Meier survival function for

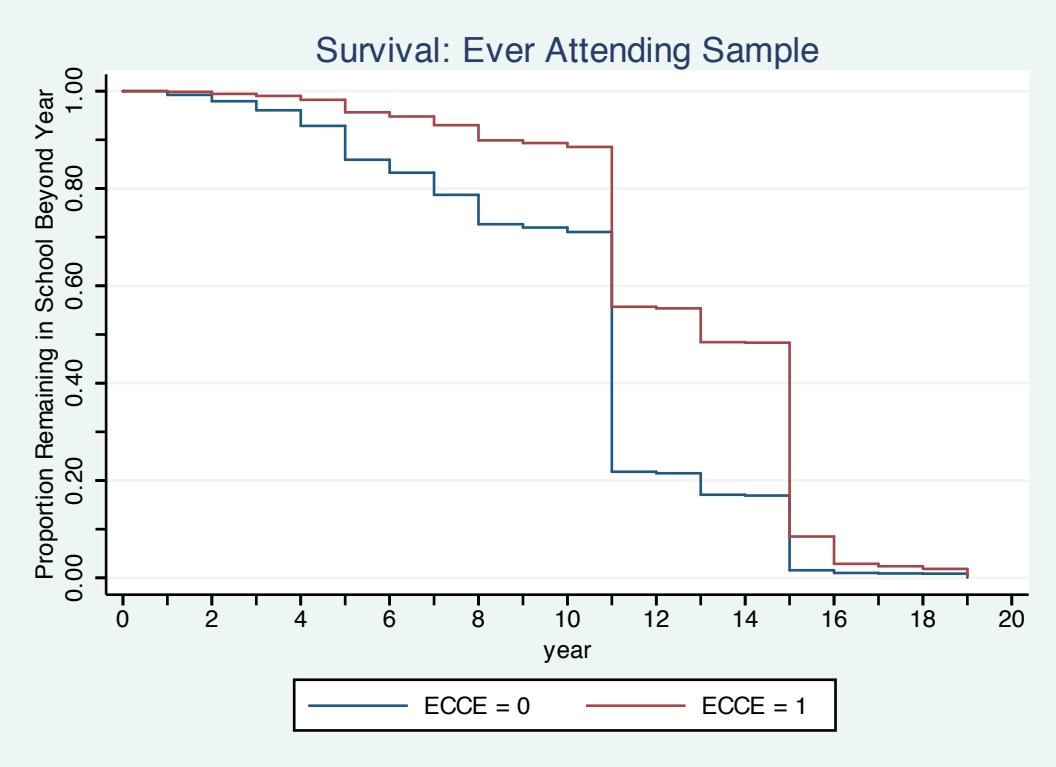
[4] Governorate of birth was only available for youth who answered the migration module, that is, youth 15-29. Current governorate of residence used for governorate of birth for youth 10-14

all ever-attendees. It displays the proportion of youth remaining in school beyond a given year by ECCE status.[5] ECCE=0 individuals did not attend ECCE and ECCE=1 individuals did attend ECCE.

The survival function, like the regressions without covariates, suggests a substantial advantage in schooling attainment for those who attend ECCE. Differences are small in the first few years of primary, but widen substantially by year 5, the end of primary. Differences continue to widen between years six and eight, during preparatory. There is also a substantial difference between those who cease at year 8, the end of preparatory and required schooling, on the basis of ECCE. Interestingly, the gap does not widen in the additional years of secondary, suggesting the fade out of a positive educational effect on drop out during those years. There is, however, the largest gap at the decision to stop at year 11, the end of secondary, or continue to university. After university (ending in year 15) individuals of both backgrounds tend to stop, but there is still a slight advantage associated with ECCE in continuing to above university.

[5] Because of the nature of the SYPE questionnaire, the data collected is on the highest level of schooling an individual passed, years of schooling completed or attained. So, for instance, if an individual entered but did not complete their fourth year of primary school, they would be counted as having attained three years of schooling, and having then failed (not successfully continued) at the end of year 3. It is therefore not possible to distinguish between those who don't continue at the end of year 3 and those who fail before the end of year 4; these groups are both considered as having attained three years. Additionally, those who entered but failed during their first year (N=30) are excluded from the analysis in order to maintain comparability in attainment as the failure at the end of a year or failure to fully complete the subsequent year.

Figure 3 Kaplan-Meier Survival Function for All Ever Attendees



ECCE attendees, have, however, been shown to be substantially advantaged by their backgrounds in a number of dimensions. The real issue is the effect of ECCE once these differences have been accounted for. The Cox proportional hazard model with time interactions for ECCE is better suited to answering these questions. Aside from the specification of ECCE as time interacted,[6] the same covariates are included in this model as in the OLS regressions. All of the hazard models are also limited to the ever-attending sample.

Table 4 shows the hazard model,[7] the results of which remain generally consistent with the Kaplan-Meier Survival function, but are substantially less dramatic. Coefficients

[6] Time interactions were only included through the end of the fourth year of tertiary (end of university) as sample size diminished drastically beyond that point, and ECCE effects had also substantially faded out. Time interactions also correct for the non-proportionality of ECCE; when tested the proportional hazard criterion for ECCE was not met.

[7] This model was estimated with the Efron method for ties. Although the exact partial method is ideal, it suffered from a flat region and could not estimate likelihood. Bias introduced by the Efron method with a large sample (even with a large number of ties) is estimated to be around 1% (Hertz-Picciotto and Rockhill 1997). Differences in hazard ratios by method were minimal when tested empirically to the extent possible in the general population, and fully within the within-family estimate. All the hazard models were also estimated

are hazard ratios and can be interpreted as deviations from one. For instance, the time interacted ECCE hazard for the end of year 1 indicates the hazard of leaving at the end of year 1 is 0.31 of what it would otherwise be without ECCE. ECCE diminishes by half or more the hazard of leaving school for every year through the end of year 7. The hazard of leaving the schooling system at the end of preparatory is also decreased, but to a lesser degree (with ECCE is .611 of the hazard without ECCE). As was suggested by the survival function, during secondary there appears to be no real additional advantage to ECCE. However, whether individuals continue on for higher education is impacted substantially by ECCE. With ECCE a youth has only three-fifths (0.606) of the risk of stopping at the end of secondary that one would without ECCE. Hazard ratios during tertiary are not significant, except for a slight decrease in the chances of continuing on to above university education if one has ECCE.

Other coefficients are similar or as expected from the OLS models. Compared to the (disadvantaged on most dimensions) reference case, improved background characteristics decrease the hazard of ending school at any given time.

without weights; very little difference was observed in coefficients with and without weights using the Breslow method for ties, and the other methods for handling ties cannot handle weights.

Table 4 Hazard Model for All Ever Attendees

ECCE	Hazard Ratio	Standard Error
End at Year 1	0.310**	(0.111)
End at Year 2	0.510**	(0.114)
End at Year 3	0.351***	(0.076)
End at Year 4	0.370***	(0.060)
End at Year 5 (Attain Primary)	0.516***	(0.051)
End at Year 6	0.413***	(0.075)
End at Year 7	0.485***	(0.065)
End at Year 8 (Attain Preparatory)	0.611***	(0.068)
End at Year 9	0.931	(0.270)
End at Year 10	0.999	(0.250)
End at Year 11 (Attain Secondary)	0.606***	(0.026)
End at Year 12	0.599	(0.274)
End at Year 13	0.847	(0.100)
End at Year 14	0.326	(0.273)
End at Year 15 (Attain University)	1.169*	(0.081)
Female	0.965	(0.025)
Father Primary	0.869**	(0.038)
Preparatory	0.769***	(0.055)
General Secondary	0.711*	(0.114)
Vocational Secondary	0.628***	(0.038)
Post-secondary Inst	0.543***	(0.078)
University & above	0.558***	(0.048)
Missing	0.921	(0.039)
Mother Primary	0.952	(0.039)
Preparatory	0.939	(0.069)
General Secondary	0.532**	(0.107)
Vocational Secondary	0.625***	(0.043)
Post-secondary Inst	0.525**	(0.109)
University & above	0.498***	(0.052)
Missing	1.441***	(0.059)
Wealth Quintile Second	0.813***	(0.033)
Third	0.668***	(0.027)
Fourth	0.475***	(0.021)
Highest	0.253***	(0.014)
Individuals Observed	13,826	

* p<0.05, ** p<0.01, *** p<0.001
Coefficients are hazard ratios
Standard Errors can be used to test whether hazard ratios are significantly different from 1
Efron method used for ties
Reference Case: male, father illiterate, mother illiterate, lowest wealth quintile. Birth Cohort (1979 reference), governorate of birth (Cairo reference) and rural dummy are also included but not shown

These changes in hazard can also be used to estimate the additional years of school and changed final attainments ECCE causes. Table 5 presents the final attainments that ever attending youth would, on average, attain without ECCE and with ECCE.[8] Additional tables showing how attainments were calculated are available in the appendix, Table 23 and Table 25.

Ending during or before the end of basic (primary and preparatory) education is substantially diminished by ECCE. Substantially fewer youth attain secondary education (48.9% without ECCE and 34.1% with) because so many more are expected to attain higher education (17.9% without ECCE versus 43.6% with). By summing the changes in the survival function, it is also possible to estimate the average change in years of school, which is an increase of 1.57 years on average due to ECCE. This estimate is substantially higher than the OLS estimate for 18-29 year olds by nearly half a year. This is likely due to younger populations generally attaining more education, the hazard of dropping out at any year having been shown to have declined over time, both in the coefficients on this paper's models (not shown) and in other research (Lloyd, El Tawila, Clark, & Mensch, 2003).

[8] These attainments are based on an estimate of the underlying 'No ECCE' survival function for those who did receive ECCE, had they not, combined on a proportional population basis with the survival function of those who did not receive ECCE and then compared to the survival of those who did receive ECCE, and an estimate of what those who did not would have attained, had they received ECCE. Essentially the population estimated to be entirely without ECCE has its hazard diminished by the hazards in Table 4. Simply using the current population survival function would be including the ECCE effect twice for those who already had it.

Table 5 Ever Enter Attainments--Changes due to ECCE based on Hazard Model

Year	% Attain without ECCE	% Attain with ECCE	% Change due to ECCE
End at Year 1	0.7	0.2	-0.5
End at Year 2	1.1	0.6	-0.5
End at Year 3	1.6	0.6	-1.0
End at Year 4	2.8	1.0	-1.7
End at Year 5 (Attain Primary)	6.0	3.2	-2.8
End at Year 6	2.4	1.1	-1.3
End at Year 7	4.1	2.2	-1.9
End at Year 8 (Attain Preparatory)	5.5	3.7	-1.7
End at Year 9	0.6	0.7	0.0
End at Year 10	0.8	1.0	0.1
End at Year 11 (Attain Secondary)	48.9	34.1	-14.8
End at Year 12	0.3	0.4	0.1
End at Year 13	4.4	7.6	3.2
End at Year 14	0.2	0.1	-0.1
End at Year 15 (Attain University)	17.9	43.6	25.7
End at Year 16	1.6	0.0	-1.6
End at Year 17	0.2	0.0	-0.2
End at Year 18	0.2	0.0	-0.2
End at Year 19	0.9	0.0	-0.9
Total	100.2	100.1	-0.1

Some of the literature also suggests that ECCE could have differential impacts on different groups, specifically that disadvantaged youth are particularly likely to benefit from ECCE (Heckman et al., 2006). When an interaction between ECCE and gender was tested in addition to specification 2b (OLS, 18-29 year olds, ever entered), it was not significant. Nor was it significant in the hazard model. Nor were wealth interactions jointly significant in either the hazard or OLS model. Unlike U.S. studies that suggest disadvantaged students receive the largest benefits of ECCE (Heckman, Moon, Pinto, Savelyev, & Yavitz, 2010; Temple & Reynolds, 2007) ECCE does not appear to have a uniquely positive effect for Egypt's disadvantaged youth.

Although there does not seem to be a unique effect for the disadvantaged, all these different specifications are suggestive that ECCE generally improves educational outcomes.

The fact that there is such a substantial difference between the estimated ECCE effect in the simple unadjusted mean difference models (Table 2) and the models with observed characteristics included suggests a potentially nontrivial role for selection bias resulting from unobservable family characteristics as well. Although the R-squared of 27.2% for specification 2b is quite respectable, a great deal of schooling variation remains unexplained and the inclusion of unobserved characteristics would likely further reduce the estimate of ECCE's impact. The simultaneous expansion of ECCE and overall schooling and the biases it may engender is also evident in the differences between different specifications.

Propensity Score matching, using the entire youth population but matching them on their propensity to attend ECCE for a comparison of their educational outcomes offers one route to correct selection into ECCE.[9] This approach does assume that selection into ECCE is entirely a function of observable characteristics, which may not be the case. Table 6 presents the results of propensity score matching using nearest neighbor matching with common support for the outcome of years of school. Table 21 presents sensitivity analysis of the matching method used.

The estimates from propensity score matching are quite similar to those using OLS. All coefficients on ECCE are significant. Over the entire youth population, an estimated .97 years of school are predicted to result from ECCE, but censoring from youth still in school assuredly biases this estimate. Limited to 18-29 year olds, the estimate is 1.715 years. Amongst the ever entered full sample, the estimate is .392 years, and amongst the ever-entered 18-29 year olds, 1.08 years. Given the continuing significance of ECCE on years of schooling with these multiple methods to correct for selection, that ECCE is in fact causing improved educational outcomes becomes increasingly plausible.

Table 6 also includes estimates for the impact of ECCE on two sub-groups. While there were not meaningful differences by gender based on ECCE with PSM, when

[9]While weights are used with regressions and within-family regressions, in propensity score matching, weights are not used; it is unclear how to accommodate weights properly while matching

estimating the impact for the two subgroups of the lowest two wealth quintiles and upper three quintiles, amongst those ever-attending, 18-29, the impact for the lowest two wealth quintiles is estimated at 1.535 years, an additional half year benefit compared to the top three wealth quintiles. However, the estimate for the lowest wealth quintile is within two standard errors of the estimate for the highest quintile, and can be treated as insignificant.

Table 6 Years of Schooling--Propensity Score Matching

Outcome	Years of School[10]	Years of School	Years of School	Years of School	Years of School[11]	Years of School[12]
	All	18-29	Ever Enter	Ever Enter 18-29	Two Lowest Wealth Quintiles, Ever Enter, 18-29	Three Higher Wealth Quintiles, Ever Enter, 18-29
ATT	0.970***	1.715***	.392**	1.08***	1.535***	.1.007***
Bootstrapped SE	0.117	.187	.126	.142	.310	.158
N	14,961	8,434	13,787	7,459	2,344	5,085

* p<0.05, ** p<0.01, *** p<0.001
Matching Variables include gender, parents' education, wealth, residence, birth governorate, birth cohort, number of sons/daughters in household if son/daughter

Propensity score matching can only control on observable characteristics, and especially when it comes to education, unobserved family differences may be large. Comparing educational outcomes within a family can remove the biases that make the OLS specifications and even propensity score matching dubious. Unobservables, such as parents' value for education and involvement in their children's lives, are likely to be much diminished, if not entirely removed, in comparing children within families. Although family resources available at the time of ECCE enrollment may also affect educational outcomes, they are likely to affect the trajectory of any then-born children as well, diminishing a possible source of bias there. One bias that may, however, remain is if parents invest in ECCE for their more able children. If parents choose to send smarter children to ECCE, it might be that latent ability, not ECCE, is what is being identified by within-family

[10] Governorate 18 is not balanced in block 1, cohort 9 is not balanced in block 9, Governorate 24 is not balanced in block 24
[11] Governorate 9 is not balanced in block 18
[12] Governorate 17 is not balanced in block 4

comparisons. In the next set of analyses, family fixed effects models are used in an attempt to control for unobserved family-specific characteristics that may be associated with educational attainment.

Table 7 presents within-family estimates for sibling youth who ever entered school living with their parents. The within-family estimates are restricted to siblings in order to avoid comparing two youth in the same household with different parents, or a married couple. Only coefficients for ECCE are presented; gender and birth cohort variables (which vary within family) are also included in the model. The youth used for within-family comparisons are actually more representative of the overall population than the ECCE receiving population. This is shown by Table 22 in the appendix, which compares the composition of ECCE attendees, youth used in the within-family comparisons, and the general population.

Specification 6 compares all youth within a family where all youth entered school and at least one attended ECCE and at least one did not. Within families, ECCE predicted a highly significant additional .393 years of school. This finding was robust to when the oldest family member attended ECCE and others did not (Specification 7, .586 years), and when the youngest attended ECCE and others did not (Specification 9, .522 years). The finding was, however, somewhat sensitive to gender. Within families, comparing only males when at least one male attended ECCE and at least one did not (specification 9), ECCE attendance predicted an additional .613 years of school. For females (specification 10), ECCE attendance was not significant and was in fact a small negative. The relatively small number of observations and groups with variation between two females may contribute to this finding.

Table 7 Years of Schooling--Within-Family

	Years of School	Years of School	Years of School	Years of School	Years of School
	Spec. 6 ALL within-family	Spec. 7 OLDEST Treated	Spec.8 YOUNGEST Treated	Spec. 9 Males ONLY	Spec. 10 Females ONLY
ECCE	0.393***	0.586***	0.522**	0.613**	-0.0263
	(0.086)	(0.153)	(0.131)	(0.178)	(0.190)
R-squared within	0.640	0.688	0.636	0.648	0.807
R-squared between	0.475	0.488	0.482	0.364	0.678
R-squared overall	0.5442	0.577	0.547	0.510	0.730
N	2482	1021	1526	604	324
N Groups	996	401	616	285	154

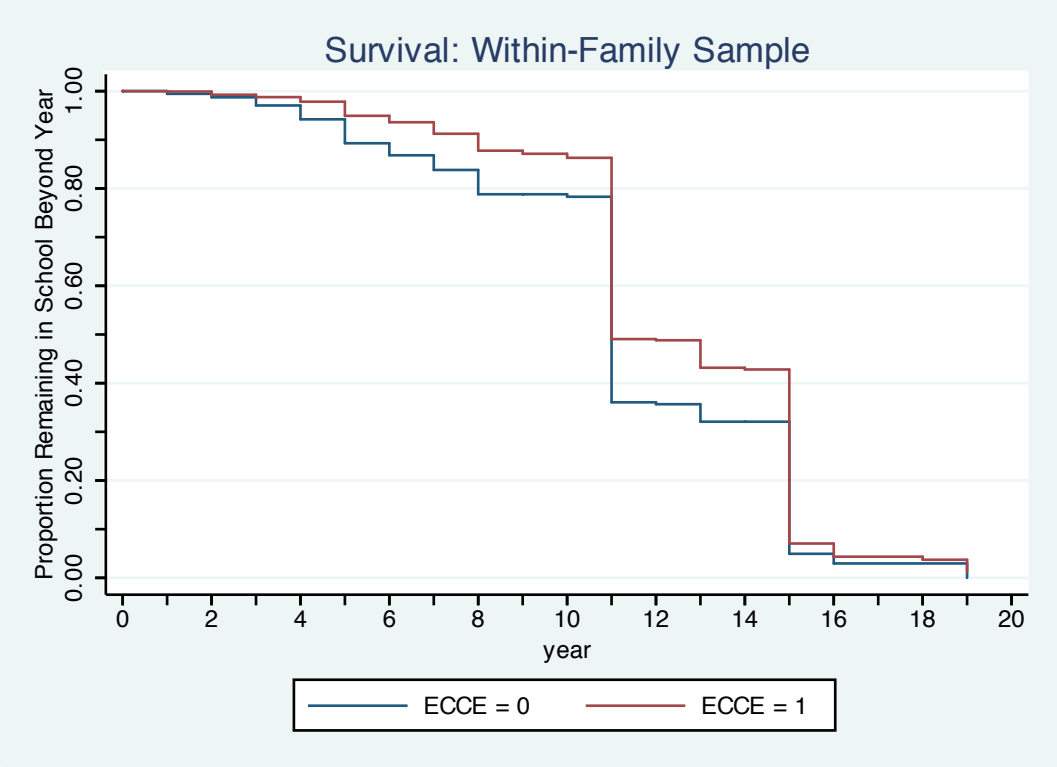
* p<0.05, ** p<0.01, *** p<0.001
Standard Errors in parentheses, corrected for household clusters
Regressors included for gender and birth cohort[13]
Reference Case: male, born 1979

It is noteworthy that all of these estimates of ECCE's impact are substantially smaller than those generated by OLS or propensity score matching, suggesting ongoing selection on the unobservables. Although the youngest treated and oldest treated both demonstrate a positive and significant ECCE effect, that many of the within-family youth are currently in school may be biasing the size of the coefficient downward. Survival analysis using within-family estimates provides an opportunity to generate a reliable estimate of ECCE impact while managing censoring and addressing selection. Figure 4 presents the survival function for the within-family sample.

The within-family Kaplan-Meier survival function indicates a much reduced but still sizeable difference in attainment based on ECCE when compared with the entire ever-entered population (Figure 3). ECCE and non-ECCE individuals start to diverge towards the end of primary, remain separated (but without further divergence) through preparatory, diverge further in continuing to secondary, and show an important gap in continuing for higher education.

[13] Very few (N=37) youth in the within-family analysis had birth governorates different from their other family members. Additionally, some variation may be due to the lack of birth governorate data for 10-14 year olds requiring the use of current governorate. Therefore, birth governorate variables were not used in this model.

Figure 4 Within-Family Kaplan-Meier Survival Function



Although there are very limited observable differences within the family, it is important to fully control for differences in children. Therefore, within-family estimates are also re-estimated using hazard models (Table 8). Because of a limited sample of families with two individuals who went through secondary and varied in ECCE, hazard ratios are only estimated through the effect in continuing on after preparatory (at which point the impact was generally observed to fade in the general population). These changes in hazard ratios will nonetheless affect the entire course of education.

The within-family ECCE coefficients are jointly significant, and always reduce the hazard of leaving school, but are not always significant for every individual year. If insignificant coefficients are due to small sample and multi-collinearity, then the general trend is for ECCE to have the greatest impact early, and then for the impact to fade out somewhat during preparatory, but have a strong impact in increasing the chances of an individual continuing on to secondary from the end of preparatory. The impact at the end of primary and end of preparatory is particularly important in practical terms, as the

baseline hazard at that time is much greater. It is also noteworthy that there is a sizeable decrease in the hazard of school exit simply on the basis of gender; females are less likely to leave school at any given time than males, contingent on entry, within families. This result was not found in the entire ever-entered sample hazard model.

Table 8 Within-Family Hazard Model

ECCE	Hazard ratio	Standard Error
End at Year 1	0.090*	(0.107)
End at Year 2	0.742	(0.478)
End at Year 3	0.259**	(0.129)
End at Year 4	0.241**	(0.121)
End at Year 5 (Attain Primary	0.458**	(0.131)
End at Year 6	0.428	(0.214)
End at Year 7	0.466	(0.253)
End at Year 8 (Attain Preparatory)	0.401*	(0.150)
Female	0.676**	(0.094)
Individuals Observed	2,478	

* p<0.05, ** p<0.01, *** p<0.001
Coefficients are hazard ratios
Standard Errors can be used to test whether hazard ratios are significantly different from 1
Exact Partial method used for ties
Reference Case: male, Birth Cohort (1979 reference) also included but not shown

The differences in educational attainment achieved if the population had entirely not had ECCE or entirely had ECCE remain quite striking (Table 9). A much greater proportion of the population completes compulsory education, and goes on for secondary education with ECCE. Adding ECCE using the within-family estimates, nearly half of the population (48.0%) attains a secondary education, an 8.1% increase. There is also an important increase in university attainment, rising from 23.3% without ECCE to 27.8% with ECCE. These results emphasize a substantial increase in secondary, in contrast with the entire ever-entered sample, which projected a much larger tertiary outcome. The modest increase in tertiary outcomes and substantial increase in secondary outcomes seems both more practically plausible, in terms of the education system, and much more believable for having corrected for selection using within-family estimates. The resulting difference in total years of schooling is 1.09, substantially less than the 1.57 estimated

using the full ever-entered sample hazard model. Educational attainment calculations for the within-family model can be found in more detail in the appendix, Table 24 and Table 25.

Table 9 Educational Attainment Based on Within-Family Hazard Model

Year	% Attain without ECCE	% Attain with ECCE	% Change due to ECCE
End at Year 1	1.2	0.1	-1.1
End at Year 2	1.0	0.7	-0.2
End at Year 3	1.7	0.5	-1.3
End at Year 4	3.2	0.8	-2.4
End at Year 5 (Attain Primary	6.2	3.0	-3.2
End at Year 6	2.3	1.1	-1.2
End at Year 7	4.1	2.1	-2.0
End at Year 8 (Attain Preparatory)	6.4	2.9	-3.5
End at Year 9	0.6	0.7	0.1
End at Year 10	0.8	1.0	0.2
End at Year 11 (Attain Secondary)	39.9	48.0	8.1
End at Year 12	0.3	0.4	0.1
End at Year 13	5.0	6.0	1.0
End at Year 14	0.1	0.2	0.0
End at Year 15 (Attain University)	23.2	27.8	4.7
End at Year 16	2.4	2.8	0.5
End at Year 17	0.2	0.3	0.0
End at Year 18	0.2	0.3	0.0
End at Year 19	1.1	1.4	0.2
Total	99.9	100.1	0.0

It is noteworthy that with the within-family hazard model, ECCE remains significant both when older and younger siblings are treated, and when comparing between two males. The results comparing between two females within a family are insignificant, but continue to suffer from a small sample. There are not significant interactions between wealth or gender and ECCE in the within-family models.[14]

[14] Sub-groups and interactions estimated with ECCE as a proportional hazard due to the excessive variables necessary to compute as time variant.

ECCE has shown a consistently positive and statistically significant effect on the years of schooling, across ordinary least squares, propensity score estimation, and within-family estimation methods. The size of the effect remains unclear. The propensity score matching estimates are quite similar to the OLS estimates restricted to 18-29 year olds, but comparing the hazard models of the within-family estimates to those of the ever entered sample, the resulting estimates are much lower, suggesting persistent selection on unobservables is a serious problem. Given the evidence for selection on unobservables, the within-family estimates are the most believable.

6.3 General vs. Technical Secondary

Access to higher education has an important impact on youth's access to government jobs and the employment security they bring. Access to higher education is effectively determined at the end of preparatory education, when youth are tracked into either technical (essentially terminal) secondary or general secondary (essentially a direct track to university). Especially in determining economic opportunity, ECCE's impact on accessing general secondary is quite important. While the educational attainment estimates indicated additional higher education with ECCE, this can also be estimated by the tracking of individuals into general and technical secondary.

Table 10 shows the relationship between ECCE and general secondary using a logit model. For those who enter secondary, 40.2% do so in the general secondary track. For the reference individual, ECCE significantly increases the probability of attending general secondary by 7.2 percentage points, a substantial change. There is not, however, any interaction between ECCE, wealth, and the probability of tracking into general secondary.[15]

[15] Wealth interactions were not jointly significant at the $p<.05$ level.

Table 10 General Secondary--Logit

	General Secondary
Percent of all Secondary Attendees attended General	40.2%
ECCE	0.072***
	(0.015)
Pseudo R-squared	0.211
N	7196

* p<0.05, ** p<0.01, *** p<0.001
Coefficients are marginal effects
Standard Errors in Parentheses
Additional regressors include: gender, parents' education, wealth, residence, birth cohort
Reference Case: male, father illiterate, mother illiterate, lowest wealth quintile, resident of urban governorates, born 1979.

The propensity score matching model is generally consistent with the findings of the logit model, suggesting a 9.9 percentage point increase in the probability of attending general secondary as opposed to technical secondary (Table 11). Table 12 examines general secondary using within-family comparisons for families with variation in ECCE and two youth who entered secondary. ECCE increases general secondary even within a family, in fact by 7.8 percentage points, slightly more than even the logit ever-entered estimate. ECCE consistently and substantially affects youth's access to higher education, and the employment impact it entails.

Table 11 General Secondary--Propensity Score Matching

Outcome	General v. Technical Secondary
ATT	0.0988***
Bootstrapped Standard Error	0.0217
N	7,169

* p<0.05, ** p<0.01, *** p<0.001
Matching variables include: gender, parents' education, wealth, residence, birth cohort, birth governorate, number of sons or daughters if respondent son or daughter

Table 12 General Secondary--Within-Family

	General v. Technical Secondary
ECCE	0.078*
	(0.032)
R-squared within	0.053
R-squared between	0.005
R-squared overall	0.021
N	790

* p<0.05, ** p<0.01, *** p<0.001
Standard Errors in Parentheses, corrected for household clusters
Regressors included for gender and birth cohort
Reference Case: male, born 1979
Estimated using OLS

6.4 Repetition

Grade repetition is pervasive in the Egyptian educational system (Population Council, 2010). Repetition is both expensive and frequently harmful to educational outcomes. Table 13 presents the logit models for grade repetition, and any benefit of ECCE. Data was collected only on whether an individual repeated during a level. Given the possibility of multiple repeats within a level, which is likely given strong evidence on multiple repeats across levels, ECCE impacts will be an underestimate of potential impacts.

At the primary level, the repetition rate is 5.83% (5.83% of people repeat at least once), and at the preparatory level, it is 11.24%. ECCE has a significant effect on primary and preparatory repetition, with a larger effect on preparatory repetition, reducing probability by 10.1 percentage points for the reference case. Because the reference case is particularly disadvantaged, he is likely to face higher than the average population repetition rates, but it is noteworthy that if the effect for the reference case were to be the same across backgrounds, primary repetition would be reduced to zero and preparatory repetition would drop from 11.24% to 1.23%. At the primary and preparatory levels, there was not significant evidence for a differential ECCE effect on repetition by wealth (results

not shown).[16] ECCE does not appear to impact any secondary or university repetition, further evidence for a substantial effect that dissipates by entry into secondary.

Table 13 Repetition--Logit

	Primary Repetition	Preparatory Repetition	Technical Secondary Repeat	General Secondary Repeat	University Repeat
Repetition amongst all level attendees	5.83%	11.24%	6.57%	5.21%	8.99%
ECCE	-0.069***	-0.101***	-0.005	0.003	-0.01
	(0.021)	(0.022)	(0.012)	(0.007)	(0.024)
Pseudo R-squared	0.1	0.106	0.11	0.138	0.124
N	13734	10444	4293	2728	2347

* p<0.05, ** p<0.01, *** p<0.001
Coefficients are marginal effects
Standard Errors in parentheses
Additional regressors include: gender, parents' education, wealth, residence, birth cohort
Reference Case: male, father illiterate, mother illiterate, lowest wealth quintile, resident of urban governorates, born 1979.

Table 14, showing the repetition using propensity score matching, is likewise consistent with the other estimates in suggesting a significant decrease in repetition at the preparatory and primary levels, but not the secondary or university level. The propensity score estimates are smaller than the logit marginal effects, again suggesting some selection issues, but remain significant and meaningful at the primary and preparatory level.

[16] Wealth interactions with ECCE included in estimating primary or preparatory repetition were not jointly significant at the p<.05 level. Wealth interactions were not tested for secondary level due to diminishing sample sizes of both repeaters and individuals attending from lower wealth quintiles.

Table 14 Repetition--Propensity Score Matching

Outcome	Primary Repeat[17]	Preparatory Repeat	Technical Secondary Repeat	General Secondary Repeat[18]
ATT	-0.0114*	-0.0357**	-0.00501	-0.00631
Bootstrapped SE	.00493	0.0109	.0140	.0166
N	13, 812	10,550	4,253	2,833

* p<0.05, ** p<0.01, *** p<0.001
Matching variables include: gender, parents' education, wealth, residence, birth cohort, birth governorate, number of sons or daughters if respondent son or daughter

The within-family estimates for repetition are consistent with the logit models in being significant for primary and preparatory but not secondary or university (Table 15), but are much closer to the propensity score estimates in the magnitude of their effect. In the within-family estimates, ECCE decreases primary repetition probability 3.4 percentage points and preparatory repetition 3.7 percentage points.

Table 15 Repetition—Within-Family

	Primary Repetition	Preparatory Repetition
ECCE	-0.034***	-0.037*
	(0.010)	(0.015)
R-squared within	0.019	0.066
R-squared between	0.004	0.015
R-squared overall	0.01	0.038
N	2482	1657

* p<0.05, ** p<0.01, *** p<0.001
Regressors included for gender and birth cohort
Reference Case: male, born 1979
Standard Errors in parentheses, corrected for household clusters
Estimated with OLS

6.5 Test Scores

Youth in Egypt test out of the different levels of school. Although imperfect, these tests can serve as a measure of improved cognitive/learning outcomes. These test scores also determine whether a youth passes and graduates from a level, as well as determining access to secondary and higher education types. Scores are out of one hundred and are

[17] Governorate 24 is not balanced in block 23
[18] Governorate 9 is not balanced in block 3

recalled; some youth do not have scores or do not recall scores. Those youth that do recall scores have often rounded to the nearest whole point. However, if recall or rounding biases result, it is likely that the biases are relatively similarly for ECCE and non-ECCE attendees. An ECCE impact can therefore still be estimated.

In the OLS regressions (Table 16), ECCE attendance significantly increases primary test scores by 3.5 points, and preparatory scores by 3.1 points. Interactions between wealth and ECCE are not jointly significant (at $p<.05$) for either primary or preparatory test scores. Although jointly insignificant, a comparison of the coefficients on the interactions between primary and preparatory scores suggests a pattern that is quite interesting. At the primary level, ECCE-wealth interactions suggest an insignificant but additional benefit to disadvantaged children; at the preparatory level, ECCE-wealth interactions suggest an insignificant but additional benefit to *advantaged* children, to the point that the coefficient on ECCE itself is substantially diminished and insignificant. This suggests that ECCE may confer extra cognitive gains to the disadvantaged at the primary level that substantially fade out. If disadvantaged youth experience poorer quality schools, this may account for the fade out of ECCE effects (Currie & Thomas, 1995).

Additionally, specific structures of the Egyptian school system, such as the prevalence of expensive private tutoring (Population Council, 2010), may make it difficult for poorer students to leverage any ECCE advantage into improved test scores. The preparatory exam, which determines secondary tracking, is extremely high-stakes. Almost two-thirds of preparatory students receive tutoring, but poorer students are less likely to receive tutoring, and those that do have lower expenditures (Population Council, 2010).

Scores in secondary do not show a statistically significant difference based on ECCE, although they are consistently positive. This again points to a positive but dissipating effect. Scores at the post-secondary and university level were collected, but because they are not comparable across degree types, estimates of ECCE impact are not attempted.

To understand the relative magnitude of the effect, the means and standard deviations of test scores are also included. The impact of ECCE on primary and preparatory is around a quarter of a standard deviation. This is the equivalent of moving someone who is at the 50th percentile to the 59th percentile, an important change.

Table 16 Test Scores—Means and OLS

	Primary Score	Preparatory Score	Technical Secondary Score	General Secondary Score
Mean Score	80.599	74.303	69.730	79.557
Standard Deviation	(11.847)	(12.961)	(9.093)	(11.094)
ECCE	3.510***	3.081***	0.404	0.982
	(0.435)	(0.464)	(0.448)	(0.612)
R-squared	0.218	0.249	0.146	0.135
N	4555	4462	2368	2031

* p<0.05, ** p<0.01, *** p<0.001
Standard Errors in parentheses
Additional regressors include: gender, parents' education, wealth, residence, birth cohort
Reference Case: male, father illiterate, mother illiterate, lowest wealth quintile, urban, born in Cairo, born 1979.

The propensity score matching estimates (Table 17) generally confirm ECCE impacts at the primary and preparatory levels, increasing primary scores 3.2 points and preparatory scores 2.3 points. These estimates are again lower than those using OLS, suggesting observable selection into ECCE also matters when estimating its impact on test scores.

Table 17 Test Scores--Propensity Score Matching

Outcome	Primary Score[19]	Preparatory Score[20]	Technical Secondary Score[21]	General Secondary Score[22]
ATT	3.246***	2.271**	-0.316	1.252
Bootstrap SE	0.672	.752	.693	.911
N	4,553	4,450	2,281	2,013

* p<0.05, ** p<0.01, *** p<0.001
Matching variables include gender, parents' education, wealth, residence, birth cohort, birth governorate, number of sons or daughters if respondent son or daughter

Within-family estimates (Table 18) indicate a somewhat smaller impact than even propensity score matching, suggesting unobservable selection biases the other estimates of ECCE. The within-family estimates indicate ECCE increases primary scores 1.9 points, and preparatory scores (a marginally insignificant) 2.2 points. There is a relatively small sample of youth within families both recollecting scores and varying in ECCE attendance, which might be the reason for preparatory score difference insignificance.

Table 18 Test Scores--Within-Family

	Primary Score	Preparatory Score
ECCE	1.932*	2.200
	(0.977)	(1.223)
R-squared within	0.088	0.135
R-squared between	0.01	0.037
R-squared overall	0.036	0.071
N	480	387

* p<0.05, ** p<0.01, *** p<0.001
Regressors included for gender and birth cohort
Reference Case: male, born 1979
Standard Errors in parentheses, corrected for household clusters

Overall, ECCE has been shown across several methodologies to consistently improve a number of educational outcomes, including years of school, primary and preparatory

[19] Father Post-Secondary Institute Educated not balanced in block 3. Highest Wealth Quintile not balanced in block 3. Governorate 11 not balanced in block 23, governorate 10 is not balanced in block 25, cohort 10 is not balanced in block 25
[20] Mother general secondary educated not balanced in block 4, cohort 4 not balanced in block 5, governorate 10 not balanced in block 24
[21] Governorate 10 is not balanced in block 15
[22] Cohort 3 is not balanced in block 5

repetition and drop out, tracking into general secondary, and primary and preparatory test scores. Comparing the regressions without selection corrections to propensity score matching and within-family estimates indicates substantial selection into ECCE on both observable and unobservable characteristics. The within-family estimates are therefore considered the best estimate of ECCE's effect as they correct for unobserved family characteristics and observable individual characteristics. Consequently, the within-family estimates are used in the cost-benefit analysis.

7. Cost-Benefit Analysis

The Egyptian government is making a substantial investment in early childhood education through an expansion in access to kindergarten. The cost to the government of providing kindergarten to just 30% of children by 2015 is estimated to be $103 million (UNDP, 2008). As well as substantial Egyptian investment, the World Bank, Canadian International Development Agency, and World Food Program have granted ECCE loans and grants in the amount of $20 million, $14.5 million, and $16.7 million, respectively (Arab Republic of Egypt & International Bank for Reconstruction and Development, 2005). The World Bank's involvement is in part predicated on a cost-benefit analysis indicating that ECCE's educational benefits alone would exceed the costs (Janssens, Van Der Gaag, & Tanaka, 2001). Their analysis, however, was based on international evidence on the impact of ECCE, not on evidence from the Egyptian context.

The analysis contained herein provides an excellent opportunity to reassess the costs and benefits of ECCE within the Egyptian context. While this research has consistently shown substantial and significant improvements in a number of educational outcomes, whether the benefits of these educational improvements outweigh their costs is a question I will now investigate.

7.1 Costs

The costs of ECCE in Egypt are highly variable depending on both the data source and the quality of the ECCE. Annual costs range from 25 Egyptian Pounds (LE) (UNDP, 2008) for extremely poor quality nursery to 800 LE for extremely high quality programs

(Neugebaur, 2007). Private ECCE fees for quality ECCE range from 200-400 LE (Neugebaur, 2007). The World Bank's CBA includes data on average Kindergarten costs from 1994/95-1999/2000 at 385 LE annually (Janssens, Van Der Gaag, & Tanaka, 2001). This number is close to UNESCO estimates (417 LE, 2007), and also has the closest ties to the costs of an expansion policy, as it includes classroom expansion (Janssens, Van Der Gaag, & Tanaka, 2001). It is therefore the ECCE cost used in this cost-benefit analysis. It is assumed that children attend 1.5 years of preschool. No data is available on actual time spent in ECCE in the SYPE or elsewhere, but Kindergarten programs are one or two years (UNDP, 2008), and 1.5 years is the average of these two possibilities.

In addition to ECCE costs, if ECCE improves educational outcomes, it will generate additional costs for additional years of schooling. There is also the opportunity cost of lost employment or leisure during any additional years of schooling. Opportunity cost in terms of lost wages is counted only for individuals 15 and older, 15 being the legal age of employment (Population Council, 2010). Child labor does not have standing in this analysis, nor is it a particularly large problem. Among 10-14 year olds, only 3.0% report being currently employed (Population Council, 2010). Parents do have standing, and may also experience time costs in facilitating their children's ECCE attendance, as well as associated costs, such as for transit to take children to an ECCE facility. However, these costs are unknown and are therefore omitted.

Schooling costs are evaluated based on the costs per year at a particular level of schooling based on the total of both public and private costs from the Ministry of Education and Institute of National Planning (Janssens, Van Der Gaag, & Tanaka, 2001). Opportunity costs are evaluated based on average wages for urban males in Egypt as of 2006 (Salehi-Isfahani, Tulani, & Assaad, 2009).

7.2 Benefits

The educational benefits of ECCE are based on this paper's estimates and translated into increased wages due to increased educational attainment. It is important to keep in mind that these educational benefits are unlikely to be the only benefits from ECCE. ECCE

also has been shown in other settings to generate health and nutrition and behavioral improvements (Nores & Barnett, 2010), reductions in crime, reductions in special education, and reductions in reliance on social/welfare services (Temple & Reynolds, 2007). Educational effects can spillover into the next generation; parental, especially maternal education matters for both maternal and child health (Psacharopoulos & Patrinos, 2008). ECCE can also act as daycare, providing a benefit to parents in that respect. Female labor force participation is quite low in Egypt. Evidence from studies of Arab mothers in Israel (Schlosser, 2005) and studies in Turkey (World Bank, 2010) indicates that ECCE access can increase mothers' labor force participation to a substantial extent. The benefits of these effects are not included, and this cost-benefit analysis can therefore be considered an extremely conservative estimate of ECCE benefits.

Although a number of different educational impacts have been examined, the CBA focuses primarily on the cost-savings from reduced repetition and the increased earnings resulting from additional schooling. Test scores are not readily translatable into increased earnings or monetary terms in the Egyptian context, and including both test scores and educational attainment could lead to double counting. Repetition was significantly reduced in both primary and preparatory years; this is evaluated at the percent of the population attending these levels. Returns to additional schooling are evaluated at the same average wages for urban males[23] in Egypt as of 2006 (Salehi-Isfahani, Tulani, & Assaad, 2009) as were used for calculating the opportunity costs of additional schooling.

In evaluating the costs and benefits of ECCE the within-family estimates, being the most plausible, are used. The focus is on within-family estimates for repetition and the within-family estimates from the hazard model for changes in schooling attainment. The cost-benefit analysis is solely for children who ever enter school; whether or not causally so, the ECCE attending population is essentially a school-entry population. Table 19 presents the elements and assumptions that enter into the cost-benefit calculations. The

[23] These results are acknowledged to be not necessarily generalizable onto the female or rural population. However, they represent at least the potential returns in the absence of gender discrimination and with the mobility potential of migration.

costs of ECCE itself are fairly substantial, but the greatest cost is the cost of additional schooling, and the opportunity cost of lost work or leisure. The benefits are primarily the returns to education, which are diffuse and spread over the adult lifetime. These wage benefits are based on estimated Egyptian wage equations (Salehi-Isfahani, Tulani, & Assaad, 2009) and hours worked estimates of 46.5 hours per week (Abulata, 2009), both based on the 2006 Egyptian Labor Market Panel Survey.

Table 19 CBA Elements

Age of cost or benefit	Element	Effect	Undiscounted Cost (-) or Benefit (+) (in 2000 LE)	Discounted Cost (-) or Benefit (+) (in 2000 LE)	Source
5	ECCE	0.5 yr	-192.50	-192.50	using 1994/95-1999/00 MOE unit costs
6	ECCE	1 yr	-385.00	-373.79	using 1994/95-1999/00 MOE unit costs
9	Decreased Primary repetition	3.40%	+25.98	+23.08	total costs by school level and % attending
13	Decreased Preparatory Repetition	3.47%	+33.43	+26.93	total costs by school level and % attending
8-26	Additional Schooling	1.09 yrs	-2,297.70	-1,613.52	total costs by school level and additional years
15-21	Opportunity Cost		-450.81	-313.49	opportunity cost of lost wages > increased wages due to additional years of schooling (work legal at age 15)
22-59	Returns to Schooling	Linear	+10,714.51	+3,225.29	higher wages*additional years with 46.5 hours/week of work
60	Retirement				retirement (end of returns)
	Discount Rate	3%	NPV=	781.45	
			B/C ratio=	1.31	
			IRR=	3.98%	

The costs and benefits are evaluated with a 3% discount rate in Table 19. A 3% discount rate is typical of other cost-benefit analyses looking at ECCE (Heckman, Moon, Pinto, Savelyev, & Yavitz, 2010; Temple & Reynolds, 2007) and is recommended by *The International Handbook of Educational Evaluation* (Levin & McEwan, 2003). This flow of lifetime costs and benefits using the linear wage equation is graphed in Figure 5. In the

appendix, Table 26 provides a more detailed expansion of the wages on an annual basis. Additionally, Table 27 presents an example of the calculation of wages, costs, and benefits using the linear wage equation.

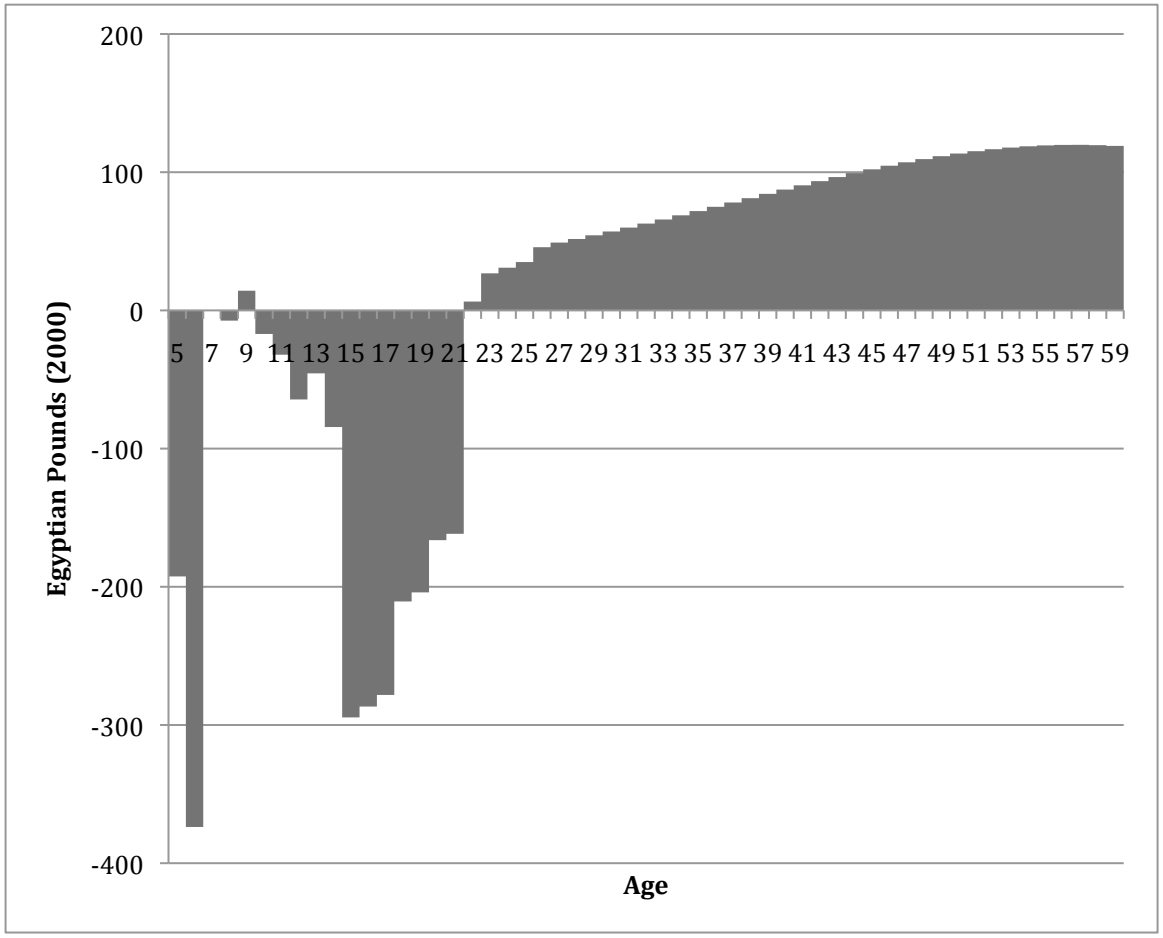
The reference year for the analysis is age 5, the age at the end of the first year of ECCE. The analysis presents the costs and benefits on an average individual basis. The estimated half year of ECCE costs 192.5 LE (2000 LE), and the full year is 385 LE or 373.79 when discounted. Decreased primary and preparatory repetition is placed at the midpoint for each level, age 9 for primary, and age 13 for preparatory. It is evaluated by the costs for that level, the percent of youth attending that level with ECCE, and the percentage point reduction in repetition. Decreased repetition contributes a relatively modest benefit, around 25 LE at each level once discounted.

Additional schooling is by far the largest cost generated be ECCE. Evaluated at the costs per level and the additional proportion of the population attending each year, additional schooling from ages 8-26 has a discounted cost of 1,613.52 LE (in 2000 LE). The opportunity cost of lost wages or leisure due to additional time spent in school is also substantial, 313.49 2000 LE experienced between age 15, the legal working age, and age 21, after which age the average individual would experience higher wages due to increased education, and despite diminished years of experience in the work force. Higher wages are evaluated from age 22-59, and are the main benefit of ECCE. They are 10,714.59 2000 LE when undiscounted, but only 3,225.29 once discounted. At age 60 an individual is assumed to have retired and to experience no more benefits.

As Figure 5 shows, using the calculations from Table 19, ECCE represents substantial costs up front and during school years. However, it also generates sizeable returns, in increased earnings, during an individual's working years. The net present value using the linear wage equation is 781.45 2000 LE. The benefit/cost ratio for the linear wage equation is in fact 1.31. The internal rate of return, the interest rate at which costs would equal benefits, is 3.98%. All these different measures indicate the educational

impacts of ECCE in terms of wages alone substantially exceed the costs of ECCE and additional education.

Figure 5 Discounted Lifetime Costs and Benefits: Linear Wage Equation



While the World Bank had estimated educational benefit-cost ratios, focused on simulations of the same benefits of reduced repetition and increased years of schooling, and found cost benefit ratios averaging 2.3 (Janssens, Van Der Gaag, & Tanaka, 2001), actual evidence from Egypt suggests a lower, but still worthwhile, ratio. Nor does the assertion that ratios run as high as 5.8 with at-risk groups (Janssens, Van Der Gaag, & Tanaka, 2001) find much support; the evidence for an extra benefit for disadvantaged groups is tentative at best, and not of such a large magnitude.

8. Sensitivity Analysis

8.1 Sensitivity of Cost-Benefit Analysis

The finding that the educational benefits of ECCE exceed its costs and the magnitude of returns are sensitive to a number of dimensions of the cost-benefit analysis. The estimates of the ultimate benefits and costs are also sensitive to assumptions around the returns to education. In the Egyptian context, there are several different plausible specifications for returns to education (Salehi-Isfahani, Tulani, & Assaad, 2009). Under the traditional Mincer assumption of constant linear returns to education, used in the linear scenario, returns in Egypt are estimated around 5% (Salehi-Isfahani, Tulani, & Assaad, 2009). This is actually quite low compared to other international estimates which indicate an ~10% average rate of return to education (Psacharopouls & Patrinos, 2004). However, evidence from Egypt actually shows substantial non-linearities in the returns to education, due to inflexible labor markets focused on credentials rather than productivity. Both quadratic and degree-based estimates of the returns to education are offered as alternatives (Salehi-Isfahani, Tulani, & Assaad, 2009).

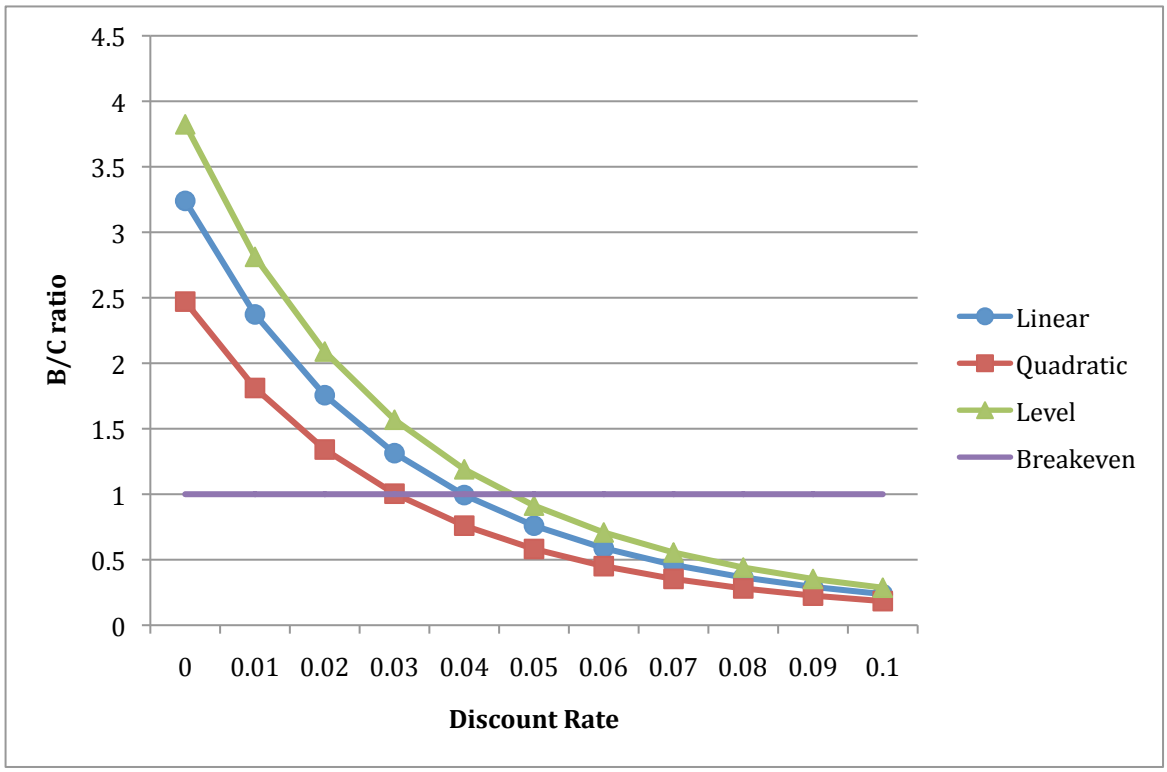
Table 20 presents, as well as the linear wage equation scenario, quadratic and level wage equation scenarios and their costs and benefits. The scenarios consistently use the same within-family estimates and other assumptions. Under all the different wage assumptions, benefits do exceed costs, but to a varying degree. The benefit-cost ratio based on quadratic wage assumptions is almost exactly 1 at a 3% discount rate (the internal rate of return being 3.01%). If quadratic wage assumptions are correct, the net present value of the program would be 9.83 (in 2000 LE). The linear wage equation has more favorable findings, a 1.31 benefit-cost ratio, a 3.98% IRR, and a net present value of 781.45 (in 2000 LE). The 'level' wage equation, where only the attainment of an additional level of schooling matters (and not additional years), shows the most favorable returns; a 1.57 benefit/cost ratio, an IRR of 4.65%, and a net present value of 1403.88 (in 2000 LE). All indicate that ECCE is a worthwhile investment, but one for which the exact actual return is somewhat uncertain.

Table 20 Costs and Benefits under different wage assumptions

	Linear Wages	Quadratic Wages	Level Wages
Benefit/Cost Ratio (3% Discount Rate)	1.31	1.00	1.57
IRR	3.98%	3.01%	4.65%
NPV (2000 LE)	781.45	9.83	1403.88

Because the majority of costs are early in a youth's life, and the majority of benefits come in later, working years, the B/C ratio is particularly sensitive to the discount rate used. Figure 6 presents the sensitivity of this ratio to the discount rate for the linear, quadratic, and level wage scenarios. All break even at discount rates 3% and less. Each crosses the break-even point at its IRR. As discount rates go lower than 3%, the different wage equations all show substantially higher returns. For rates 5% and beyond, none is a good investment.

Figure 6 Sensitivity of B/C ratio to discount rate



Several additional labor market issues may make even this range of benefits overly optimistic. The Egyptian labor market also suffers substantially from low female labor force

participation and high unemployment, especially youth unemployment (Population Council, 2010). The estimates presented here assume everyone receives the benefit of returns to education regardless of their labor market status. Those who remain outside of the labor force are assumed to have valued their leisure at the market wage. The same returns can therefore be used for the employed and those out of the labor force. As to unemployment, high unemployment is primarily an educated phenomenon (Population Council, 2010), which indicates a high reservation wage (value for leisure) relative to easily attainable jobs, a form of voluntary unemployment. If these assumptions are violated and unemployment is involuntary, ECCE might actually have lower returns. However, with these assumptions the same returns to education can be evaluated for the entire youth population, despite unemployment and low labor force participation.

Although these labor market issues could reduce the benefits of ECCE, they could also effectively reduce the opportunity cost of additional education. If the alternative is involuntary unemployment, the opportunity costs of an additional year of schooling ought to be either substantially decreased or eliminated entirely. Additionally, decreased repetition could not only reduce schooling costs, but also reduce opportunity costs, but is not included because the exact time of repetition is unknown. Another labor market issue that may be causing the presented estimates to be lower than actual returns is retirement. Benefits are estimated only through the end of age 59; Egyptians retire at 60 (El Ghonemy, 2003). However, if retirement is a choice rather than forced, leisure time in retirement, potentially until death, is valued at the market wage and should also be considered a benefit.

8.2 Sensitivity of Propensity Score Matching

The analysis using propensity score matching can be sensitive to the form of the match. Table 21 presents the sensitivity of several outcomes to the form of the matching used. While nearest neighbor matching was used in the majority of the analysis, alternative estimates based on the 5 nearest neighbors, kernel (Epanechnikov), a radius of .001 and a radius of .0001 are also presented.

Looking at the years of school outcome for all respondents, the nearest neighbor estimate is the lowest, at .970 additional years from ECCE. Although the other estimates are slightly higher, all are within two standard errors of the original nearest neighbor estimate. A similar case occurs for the probability of general versus technical secondary. While the nearest neighbor matching yields the lowest estimate, a 9.8 percentage point increase in general versus technical secondary, all the other estimates except the .0001 caliper radius are within two standard errors of the nearest neighbor estimate. Across the board the radius .0001 caliper estimate tends to be substantially higher than the other estimates.

In the case of primary test scores, the primary method, nearest neighbor matching, yields a 3.246-point increase from ECCE on the hundred-point test. This estimate is higher than all except the radius .0001-caliper estimate, but all the other estimates are within a single bootstrapped standard error of the original nearest neighbor estimate. While different methods of matching the propensity scores do yield different estimates of ECCE's impact, the differences are neither large nor would a different method substantially alter the key findings of the analysis.

Table 21 Propensity Score Matching Sensitivity Analysis

	Years of School, ALL[24]	General vs. Technical Secondary	Primary Test Score[25]
Nearest Neighbor	.970***	0.0988***	3.246***
	(0.143)	(0.0236)	(0.593)
Nearest Neighbor (5)	1.051***	0.0991***	2.730***
	(0.113)	(0.0184)	(0.578)
Kernel (Epanechnikov)	1.04***	0.102***	2.923***
	(0.103)	(0.0183)	(0.575)
Radius (.001 caliper)	1.022***	0.106***	2.978***
	(0.141)	(0.0188)	(0.531)
Radius (.0001 caliper)	1.211***	0.124***	3.328**
	(0.115)	(0.025)	(1.026)
N	14,959	7,169	4,552

* p<0.05, ** p<0.01, *** p<0.001
Coefficients are ECCE impact estimate. Bootstrapped standard errors in parentheses.

[24] Governorate 18 is not balanced in block 1, cohort 9 is not balanced in block 9, governorate 24 is not balanced in block 24

[25] Father post-secondary institute not balanced in block 3, highest wealth quintile not balanced in block 3, governorate 11 is not balanced in block 23, governorate 10 not balanced in block 25, cohort 10 is not balanced in block 25

Matching variables include: gender, parents' education, wealth, residence, birth cohort, birth governorate, number of sons or daughters if respondent son or daughter

9. Discussion

9.1 Policy Implications

The Egyptian government is pursuing a major investment in early childhood education. This analysis has provided substantial evidence for meaningful ECCE effects across an important array of educational outcomes in the context of Egypt and benefits that exceed ECCE costs. ECCE is a worthwhile investment for the Egyptian government. The analysis of benefits has focused solely on educational outcomes and private wage gains mediated through additional schooling. Increased wages might result from ECCE even for those of the same educational level. Additionally, international evidence suggests there may be health, nutrition and behavioral improvements (Nores & Barnett, 2010), reductions in crime, reductions in special education, and reductions in reliance on social services (Temple & Reynolds, 2007), and a female labor force participation (Schlosser, 2005) or daycare benefit (World Bank, 2010).

While only the private benefits in terms of higher lifetime wages mediated through increased educational attainment were included in the benefit-cost analysis, the beneficial effect of ECCE on nonwage outcomes is likely to be substantial. One recent longitudinal study of preschool in the U.S. included additional benefits such as reductions in the costs of crime and poverty assistance programs, as well as some dimensions of improved health in its cost-benefit analysis. The study found that the ratio of total benefits to private wage benefits was greater than 4 to 1 (Reynolds et al. 2011). There are also likely additional benefits that were beyond the scope of even the broader U.S. study. If the same pattern holds in Egypt, total benefits would be at least four times this paper's estimate. Although the magnitude of these additional benefits in Egypt is uncertain, evidence suggests these additional impacts drive the benefits to the point where ECCE is not just a good, but indeed a superlative investment. Research into these effects in the context of Egypt would be worthwhile, although difficult given currently available data.

It is also worth considering why, in an Egyptian context, ECCE is yielding a somewhat lower return in terms of private wages alone than simulations (Janssens, Van Der Gaag, & Tanaka, 2001) and international evidence had suggested. Quality may be an issue with ECCE. Many ECCE programs, especially nursery schools, are of low quality and lack a strong educational component (UNDP, 2008). Much of the ECCE effect observed in this study is from children who attended nursery schools, and not Kindergartens. Only around 10% of youth were enrolled in Kindergarten between 1994 and 2000, corresponding to the younger end of the SYPE (Janssens, Van Der Gaag, & Tanaka, 2001). Yet ECCE is reported at rates above 40%, suggesting that one-quarter of youth are attending Kindergarten, and the rest nursery schools. Around half of the Kindergartens are public and half private as of 2000, but in earlier years Kindergarten provision was primarily private, a mix of NGO and for-profit providers (Janssens, Van Der Gaag, & Tanaka, 2001). Nursery provision is around one-third public two-thirds private, NGOs and for-profit (UNDP, 2008). Expansion in ECCE, although focusing on Kindergarten, is expected to continue this more or less equal private/public division. The diversity of organizations, especially private nurseries of unknown quality providing ECCE may contribute to the modest returns. There may be costless or low cost ways of improving ECCE in both locations, but especially in nurseries, through improved pedagogies and curricula. There is a demonstrated need for improved training for ECCE teachers and improved coordination within the Egyptian government (World Bank, 2002). Given the substantial proportion of ECCE analyzed herein that is nursery based, if Kindergartens are higher quality and have greater impacts, this analysis could be a very conservative estimate of the impact of a Kindergarten expansion.

The quality of the educational system may also be dampening the effect of ECCE. The benefits of pre-schooling have been shown in other contexts to be substantially diminished when not complemented by quality schooling (Currie & Thomas, 1995). In the context of Egypt, a number of school quality problems, such as multiple shifts and high ratios of temporary teachers, have been shown to increase the probability of drop out (Lloyd, El Tawila, Clark, & Mensch, 2003). The expansion and improvement of ECCE coupled with improvements in later formal school quality could enhance the effects of both policies.

Both within the educational system and within the labor market, there are substantial deviations from meritocracy. Within the educational system, access to education, especially higher education, is primarily determined by background characteristics rather than innate intelligence. Even in comparing youth with the same scores on entry exams for the general secondary track, wealth was a substantial determinant of access to higher education (Assaad & Krafft, 2010). In the labor market, 42% of youth identified connections (wasta) as more important than skills in obtaining a job (Population Council, 2010). The labor market's focus on credentials (degrees) rather than productivity, and the concomitant low productivity of education (Salehi-Isfahani, Tulani, & Assaad, 2009) also dilutes the possible impacts of ECCE. For economic efficiency, wages ought to reflect the marginal product of labor. If, as the evidence suggests, wages do not reflect the marginal product of labor, productivity gains from ECCE will not be realized as increased wages. Improvements in the connections between merit, education, and labor force outcomes have the potential to increase the returns to ECCE.

Such improvements might also increase the benefit-cost ratios of ECCE for disadvantaged groups, if cognitive gains from ECCE could be better realized in educational and employment gains. This analysis has consistently indicated that there are not significantly different ECCE impacts by wealth; economically disadvantaged youth do not experience additional ECCE benefits. Targeting ECCE to disadvantaged children is therefore not justified in terms of a greater return. Equity considerations, however, could justify targeting disadvantaged children for ECCE interventions. ECCE could compensate for otherwise poor childhood environments. Targeting would also help to ensure that the government would be funding quality ECCE primarily for children who would not otherwise have gone to ECCE or quality ECCE, rather than the public funding ECCE for advantaged children whose parents would have purchased quality ECCE on the private market.

Given that there is a substantial private market and demand for ECCE in Egypt, why is additional public provision important? As well as the substantial private benefits, some benefits, such as reduced crime and reduced reliance on social services (Temple &

Reynolds, 2007), are public benefits, and the private market alone would under-provide ECCE. There are also substantial informational and financing problems that could lead to a sub-optimal quantity of private ECCE. Parents and children may hold inaccurate perceptions of the returns to education; especially amongst families with low parental education, international studies suggest that perceived returns to education can be around a third of actual rates of return (Fiszbein & Schady, 2009). Adding an expectation for parents to connect ECCE to additional education and accurate returns is likely only to worsen this problem. The problem of imperfect credit markets, where parents cannot borrow to finance future educational returns, or even have difficulty borrowing against assets, can further compound this problem (Fiszbein & Schady, 2009). The combination of externalities, misinformation, and imperfect credit markets indicates an important role for government in providing ECCE.

ECCE targeting could also address some of these issues by targeting areas with low parental education and poor credit markets. The implementation of ECCE targeting could be difficult if attempted on a means-tested basis, which has a substantial administrative burden (Fiszbein & Schady, 2009) and can be challenging in the highly non-cash or informal economy (Coady, Grosh, & Hoddinott, 2004) typical of Egypt's disadvantaged areas. However, given the current substantial relationship between geography, wealth, and ECCE (Janssens, Van Der Gaag, & Tanaka, 2001) where the wealthiest governorates have by far the most ECCE, geographic targeting of disadvantaged communities in the construction of government kindergartens could be effective and costless relative to non-targeted expansion. Although targeting is desirable on equity grounds, an un-targeted push towards universal Kindergarten would still generate the same returns as a targeted effort, given current labor market and educational conditions in Egypt.

As well as being considered in the context of other educational issues, ECCE ought to be compared to other potential educational investments, or considered in conjunction with them, health intervention and ECCE combinations being one example of a frequent synergy. There are a wide variety of other interventions that could improve educational outcomes in Egypt. Numerous approaches for improving educational outcomes are being considered

and implemented by the Egyptian government (Todd, 2010). Programs that have been shown to have a greater benefit-cost ratio for educational outcomes in the context of Egypt should be prioritized above ECCE expansion. Unfortunately, most of these programs also lack a benefit-cost analysis in an Egyptian context. Further research on the part of the government into which educational interventions are, in fact, effective in Egypt would be extremely helpful for prioritizing educational investments such as ECCE. Additionally, consideration needs to be given to the fact that the estimates herein are based on private returns in increased income; if the government is to recapture the cost of the program and additional schooling, it will require substantial additional taxation.

9.2 Limitations

Although this research has advanced estimates of ECCE's educational impact and costs and benefits in an Egyptian context, it is important to be mindful of the limitations of these estimates. Selection into ECCE and the simultaneous increase of both ECCE and other forms of education have the potential to majorly bias OLS estimates. Propensity score matching attempts to correct for selection into ECCE, but is limited to observed background characteristics in eliminating this bias. Using within-family estimates to remove the relationship between background, especially unobservable family characteristics and ECCE, is distinctly an improvement. However, selection into ECCE can occur within a family based on parents' perception of child cognitive ability or because a within-family circumstance, especially income, changes. Balancing these potential upward biases are downward biases due to spillovers between siblings, both in terms of learning (Graces, Thomas, & Currie, 2000) and the removal of childcare burdens (Lokshin, Glinskaya, & Garcia, 2000).

The generalizability of these estimates is also imperfect. While the SYPE is nationally representative of Egyptian youth, the youth attending ECCE are not randomly selected or nationally represented. Estimates of ECCE impacts on the attending population may be relevant but imperfectly generalizable to the general population. The greater congruence between the within-family population and the general population (Table 22) indicates that this issue is not too extensive. However, the impact of ECCE is also imperfectly generalizable to future generations of Egyptian youth. For instance, if other

interventions substantially reduce the probability of leaving school before attaining a good education, the scope of ECCE impacts through the avenue of educational attainment will be decreased. These estimates are also focused on the ever-entering population, which, as Egypt is approaching universal primary entry, is approaching the entire youth population, and is essentially the ECCE attending population.

The cost-benefit analysis is also limited in its ability to only account for past estimates of costs and benefits; future changes in the educational system or labor market, which would be experienced after ECCE, could substantially alter the real flow of costs and benefits. The use of urban males' returns to education and wages is also less than ideal, but does represent at least the *potential* wage benefits of ECCE in the absence of gender discrimination and the presence of easy rural-urban migration. The analysis is, however, quite conservative in focusing only on ECCE's impact on wages as mediated through additional schooling. The broad array of additional benefits, from health to crime, that ECCE potentially generates are not included in the analysis. The estimates contained herein are effectively a lower bound on the full array of ECCE benefits.

10. Conclusion

Egypt has a substantial youth population with the potential to greatly advance the country's development and the wellbeing of its citizens. As it approaches near-universal school entry (UNDP, 2008), Egypt is looking for other avenues to improve educational outcomes and promote development. Early childhood education has shown substantial educational impacts and benefit-cost ratios in the international literature. For these reasons, Egypt is now seeking to substantially expand access to early childhood education. It is doing so, however, based on the international evidence, rather than evidence from the context of Egypt.

There is a lack of ECCE experiments in an Egyptian context, and conducting such experiments would require many years of follow up in order to estimate ECCE impacts. However, the recent release of the 2009 Survey of Young People in Egypt provided an opportunity to estimate the impact of ECCE from non-random data. By employing

propensity score matching and especially by using within-family comparisons, this paper has reliably estimated the impact of ECCE on a number of important educational outcomes. ECCE has been shown to consistently improve educational attainment, primary and preparatory repetition and drop out, tracking into general secondary, and primary and preparatory test scores.

The costs of ECCE and its educational benefits have also been monetized to facilitate a cost-benefit analysis. The CBA indicates that increased wages mediated through increased educational attainment *alone* are greater than ECCE's costs. However, the CBA also indicates returns lower than for other ECCE programs around the world, and below those simulated for Egypt (Janssens, Van Der Gaag, & Tanaka, 2001). The conclusion that ECCE is a good investment is also very sensitive to the assumptions used in the CBA. However, there remain a number of other dimensions of health and well being that might be improved by ECCE that are absent from these estimates. There may be the potential for even greater returns with improvements to ECCE and improvements in the connections between merit, education, and labor market outcomes in Egypt. While the Egyptian government's plans to substantially expand ECCE are worthwhile, pairing ECCE expansion with other reforms could make ECCE a truly exceptional and transformative investment.

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Appendix: Additional Tables

Table 22 The composition of ECCE, Within-Family youth, and Total Population

	% of ECCE Attendees	% of Within-Family Sample	% of Population
Gender			
Males	53.41	58.01	51.07
Females	46.59	41.99	48.93
Age Group			
10-14	37.21	25.78	28.57
15-17	16.2	23.64	16.1
18-24	31.92	40.23	36.03
25-29	14.67	10.34	19.3
Wealth			
Lowest	8.22	16.12	19.93
Second	12.05	18.53	20.57
Middle	18.28	24.17	21.87
Fourth	26.34	26.69	19.92
Highest	35.11	14.48	17.71
Father's Education			
Illiterate	11.8	25.13	20.64
Primary	16.61	23.48	17.37
Preparatory	6.93	7.85	5.95
Vocational Secondary	20.59	18.11	14.06
General Secondary	1.34	1.48	0.95
Post-secondary Institute	2.46	1.93	1.94
University & Above	16.36	9.06	8.43
Father's Education Missing	22.81	12.95	30.66
Mother's Education			
Illiterate	23.59	43.57	37.12
Primary	17.21	24.02	15.8
Preparatory	7.25	6.96	5.36
Vocational Secondary	21.9	15.7	13.01
General Secondary	1.48	1.12	0.78
Post-secondary Institute	2.57	0.84	1.19
University & Above	11.58	3.95	5.28
Mother's Education Missing	14.41	3.83	21.46
Region			
Urban Governorates	37.93	22.77	21.42
Urban Lower Egypt	15.81	12.45	11.05

	% of ECCE Attendees	% of Within-Family Sample	% of Population
Rural Lower Egypt	27.3	34.06	31.54
Urban Upper Egypt	6.31	8.52	7.66
Rural Upper Egypt	11.24	19.96	26.58
Frontier Governorates	1.41	2.24	1.75
Residence			
Urban	49.3	34.32	31.57
Rural	38.89	54.71	58.87
Slum	11.81	10.96	9.56

Table 23 Ever Enter Attainment Calculations

EVER-ENTER Time	Underlying Survivor Function	Hazard	Change in Hazard from Model	Decreased Hazard	Increased Survivor Function	Change in survivor function	Proportion attaining w/o ECCE	Proportion attaining w/ECCE	Proportion Change in attainment	Notes
0	1.000				1	0	0	0	0.000	
1	0.993	0.007	0.310	0.002	0.998	0.005	0.007	0.002	-0.005	
2	0.983	0.011	0.510	0.006	0.992	0.010	0.011	0.006	-0.005	
3	0.967	0.016	0.351	0.006	0.987	0.020	0.016	0.006	-0.010	
4	0.939	0.028	0.370	0.011	0.976	0.037	0.028	0.010	-0.017	
5	0.879	0.064	0.516	0.033	0.944	0.065	0.060	0.032	-0.028	
6	0.855	0.027	0.413	0.011	0.934	0.078	0.024	0.011	-0.013	
7	0.815	0.048	0.485	0.023	0.912	0.097	0.041	0.022	-0.019	
8	0.760	0.067	0.611	0.041	0.875	0.115	0.055	0.037	-0.017	
9	0.754	0.008	0.931	0.008	0.868	0.114	0.006	0.007	0.000	
10	0.746	0.011	0.999	0.011	0.859	0.113	0.008	0.010	0.001	
11	0.256	0.656	0.606	0.398	0.517	0.261	0.489	0.341	-0.148	
12	0.253	0.012	0.599	0.007	0.513	0.260	0.003	0.004	0.001	
13	0.209	0.175	0.847	0.148	0.437	0.229	0.044	0.076	0.032	
14	0.207	0.008	0.326	0.003	0.436	0.229	0.002	0.001	-0.001	
15	0.028	0.864	1.169	1.000	0.000	-0.028	0.179	0.436	0.257	Force to one/zero to avoid negative
16	0.012	0.569	1.000	0.569	0.000	-0.012	0.016	0.000	-0.016	
17	0.010	0.141	1.000	0.141	0.000	-0.010	0.002	0.000	-0.002	
18	0.009	0.148	1.000	0.148	0.000	-0.009	0.002	0.000	-0.002	
19	0.001	0.850	1.000	0.850	0.000	-0.001	0.009	0.000	-0.009	
20	0.000	1.000	1.000	1.000	0.000	0.000				Force to end
AVERAGE TOTAL YEARS	10.677				12.249					
CHANGE					**1.572**					

Table 24 Within-Family Attainment Calculations

WITHIN	Underlying Survival No ECCE	Population Hazard	Chang in Hazard	Decreased Hazard	Increased Survivor Function	Change in Survivor Function	Proportion Attaining No ECCE	Proportion Attaining ECCE	Proportion Change in attainment	
0	1.000				1.000	0.000	0.000	0.000	0.000	
1	0.988	0.012	0.090	0.001	0.999	0.011	0.012	0.001	-0.011	
2	0.979	0.010	0.742	0.007	0.992	0.013	0.010	0.007	-0.002	
3	0.961	0.018	0.259	0.005	0.987	0.026	0.017	0.005	-0.013	
4	0.929	0.034	0.241	0.008	0.979	0.050	0.032	0.008	-0.024	
5	0.867	0.067	0.458	0.031	0.949	0.082	0.062	0.030	-0.032	
6	0.843	0.027	0.428	0.011	0.938	0.095	0.023	0.011	-0.012	
7	0.803	0.048	0.466	0.023	0.917	0.114	0.041	0.021	-0.020	
8	0.738	0.080	0.401	0.032	0.888	0.149	0.064	0.029	-0.035	
9	0.733	0.008	1.000	0.008	0.881	0.148	0.006	0.007	0.001	
10	0.724	0.011	1.000	0.011	0.871	0.146	0.008	0.010	0.002	
11	0.325	0.551	1.000	0.551	0.391	0.066	0.399	0.480	0.081	
12	0.322	0.009	1.000	0.009	0.387	0.065	0.003	0.004	0.001	
13	0.272	0.155	1.000	0.155	0.327	0.055	0.050	0.060	0.010	
14	0.271	0.005	1.000	0.005	0.326	0.055	0.001	0.002	0.000	
15	0.039	0.855	1.000	0.855	0.047	0.008	0.232	0.278	0.047	
16	0.016	0.596	1.000	0.596	0.019	0.003	0.024	0.028	0.005	
17	0.014	0.149	1.000	0.149	0.016	0.003	0.002	0.003	0.000	
18	0.011	0.168	1.000	0.168	0.014	0.002	0.002	0.003	0.000	
19	0.002	0.827	1.000	0.827	0.002	0.000	0.011	0.014	0.002	Force to end
AVERAGE TOTAL YEARS	10.838				11.930					
CHANGE					1.091	1.091				

Table 25 Observed Survival with and without ECCE

Time	Survival Function Observed w/o ECCE	Survival Function Observed w/ECCE
0	1	1
1	0.992	0.999
2	0.979	0.994
3	0.961	0.990
4	0.929	0.982
5	0.859	0.957
6	0.832	0.948
7	0.787	0.930
8	0.726	0.899
9	0.720	0.893
10	0.710	0.885
11	0.218	0.557
12	0.215	0.554
13	0.171	0.484
14	0.169	0.483
15	0.016	0.084
16	0.010	0.028
17	0.009	0.023
18	0.009	0.018
19	0.001	0.005
20	0	0

Table 26 Linear Wage Calculation Example for Age 15-27 by ECCE

Equation	Coefficients	Years of School	0.054											
ln(hourly wage)=		Experience	0.039											
		Exp^2	-0.043											
		Constant	-0.859											
UNITS 2000 INTL PPP														
Age (start at 15)	15	16	17	18	19	20	21	22	23	24	25	26	27	
T	10	11	12	13	14	15	16	17	18	19	20	21	22	
LN														
Experience	0	1	2	3	4	5	6	7	8	9	10	11	12	
Attainment														
Primary (1)	-0.805	-0.766	-0.729	-0.692	-0.656	-0.621	-0.586	-0.553	-0.521	-0.489	-0.458	-0.428	-0.399	
Primary (2)	-0.751	-0.712	-0.675	-0.638	-0.602	-0.567	-0.532	-0.499	-0.467	-0.435	-0.404	-0.374	-0.345	
Primary (3)	-0.697	-0.658	-0.621	-0.584	-0.548	-0.513	-0.478	-0.445	-0.413	-0.381	-0.350	-0.320	-0.291	
Primary (4)	-0.643	-0.604	-0.567	-0.530	-0.494	-0.459	-0.424	-0.391	-0.359	-0.327	-0.296	-0.266	-0.237	
Primary (5)	-0.589	-0.550	-0.513	-0.476	-0.440	-0.405	-0.370	-0.337	-0.305	-0.273	-0.242	-0.212	-0.183	
Preparatory (6)	-0.535	-0.496	-0.459	-0.422	-0.386	-0.351	-0.316	-0.283	-0.251	-0.219	-0.188	-0.158	-0.129	
Preparatory (7)	-0.481	-0.442	-0.405	-0.368	-0.332	-0.297	-0.262	-0.229	-0.197	-0.165	-0.134	-0.104	-0.075	
Preparatory (8)	-0.427	-0.388	-0.351	-0.314	-0.278	-0.243	-0.208	-0.175	-0.143	-0.111	-0.080	-0.050	-0.021	
Secondary (9) OC Starts		-0.373	-0.334	-0.297	-0.260	-0.224	-0.189	-0.154	-0.121	-0.089	-0.057	-0.026	0.004	
Secondary (10)			-0.319	-0.280	-0.243	-0.206	-0.170	-0.135	-0.100	-0.067	-0.035	-0.003	0.028	
Secondary (11)				-0.265	-0.226	-0.189	-0.152	-0.116	-0.081	-0.046	-0.013	0.019	0.051	
Tertiary (12)					-0.211	-0.172	-0.135	-0.098	-0.062	-0.027	0.008	0.041	0.073	
Tertiary (13)						-0.157	-0.118	-0.081	-0.044	-0.008	0.027	0.062	0.095	
Tertiary (14)							-0.103	-0.064	-0.027	0.010	0.046	0.081	0.116	
Tertiary (15)								-0.049	-0.010	0.027	0.064	0.100	0.135	
Tertiary (16)									0.005	0.044	0.081	0.118	0.154	
Tertiary (17)										0.059	0.098	0.135	0.172	
Tertiary (18)											0.113	0.152	0.189	
Tertiary (19)												0.167	0.206	
EXPONENTIATED INTL DOLLAR														
Primary (1)	0.447	0.465	0.483	0.501	0.519	0.538	0.556	0.575	0.594	0.613	0.633	0.652	0.671	
Primary (2)	0.472	0.490	0.509	0.528	0.548	0.567	0.587	0.607	0.627	0.647	0.668	0.688	0.708	
Primary (3)	0.498	0.518	0.538	0.558	0.578	0.599	0.620	0.641	0.662	0.683	0.705	0.726	0.748	
Primary (4)	0.526	0.546	0.567	0.589	0.610	0.632	0.654	0.676	0.699	0.721	0.744	0.766	0.789	
Primary (5)	0.555	0.577	0.599	0.621	0.644	0.667	0.690	0.714	0.737	0.761	0.785	0.809	0.833	
Preparatory (6)	0.586	0.609	0.632	0.656	0.680	0.704	0.729	0.753	0.778	0.803	0.829	0.854	0.879	
Preparatory (7)	0.618	0.642	0.667	0.692	0.718	0.743	0.769	0.795	0.822	0.848	0.875	0.901	0.928	
Preparatory (8)	0.652	0.678	0.704	0.731	0.757	0.784	0.812	0.839	0.867	0.895	0.923	0.951	0.979	
Secondary (9) OC Starts		0.689	0.716	0.743	0.771	0.799	0.828	0.857	0.886	0.915	0.945	0.974	1.004	
Secondary (10)			0.727	0.755	0.784	0.814	0.844	0.874	0.904	0.935	0.966	0.997	1.028	
Secondary (11)				0.767	0.797	0.828	0.859	0.891	0.922	0.955	0.987	1.020	1.053	
Tertiary (12)					0.810	0.842	0.874	0.907	0.940	0.974	1.008	1.042	1.076	
Tertiary (13)						0.855	0.888	0.922	0.957	0.992	1.028	1.063	1.100	
Tertiary (14)							0.902	0.938	0.974	1.010	1.047	1.085	1.122	

Equation	Coefficients	Years of School	0.054											
ln(hourly wage)=		Experience	0.039											
		Exp^2	-0.043											
		Constant	-0.859											
UNITS 2000 INTL PPP														
Age (start at 15)	15	16	17	18	19	20	21	22	23	24	25	26	27	
T	10	11	12	13	14	15	16	17	18	19	20	21	22	
LN Experience	0	1	2	3	4	5	6	7	8	9	10	11	12	
Attainment														
Tertiary (15)								0.952	0.990	1.028	1.066	1.105	1.145	
Tertiary (16)									1.005	1.045	1.085	1.125	1.167	
Tertiary (17)										1.061	1.102	1.145	1.188	
Tertiary (18)											1.120	1.164	1.208	
Tertiary (19)												1.182	1.228	
w/o ECCE hourly ln wages @ t	0.151	0.161	0.173	0.485	0.506	0.568	0.590	0.832	0.886	0.920	0.954	0.999	1.032	
w/ ECCE hourly ln wages @ t	0.066	0.073	0.083	0.454	0.475	0.544	0.566	0.852	0.911	0.947	0.983	1.033	1.067	
w/o ECCE hourly wage	1.163	1.174	1.189	1.625	1.659	1.765	1.805	2.298	2.425	2.508	2.596	2.716	2.807	
w/ ECCE hourly wage	1.068	1.076	1.087	1.575	1.608	1.723	1.761	2.343	2.487	2.578	2.673	2.809	2.908	
Difference in hourly wages	-0.095	-0.098	-0.102	-0.050	-0.052	-0.042	-0.043	0.045	0.063	0.070	0.077	0.093	0.101	
Difference in Annual wages Hourly*46.5 hours*50 weeks **(ELMPS revisited)**	-220.3	-228.8	-237.1	-116.1	-120.4	-97.4	-101.1	105.4	145.5	161.9	179.7	215.5	233.9	
INTO 2000 LE	-88.6	-92.0	-95.3	-46.7	-48.4	-39.2	-40.7	42.4	58.5	65.1	72.3	86.6	94.0	
1	International dollar													
0.4021	WB PPP conversion ratio intl$/LE													

Table 27 Linear Return CBA Calculation

Age	T	Grade Completed	Undiscounted Educational costs	Undiscounted Benefits	Discounted costs	Discounted Benefits	Undiscounted Net	Discounted Net	Change in years of schooling	Change in wages	Notes
5	0	ECCE	-192.50	0.00	-192.50	0.00	-192.50	-192.50			Half Year of ECCE
6	1	ECCE	-385.00	0.00	-373.79	0.00	-385.00	-373.79			Year of ECCE
7	2	1	0.00	0.00	0.00	0.00	0.00	0.00			
8	3	2	-8.09	0.00	-7.40	0.00	-8.09	-7.40	0.011		Change in survival fx offset by one for continuing
9	4	3	-9.95	25.98	-8.84	23.08	16.02	14.24	0.013		Cost savings for primary repetition
10	5	4	-19.78	0.00	-17.06	0.00	-19.78	-17.06	0.026		
11	6	5	-38.28	0.00	-32.06	0.00	-38.28	-32.06	0.050		
12	7	6	-79.26	0.00	-64.44	0.00	-79.26	-64.44	0.082		
13	8	7	-91.14	33.43	-71.94	26.39	-57.71	-45.56	0.095		Cost savings for preparatory repetition
14	9	8	-110.12	0.00	-84.40	0.00	-110.12	-84.40	0.114		
15	10	9	-395.80	0.00	-294.51	0.00	-395.80	-294.51	0.149	-88.57	Only Legal work--benefits start now
16	11	10	-396.78	0.00	-286.64	0.00	-396.78	-286.64	0.148	-92.00	
17	12	11	-396.72	0.00	-278.25	0.00	-396.72	-278.25	0.146	-95.32	
18	13	12	-309.29	0.00	-210.61	0.00	-309.29	-210.61	0.066	-46.68	
19	14	13	-308.63	0.00	-204.04	0.00	-308.63	-204.04	0.065	-48.41	
20	15	14	-259.03	0.00	-166.26	0.00	-259.03	-166.26	0.055	-39.17	
21	16	15	-259.41	0.00	-161.65	0.00	-259.41	-161.65	0.055	-40.66	
22	17	16	-31.82	42.39	-19.25	25.65	10.57	6.40	0.008	42.39	
23	18	17	-12.84	58.50	-7.54	34.36	45.65	26.82	0.003	58.50	
24	19	18	-10.92	65.09	-6.23	37.12	54.16	30.89	0.003	65.09	
25	20	19	-9.09	72.27	-5.03	40.01	63.18	34.98	0.002	72.27	
26	21	20	-1.57	86.63	-0.85	46.57	85.06	45.73	0.000	86.63	
27	22		0.00	94.03	0.00	49.08	94.03	49.08		94.03	
28	23		0.00	101.97	0.00	51.67	101.97	51.67		101.97	
29	24		0.00	110.46	0.00	54.34	110.46	54.34		110.46	
30	25		0.00	119.54	0.00	57.10	119.54	57.10		119.54	
31	26		0.00	129.23	0.00	59.92	129.23	59.92		129.23	
32	27		0.00	139.55	0.00	62.82	139.55	62.82		139.55	
33	28		0.00	150.51	0.00	65.78	150.51	65.78		150.51	
34	29		0.00	162.13	0.00	68.80	162.13	68.80		162.13	
35	30		0.00	174.42	0.00	71.86	174.42	71.86		174.42	
36	31		0.00	187.39	0.00	74.95	187.39	74.95		187.39	
37	32		0.00	201.04	0.00	78.07	201.04	78.07		201.04	
38	33		0.00	215.37	0.00	81.20	215.37	81.20		215.37	
39	34		0.00	230.37	0.00	84.32	230.37	84.32		230.37	
40	35		0.00	246.02	0.00	87.43	246.02	87.43		246.02	
41	36		0.00	262.30	0.00	90.50	262.30	90.50		262.30	
42	37		0.00	279.18	0.00	93.52	279.18	93.52		279.18	

Age	T	Grade Completed	Undiscounted Educational costs	Undiscounted Benefits	Discounted costs	Discounted Benefits	Undiscounted Net	Discounted Net	Change in years of schooling	Change in wages	Notes
43	38		0.00	296.62	0.00	96.47	296.62	96.47		296.62	
44	39		0.00	314.57	0.00	99.33	314.57	99.33		314.57	
45	40		0.00	332.97	0.00	102.08	332.97	102.08		332.97	
46	41		0.00	351.77	0.00	104.70	351.77	104.70		351.77	
47	42		0.00	370.88	0.00	107.17	370.88	107.17		370.88	
48	43		0.00	390.22	0.00	109.47	390.22	109.47		390.22	
49	44		0.00	409.70	0.00	111.59	409.70	111.59		409.70	
50	45		0.00	429.21	0.00	113.50	429.21	113.50		429.21	
51	46		0.00	448.66	0.00	115.19	448.66	115.19		448.66	
52	47		0.00	467.92	0.00	116.63	467.92	116.63		467.92	
53	48		0.00	486.88	0.00	117.83	486.88	117.83		486.88	
54	49		0.00	505.42	0.00	118.75	505.42	118.75		505.42	
55	50		0.00	523.40	0.00	119.39	523.40	119.39		523.40	
56	51		0.00	540.70	0.00	119.74	540.70	119.74		540.70	
57	52		0.00	557.19	0.00	119.80	557.19	119.80		557.19	
58	53		0.00	572.75	0.00	119.56	572.75	119.56		572.75	
59	54		0.00	587.26	0.00	119.02	587.26	119.02		587.26	
											Retire at 60
			NPV=		781.45		Discount rate	0.03			
			IRR		3.976%		Linear Rate				
			Benefits		3274.76		Of Return				
			Costs		2493.31						
			B/C ratio		1.31						