Essays on the Economics of Human Capital Accumulation

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Declaration

I, Lucia Rizzica, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis. All chapters in this thesis are single authored papers and have not previously been presented in identical or similar form to any other examination board.

Date

August 11, 2014 .....

Signature

Lucia Rizzica .....

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Abstract

This thesis explores channels through which human capital accumulation can be fostered focusing in particular on education policies. Chapter 1 analyzes the effects of the UK *Widening Participation Policies* which aim at raising the motivation towards school of teenagers from low socio-economic background. I use a *Sharp Regression Discontinuity* design to estimate the effects of raising aspirations on college enrollments. The estimates obtained show that the policy had a significant positive impact on pupils' aspirations and on their propensity to stay on in education after the age of 16, but did not affect college enrollment rates except for pupils coming from richer families. To interpret these empirical results I build a model of schooling choice that incorporates non cognitive traits such as aspirations in the ability production function. Chapter 2 again focuses on tertiary education policies and looks at an Italian reform which generated a substantial geographical expansion of tertiary education supply. I implement a *Difference-in-Differences* analysis and find that the reform significantly increased girls' enrollment rates but not boys'; on the other hand, boys substituted education away from home with education at the local university. These results suggest that girls face some non financial cost of moving away from home which may eventually prevent them from attending college. Chapter 3 analyzes the impact of parental migration on the household investments on the human capital of children left behind. I frame the household decision making problem as a sequential game in which the migrant spouse decides how much remittances to send back and then the one left behind allocates the total available budget according to his preferences. Such model predicts that the migrant anticipates the spouse's choice and manages to offset the possible negative impact on expenditure for children. The model predictions are tested using data from Indonesia.

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Introduction

> *There is such a thing as investment in human capital as well as investment in material capital. So soon as this is recognized, the distinction between economy in consumption and economy in investment becomes blurred. For, up to a point, consumption is investment in personal productive capacity. This is especially important in connection with children: to reduce unduly expenditure on their consumption may greatly lower their efficiency in after-life.*

With these words, Arthur Pigou introduced the term "human capital" in the economic literature in 1928 (Pigou, 1928). The idea that human beings are endowed with a certain stock of skills and capacities that can boost development and growth, nevertheless, was not new at all to economists, being already clearly stated in 1776 by Adam Smith who generically labeled such abilities as "talents" (Smith, 1776).
Cultivating these talents, as Smith would say, or investing in human capital, in the language of modern economists, entails an incredibly vast range of actions which go from neonatal breastfeeding (Rothstein, 2013) and infant vaccinations (Miguel and Kremer, 2004) up to training on the job of adult workers (Black and Lynch, 1996).
The three chapters of this thesis delve into the mechanisms behind investment in human capital accumulation in adolescent years (chapters 1 and 2) and in earlier childhood (chapter 3) providing evidence on the way individuals and households decide how much of the available resources to invest in education at different stages of life.

Chapter 1 looks at the effects of a policy initiative introduced in the UK in the late Nineties that aimed at raising the aspirations and motivation of teenagers towards higher education in order to increase the rate of enrollment to college of pupils from low socio-economic background.
I study the effects of this policy using the framework of a model of investment in human capital where individuals choose how much time to spend in school depending on their financial resources (parental income) and their ability, which incorporate both a cognitive and a non cognitive component. The model predicts that in the absence of credit constraints, a raise in aspirations will always have a weakly positive effect on the level of accumulated human capital, the effect being null if cognitive and non cognitive skills

are perfect complements and positive otherwise. On the other hand, in the presence of borrowing constraints, individuals will respond to an increase in their ability by lowering the amount of time invested in school and the final effect will depend on the relative productivity of ability with respect to time in the production of human capital.
The model is brought to the data in the context of the UK Widening Participation policy, whose scheme allows me to use a Sharp Regression Discontinuity design based on a measure of participation to higher education of older cohorts living in the same neighborhood. The results show that the policy intervention generated a significant increase in the aspirations of teenagers about higher education and that, as a consequence, these stayed longer in full time education. Yet, the rates of enrollment to college were not affected by the policy if not for students coming from the most affluent families, thus signaling the existence of binding credit constraints for a faction of the population.
In turn this chapter contributes to the recent economic literature that looks at the effects of non cognitive skills on individual choices by shedding some light on the responsiveness of these traits during adolescence and on the interaction between these, cognitive skills and parental financial resources in determining human capital investment choices.

In chapter 2 I explore another dimension of human capital investment choices which is how high school graduates respond to a geographical expansion in the supply of college education. I use data from Italy, where a number of reforms implemented in 2001 led to a massive growth of small and peripheral college campuses and analyze how boys and girls consequently changed their enrollment and mobility decisions. The geographical variation with which the reform was implemented allows me to use a difference-in-differences strategy whose results reveal that boys and girls reacted very differently to the reform: girls' enrollment rates rose by about six percentage points whereas boys did not increase their overall participation to college but rather switched from studying away from home to studying at the local college as this was made available. Analysis of heterogeneity in the results further reveals that among girls, those whose families were more affluent exhibited a larger propensity to switch from studying away from home to studying at the local college which suggests that girls face a non financial cost of moving from home which may eventually prevent them from attending higher education at all. Indeed all students revealed a preference towards studying at the local university but, while boys could just substitute this option with a farther away college, girls rather dropped out of school.

In conclusion this paper provides meaningful insights about the way boys and girls value the benefits and the costs associated to investing in human capital accumulation at the stage of college choice revealing the existence of potential obstacles to an efficient allocation of human resources.

Finally, chapter 3 drives attention to an earlier stage of life looking at investment in the human capital of children. In this setting it is the parents that decide how much of the household budget to spend for the consumption, the education and the health of their children in a setting in which each parent cares about her own consumption and both care about the children.
I study the allocation of the family budget on expenditure for children in the case in which one of the parents migrates and leaves the children behind together with the spouse. A theoretical model in which the two spouses sequentially choose how much remittances to send back to the household (the migrant spouse) and how to distribute the total available budget made of own income and received remittances (the spouse left behind) is used to interpret the empirical results. The model predicts that, even in the presence of different preferences between the two spouses over the allocation of the budget between own and children related consumption, the share of total household income spent on children will not be affected by which of the parent migrates. This is due to the possibility of the migrant spouse to anticipate the partner's choice and incorporate it in the decision of how much remittances to send back.
The empirical part of the paper relies on data from Indonesia, a country where female migration is particularly high, and exploits variation in the expected returns and risk associated to respectively female and male migration to instrument for the household's choice of which spouse to send away for migration. The empirical results are in line with the model's predictions and show that there is no difference in the share of family resources spent on children between the case in which the father migrates and that in which it is the mother. This suggests that migration of young women who temporarily leave their children behind does not determine a decrease in the amount of resources spent for children as long as women can choose how much to send back through remittances. This result carries particular relevance in the light of the increasing migration flows of women around the world, a phenomenon which creates concern in the international political arena for the possible detrimental effects on children left behind.

Chapter 1

Raising Aspirations and Higher Education: Lessons from the UK Widening Participation Policies

Abstract

This paper explores the impact of a non cognitive trait, aspirations, on college attendance. The relationship between aspirations and schooling is framed in a model of inter temporal consumption where returns to education and success in school depend on individual ability which incorporates a non cognitive component. According to the model, the final impact of an exogenous raise in the level of non cognitive skills will depend on the degree of substitutability between cognitive skills, non cognitive skills and parental background in the production of ability, but also on credit accessibility.

The model's predictions are tested exploiting a national scale British policy intervention, *Widening Participation*, aimed at raising the motivation towards school of pupils from low socio-economic background. The policy scheme allows me to implement a Sharp Regression Discontinuity design to estimate the causal effect of raising aspirations on college attendance. The estimates reveal a significant impact of the policy on educational aspirations and a consequent increase in the likelihood of staying on in full time education after the compulsory school leaving age of 16, while no effect is observed on the probability of eventually going to college. The analysis of the heterogeneous effects depending on family income and pre-accumulated levels of cognitive skills allows me to shed some light on the underlying mechanisms, bringing me to the conclusion that while instilling non cognitive skills can increase the level of acquired human capital, partially substituting for the lack of adequate cognitive skills, the presence of credit constraint eventually hampers participation to higher education by pupils from low socio-economic background.

1.1 Introduction

The post World War II decades have seen sharp increases in educational attainment and access to college in most developed countries: in the US the share of youths going to college rose from 10% in 1940 to 57% in 2012 (US Census Beaureau, 2013), while in the UK participation to higher education took off from less than 5% in the '50s to about 36% in 2012 (HEFCE, 2010).

While a similar trend has been common to most OECD states (OECD, 2012), it varied across countries in timing and intensity: in the UK, in particular, the acceleration of enrollments to college took place from the late '80s when a number of reforms to the educational system were adopted in order to accelerate the pace of increase in educational attainment.[1]

In most countries, however, the growth of the college student body was not uniform across the population but rather concentrated among youths at the top of the income distribution, as documented, among others, by Belley and Lochner (2007) and Deming and Dynarski (2009) for the US and by Blanden and Machin (2004), Machin and Vignoles (2004) and Lindley and Machin (2012) for the UK or Checchi et al. (1999) for Italy.[2]

The desire to increase the student body so as to bring in those generally left behind has thus animated the action of policy makers around the world in the past fifty years: in the US the Higher Education Act of 1965 introduced for the first time grants and low interest loans for low and middle income college students, while European Governments traditionally opted for a fully state funded higher education system for all students[3] coupled with the provision of small grants for the most disadvantaged ones.

[1] In particular in 1988 the UK Government reformed the system of age 16 examinations introducing the General Certificate of Secondary Education (GCSE) which generally allowed more pupils to obtain the qualifications required to enter Higher Education (Blanden et al., 2003); in 1990, then, the first UK student loans system was introduced so as to promote access to college by pupils from less affluent families; finally, in 1992, the Further and Higher Education Act expanded significantly the number of institutions which were granted university status, thus generating an increase in the number of students counted as being in higher education (Wyness, 2010).

[2] Some recent studies, nevertheless, have documented a stabilization of the educational gap: for the UK, Blanden and Machin (2008) show that the (small) increase in graduation rates that occurred between the 1970 and the 1975 cohorts was evenly distributed across family income groups, while for Italy Checchi et al. (2013) document a decrease in inequality coupled, nevertheless, with an increased degree of polarization in educational opportunities.

[3] England, for instance, introduced tuition fees for the first time in 1998, while in Sweden higher education is still free of charge fro all Swedish and EU students.

Still, neither the cut of tuition costs, nor the allocation of means-tested grants have proved sufficient to eliminate the disparities in access to college. Kane (1995), for instance, reported "no disproportionate growth in enrollment by low income youth" after the introduction of the Pell Grant in the US in 1972;[4] Dynarski (2000) analyzed the impact of the 1993 Georgia HOPE program of scholarships for outstanding students and found that it mostly benefited medium and high income students; while for the UK Dearden et al. (2011) estimated that a £1,000 grant would currently increase the probability of going to college by only 2.6 percentage points.

To what extent credit constraints are effectively responsible for these imbalances remains an open question: Acemoglu and Pischke (2001), for instance, argue that in the presence of imperfect credit markets "family income, rather than other factors related to family background, explained 27 percentage points of the 36 percentage points difference in college enrollment rates of children from the bottom and top quartiles in 1992 in the US"[5], on the other hand Heckman and Carneiro (2003) estimated that at most 8% of the population may be prevented from going to college by short run credit constraints and suggest that the gap in educational achievements would rather result from the scarce accumulation of abilities that poorer children have experienced since they were born.
The recent economic literature has thus moved in both directions: on the one hand the evaluation of policies that act on the financial barriers (Deming and Dynarski, 2009), on the other hand the exploration of the role of accumulated cognitive and non cognitive abilities (Heckman and Carneiro, 2003).

This paper takes the moves from the analysis of a recent British policy, *Widening Participation*, that aims at raising the aspirations of youths from low socio-economic background in order to increase their participation to higher education. Indeed the British governments of the 90s' firmly believed that the lack of aspirations was a major barrier to access to higher education and, more in general, to social mobility: in October 2007, Prime Minister Gordon Brown stated that "poverty of aspiration is what lies at the heart of the failure of the British education system to be world beating [...] The great failure is

[4] Hansen (1983) as well had found no effect of the introduction of the grant on college enrollment.

[5] The major role of credit constraints as barrier to entry into higher education has also been stressed by: Kane (1995), Card (1999), Card (2000), Kane (2001), Kane (2003).

not the child who does not reach the stars, but the child who has no stars to reach for" (Brown, 2007).

A similar political belief is supported by the findings of psychologists, who show that children with higher aspirations put more effort in school and thus achieve higher outcomes than children with lower ambitions (Gutman and Akerman, 2008). More in general, the link between aspirations and achievements has been long emphasized in the sociological literature (Biddle, 1979; Flynn and Lemay, 1999) as well as in psychology.

In economics then, the idea that the individual's behavior is influenced by his aspirations, has been borrowed from the psychological literature by Kahneman and Tversky (1979) in their formulation of the "prospect theory". Yet, as Barberis (2013) recently described, the empirical applications of this theory have been rare (with notable exceptions in the field of finance), the best known example being the work of Camerer et al. (1997) on New York taxi drivers' target maximizing labor supply strategies.

More recent contributions have expanded the theory on reference points by formalizing the way these are formed and deriving interesting implications in terms of growth and "poverty traps" (Ray, 2004; Heifetz and Minelli, 2006; Mookherjee et al., 2010; Dalton et al., 2011; Genicot and Ray, 2014).

In the analysis of schooling choices instead the recent economic literature moved more in the direction of the works of Heckman considering aspirations and motivation towards school as a particular type of non cognitive ability that affects the children's learning skills and that is still malleable in adolescent years (Heckman, 1999; Cunha and Heckman, 2007; Cunha et al., 2010; Heckman et al., 2013) .

Identification of the impact of non cognitive abilities on educational outcomes and schooling choices presents major challenges in that children who are less self-confident or less motivated are also more likely to come from a disadvantaged socio-economic background and therefore simultaneously face both ability (cognitive and non cognitive) and income constraints in accessing higher education.

Indeed recent empirical contributions which have tried to shed some light on the relationship between aspirations and educational investments using experimental settings have not succeeded in disentangling the effect of raising aspirations from that of relaxing credit constraints (Chiapa et al., 2012; Wydick et al., 2013), or providing more information (Nguyen, 2013), or improving cognitive skills (Hahn et al., 1994) or generally providing

positive role models (Tierney et al., 2000).[6] A convincing identification strategy would need to rely on some exogenous source of variation of non cognitive abilities which should not affect neither the subject's economic conditions nor her cognitive abilities. Heckman et al. (2013) move in this direction and exploit changes in personality traits experimentally induced by the Perry Preschool program to analyze their impact on schooling outcomes finding that the stimulation of personality traits, among which is "motivation towards education", during early childhood has sizable and significant impact on the individual's achievements until adulthood.

In this context the contribution of this paper is to provide clear and robust evidence on the role of aspirations of *adolescents* on their educational outcomes. To do so, I exploit the design of the Widening Participation policy which, by stimulating the pupils' aspirations without providing them with any form of financial aid nor academic tutoring, allows me to overcome the endogeneity problem described above.
Moreover the present paper builds on the literature on non cognitive abilities by incorporating them in a model of schooling choice in which returns to education and success in schooling depend on individual ability and the latter is a combination of cognitive abilities, non cognitive abilities and parental background. The theoretical model allows me to interpret my empirical results and shed some light on the relationship between adolescents' non cognitive abilities, their family social background and their schooling choices.

The chapter is structured as follows: section 1.2 introduces the WP policy, its political background and its design; section 1.3 provides the theoretical framework to interpret the empirical results; section 1.4 introduces the datasets that will be employed and provides some descriptive statistics; section 1.5 describes the empirical strategy; section 1.6 is dedicated to the results, section 1.7 to the robustness checks; and section 1.8 concludes.

1.2 The Widening Participation Policies

It is estimated that until the '60s participation rates in post-compulsory (post-16) education in the UK did not reach 20% of school leavers while by the end of the '90s this rate

[6] Exploiting a particular experimental setting in Nicaragua Macours and Vakis (2009) provide some more convincing evidence on the effects of raising aspirations on business investments.

had almost reached 70% (Blanden and Machin, 2004). In the same way college attendance expanded significantly: if in the '50s no more than 5% of students were entering higher education, today that is estimated to be around 36% (HEFCE, 2010).
Still, as mentioned in the introduction, such increase in participation has not been uniform across the population but disproportionately favored those groups which were already over represented in access to higher education: according to Blanden and Machin (2004), in 1981, the proportion of 23 year olds in the population holding a higher education degree was 6% for families in the bottom income quintile and 20% for those in the top income quintile, while by 1999 these proportions had risen to only 9% for the bottom income quintile and to 46% for the top income quintile.[7]

On such premises the Kennedy (1997) and the Dearing (1997) reports, commissioned by the government in preparation for a reform of the higher education system,[8] set the issue of "Widening Participation" to higher education at the center of the national political agenda establishing that "participation should be *widened* rather than just increased" (Kennedy, 1997) and that public funds should be distributed so as to reward "institutions which can demonstrate a commitment to *widening participation*" (Dearing, 1997).

1.2.1 Policy Description

In response to the recommendations contained in the 1997 Government reports it was established that the allocation mechanism of public funds to colleges would be revised so as to reward those colleges which proved more successful in recruiting students from disadvantaged backgrounds.
The government decided to distribute the funds for Widening Participation through the

[7]The same pattern has been documented in terms of mobility across social classes: in 1990 students from social class 1-3(non manual) exhibited a rate of participation to higher education of 36.7%, while those from social class 3(manual)-5 a rate of 10.3% (Robertson and Hillman, 1997); by 1997 both numbers had increased substantially but the difference between the two had widened up, with a 49% participation rate among students from social class 1-3(non manual) and a 18.4% among youths from lower social class (Connor et al., 1999).

[8]Following the recommendations of the Dearing report, in 1998 the government introduced for the first time up-front tuition fees to be paid by all UK and EU students (Wyness, 2010).

Teaching Grant, which represents the main source of funding for colleges[9] and which, until 1998/99 was simply proportional to the number of (full time equivalent) students enrolled. From 1998/99 the formula for the allocation of the teaching grant was modified so that students from "under-represented groups" would carry a larger weight. In 2007/08, for example, a college recruiting exclusively students from the most disadvantaged areas would receive more than 10% extra funds relative to one which would not recruit any student from the target group (HEFCE, 2007).[10] The amount of resources devoted to the initiative has been substantial and rose from £78 million in 2002/03 to £307 million in 2004/2005 for an average number of target students of 222,000 per year.[11]

The public funds for WP distributed through the teaching grant are not held to specific projects and activities to be carried out by the colleges, but these remain free to design and implement their own widening participation agenda on which they have to report each year to the Government.
The type of activities carried out by Higher Education Institutions to recruit students from low participation neighborhoods typically range from visits to colleges, to summer schools, mentoring and tutoring activities and also meetings with parents to involve them in the decision and raise their awareness.[12] Figure 1.3 shows the WP initiatives that colleges carry out more often as of a recent survey among colleges WP administrators (Bowes et al., 2013).

On top of receiving public funds as a reward to the results obtained through their outreach activities, colleges typically manage to attract further funds from private donors to sponsor their widening participation activities.

[9]Following the definition adopted by HEFCE, in this work I generically refer to "colleges" or "Higher Education Institutions" to indicate Universities, Higher Education Colleges and Further Education Colleges; the latter provide mainly vocational curricula and are similar to the US Community Colleges.

[10]A secondary source of funding of the WP policies are the "Special Initiative Funds" allocated to colleges to finance specific projects aimed at increasing the participation into Higher Education of pupils from under-represented groups. This type of funding, nevertheless, remained marginal, accounting for about only 8% of the total public funding for WP in 2006/07.

[11]Data on the amount of funds are taken from the HEFCE yearly publication "Recurrent Grants for ...: Revised Allocations"; while the number of students is calculated as the average yearly size (for 1994 to 2000) of the 18 year old cohort in the target areas from the figures in HEFCE (2005).

[12]These activities are not meant to provide a better academic preparation to the pupils not better information about how to et into college (like the interventions analyzed by Bettinger et al. (2009) or Oreopoulos and Dunn (2012) but rather to give pipils a "taster" experience of college, see for example: http://www.london.ac.uk/tasters.

Indeed Higher Education Institutions generally make their commitment to widening participation a point of pride and this is recognized by a number of highly advertised awards such as the "London Education Partnership Awards".[13]
Finally, the Higher Education Statistics Agency (HESA) publishes every year detailed data on the intake of students from under-represented groups by each Higher Education Institution in England[14] thus creating an effective and transparent mechanism of public monitoring.

1.2.2 Eligibility

From 2004/2005 the English government has used a specifically designed classification system called POLAR (Participation Of Local Areas)[15] to identify which students qualified as belonging to an under-represented group and should thus be targeted by WP activities. This system is based on the youth participation rate to Higher Education in the 2001 Census wards;[16] for each ward a local youth participation rate was computed referring to the students who were aged 18-21 in 1997-1999 (HEFCE, 2010); wards were then ranked according to this rate and defined eligible for WP activities if their youth participation rate fell in the two lowest quintiles of the distribution. The POLAR system induced a lot of geographical heterogeneity in the distribution of WP funds within England, figure 1.1, for example, shows the target areas in London, distinguishing those falling in the lowest quintile from those falling in the second one.

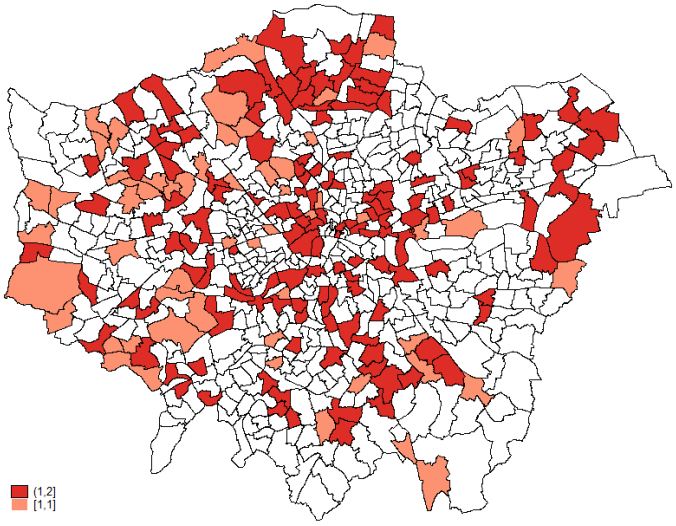
[13] The London Education Partnership Awards recognize and build on a well-established tradition among London's education providers in offering higher education opportunities to a wide range of learners raising the aspirations of young people to help them achieve their full potential. www.lepawards.org.uk

[14] www.hesa.ac.uk/index.php?option=com_content&task=view&id=2060&Itemid=141

[15] The first system used by HEFCE was a commercial product called "Super Profiles" which identified 160 clusters of neighborhoods but is not currently available to the public. The POLAR system adopted in 2004 has then been progressively improved and updated: POLAR2 has been released in 2008 and POLAR3 in 2012.

[16] England counts 8850 of them with an average adult population size of 4250 people per ward.

Figure 1.1: London Target Areas. 2001 Census wards, by youth participation rate. HEFCE.



1.3 Theoretical Framework

1.3.1 Setup

The idea that a raise in aspirations would generate an increase in the level of schooling may be translated in an economic model where returns to education and success in schooling depend on individual ability and this incorporates a non cognitive component (motivation, aspirations).
I shall consider a standard two-period model as in Lochner and Monge-Naranjo (2012) where individuals invest in schooling in the first period (youth) and work in the second (adulthood). Preferences are time separable and represented by:

$$U = u(c_0) + \beta\, u(c_1) \tag{1.1}$$

where c_t is consumption in periods $t \in \{0, 1\}$, $\beta > 0$ is a discount factor, and $u(\cdot)$ is strictly increasing and concave and satisfies standard Inada conditions.

In this model each individual is endowed in period 0 with a certain level of family income y_0 and ability a; during youth individuals choose how much time (effort) to spend

in school, h, rather than working;[17] time in school entails both a direct cost $\tau > 0$ (e.g. tuition fees) and an opportunity cost $w_0 \geq 0$ given by the wage rate for a young unskilled worker, while it increases adult labor income y_1. Indeed I shall assume that the market pays a price w_1 for accumulated human capital s and that ability increases the returns to education so that $y_1 = w_1\ a\ s$. Finally, I assume that the level of accumulated human capital depends (positively) on time in school h and ability a and that the two inputs present a positive degree of complementarity, i.e. $s = f(h, a)$, where $f(\cdot)$ is positive, strictly increasing and concave in both arguments, and $\frac{\partial^2 f}{\partial h \partial a} > 0$.

While young individuals will borrow (or save) an amount d which they will repay when they are adults at a gross interest rate R. Consumption levels in the two periods will therefore be:

$$\begin{aligned} c_0 &= y_0 + w_0(1-h) - \tau h + d \\ c_1 &= w_1\ a\ f(h,a) - Rd \end{aligned} \tag{1.2}$$

To complete the model, I eventually assume that ability a is a function of the current levels of cognitive and non cognitive skills (respectively θ_c and θ_n) and parental environment, which I shall again proxy for with parental income y_0; I model this function as a CES where the magnitude of the elasticity of substitution s will be an empirical question.

$$a = \left[a_c \theta_c^{\frac{s-1}{s}} + a_n \theta_n^{\frac{s-1}{s}} + a_0 y_0^{\frac{s-1}{s}} \right]^{\frac{s}{s-1}} \tag{1.3}$$

The ability production function chosen here recalls the formulation introduced by Cunha and Heckman (2007) as it includes parental environment as an input for skills formation but differs from it significantly in that it disregards the dynamic process of skill accumulation allowing individuals to invest in human capital only in one period, generically labeled as youth. Indeed while Cunha and Heckman (2007) focus on the time complementarities between investments in early childhood and later on, this model rather looks at the complementarities between cognitive and non cognitive skills to explain the effects of an exogenous shift in only one of these two components.

[17] The model abstracts from decisions on leisure.

1.3.2 Solution and Predictions in the case of perfect credit markets

If we assume that there are perfect credit markets then individuals will be free to borrow (or save) *any* amount d while young as long as they manage to repay it during adulthood at the gross interest rate R. Individuals thus maximize utility in equation (1.1) with respect to both h and d subject to the conditions (1.2). The resulting optimality condition for investment in human capital h will be:

$$\frac{w_1 \ a \ f'(h^*, a)}{w_0 + \tau} = R \tag{1.4}$$

This condition states that the individual chooses investment in human capital so as to maximize the present value of net lifetime income, equating the net marginal return to schooling (on the left hand side) to the return to the financial asset R.[18]
At the same time, d^* will be chosen so as to smooth consumption and satisfy a standard Euler Equation:

$$u'(y_0 + w_0(1-h) - \tau h + d^*) = \beta \ R \ u'(w_1 \ a \ f(h,a) - Rd^*) \tag{1.5}$$

In this setting the impact of a raise in the non cognitive trait which I labeled as "aspirations" on the attained level of schooling will be given by:

$$\frac{\partial s^*}{\partial \theta_n} \equiv \frac{\partial f(h^*, a)}{\partial \theta_n}$$

where $f(h^*, a)$ is the level of schooling attained when choosing the optimal level of investment in human capital h^*.
Applying a simple chain rule we obtain that:

$$\begin{aligned} \frac{\partial f(h^*,a)}{\partial \theta_n} \equiv \frac{\partial f^*}{\partial \theta_n} &= f'_h \frac{\partial h^*}{\partial \theta_n} + f'_a \frac{\partial a}{\partial \theta_n} = \\ &= f'_h \frac{\partial h^*}{\partial a}\frac{\partial a}{\partial \theta_n} + f'_a \frac{\partial a}{\partial \theta_n} = \\ &= \frac{\partial a}{\partial \theta_n}\left[f'_h \frac{\partial h^*}{\partial a} + f'_a\right] \geq 0 \end{aligned} \tag{1.6}$$

The sign of this term will be positive because $f(\cdot)$ is strictly increasing in both h and a ($f'_h > 0, f'_a > 0$), $\frac{\partial a}{\partial \theta_n}$ can be null or positive depending on the elasticity of substitution

[18] Notice that in this case the optimal level of investment in human capital, h^* depends on parental income y_0 only "indirectly" through the effect of the latter on ability.

of the ability production function and $\frac{\partial h^*}{\partial a}$ is positive if we allow for complementarities between effort and ability in the production of human capital ($\frac{\partial^2 f}{\partial h \partial a} > 0$). Indeed, call:

$$F \equiv \frac{w_1 \ a \ f'(h,a)}{w_0 + \tau} - R$$

applying the implicit function theorem:

$$\frac{\partial h^*}{\partial a} \ = \ -\frac{\partial F/\partial a}{\partial F/\partial h^*} \ = \ \frac{\frac{1}{a} f'_h + f''_{ha}}{-f''_{hh}} \ > \ 0 \tag{1.7}$$

where both terms in the numerator are positive, while $f''_{hh} < 0$ by concavity of $f(\cdot)$.

In conclusion I obtain that:

$$\frac{\partial f^*}{\partial \theta_n} \ = \ \frac{\partial a}{\partial \theta_n} \left[f'_h \ \frac{\frac{1}{a} f'_h + f''_{ha}}{-f''_{hh}} + f'_a \right] \geq 0 \tag{1.8}$$

As all the terms inside the brackets are positive, the final direction of the effect will depend only on the sign of the first term $\frac{\partial a}{\partial \theta_n}$ so that, in the case in which there are no credit constraints, estimating $\frac{\partial f^*}{\partial \theta_n}$ would allow me to infer the elasticity of substitution between the inputs in the ability production function. In particular, in the case of:

- **Substitutable Inputs:**

$$s > 0 \quad \Leftrightarrow \quad \frac{\partial a}{\partial \theta_n} > 0 \quad \Leftrightarrow \quad \frac{\partial f^*}{\partial \theta_n} > 0$$

- **Leontief production function:**

$$s \to 0 \quad \Leftrightarrow \quad \frac{\partial a}{\partial \theta_n} = \begin{cases} a_n & a_n \theta_n \leq \min\{a_c \theta_c, a_0 y_0\} \\ 0 & \text{otherwise} \end{cases}$$

$$\Leftrightarrow \quad \frac{\partial f^*}{\partial \theta_n} \quad \begin{cases} > 0 & a_n \theta_n \leq \min\{a_c \theta_c, a_0 y_0\} \\ = 0 & \text{otherwise} \end{cases}$$

The effect of an exogenous raise in non cognitive abilities will generate an increase in human capital for any positive value of s, while the only case in which a similar intervention may not have any effect is that in which the inputs of the ability production function (cognitive and non cognitive skills, and parental environment) are perfect complements to

each other; in this case the intervention will only generate a positive effect among those who already have higher cognitive skills and a more favorable parental environment.

The model in this section further relies on the assumption that an exogenous shift in non cognitive abilities will not affect the level of cognitive abilities, i.e. that there are no cross-productivity effects of non cognitive skills on cognitive skills. Cunha and Heckman (2010) claim that such effects exist and are quite significant but also show that they fade out as children get older, so that when the child is 12-13 years old the cross-productivity effect is essentially null.

1.3.3 Solution and Predictions in the case of binding credit constraints

I extend the model just introduced by relaxing the assumption made above that individuals can borrow *any* amount d^* when they are young as long as they manage to pay it back once adults. Suppose therefore that some individuals cannot borrow as much as they would like, i.e. there is a maximum level of borrowing which is allowed $\bar{d}$ and for a fraction of the population $\bar{d} < d^*$. As d^* is decreasing in family income y_0 (from equation 1.5) it turns out that it is the poorest individuals who are credit constrained. In the case of binding credit constraints individuals will just choose how much time to invest in education h, while they will borrow the maximum available amount $\bar{d}$; the only first order condition is thus:

$$-u'(y_0 + w_0\ (1 - h^*) - \tau\ h^* + \bar{d})\ +\ \beta u'(w_1\ a\ f(h^*, a) - R\bar{d})\ w_1\ a\ f'_h\ = 0 \qquad (1.9)$$

As in the case of perfect credit markets, the effect of an exogenous increase in the level of non cognitive abilities will be given by:

$$\frac{\partial f^*}{\partial \theta_n}\ =\ \frac{\partial a}{\partial \theta_n}\left[f'_h \frac{\partial h^*}{\partial a} + f'_a\right] \qquad (1.10)$$

where one needs to determine the sign of the term $\frac{\partial h^*}{\partial \theta_n}$. To do so, I shall again use the implicit function theorem and define the term on the left handside of equation 1.9 as F, so that:

$$\frac{\partial h^*}{\partial a}\ =\ -\frac{\partial F/\partial a}{\partial F/\partial h^*}\ < 0$$

It turns out that the sign of the term $\frac{\partial h^*}{\partial a}$ is now negative (see Appendix 1.10.1 for proof), i.e. an increase in the level of ability generates a decrease in the amount of time pupils invest in education. The rationale for this finding is that because individuals are not able to smooth consumption as they would like to, when they become "more efficient" in learning, i.e. they can accumulate as much human capital as before even with less investment in education (because $f'_a > 0$ and $f''_{ha} > 0$), they prefer to reduce the amount of time invested in human capital accumulation and work more during youth to increase their level of consumption at period 0.
The final sign of the term in brackets in equation 1.10 may still be positive if:

$$-\frac{\partial h^*}{\partial a} < \frac{f'_a}{f'_h} \tag{1.11}$$

in which case the magnitude of the (negative) effect described above is smaller than that of the relative marginal productivity of ability with respect to that of time in the production of human capital, i.e. the higher the marginal productivity of ability relative to that of time, the more likely that the individual will still end up with a higher level of accumulated human capital even if he is investing less time in it.

In summary, the model described predicts heterogeneous effects of an exogenous increase in the level of non cognitive skills on the level of accumulated human capital depending on the level of cognitive skills and family income. Such effects will be furthermore different in the cases in which the economy exhibits perfect or imperfect credit markets and the inputs in the ability production function are substitutable or not (see appendix 1.10.2 for a schematic summary). In particular:

1. **s>0 and perfect credit markets**:

   $\frac{\partial f^*}{\partial \theta_n} > 0$ for all individuals, irrespectively of their family income y_0 and of their cognitive skills θ_c;

2. **s>0 and imperfect credit markets**:

$$\frac{\partial f^*}{\partial \theta_n} > 0 \quad \text{for individuals with } \textit{high} \text{ family income } y_0 \text{ (not credit constrained),}$$
$$\text{irrespectively of their cognitive skills } \theta_c;$$
$$\frac{\partial f^*}{\partial \theta_n} \gtrless 0 \quad \text{for individuals with } \textit{low} \text{ family income } y_0 \text{ (credit constrained),}$$
$$\text{irrespectively of their cognitive skills } \theta_c;$$

3. **s=0 and perfect credit markets**:

$$\frac{\partial f^*}{\partial \theta_n} > 0 \quad \text{for individuals with } \textit{high} \text{ cognitive skills } \theta_c \text{ and } \textit{high} \text{ family income } y_0;$$
$$\frac{\partial f^*}{\partial \theta_n} = 0 \quad \text{for individuals with } \textit{low} \text{ cognitive skills } \theta_c \text{ and/or } \textit{low} \text{ family income } y_0;$$

4. **s=0 and imperfect credit markets**:

$$\frac{\partial f^*}{\partial \theta_n} > 0 \quad \text{for individuals with } \textit{high} \text{ cognitive skills } \theta_c \text{ and } \textit{high} \text{ family income } y_0;$$
$$\frac{\partial f^*}{\partial \theta_n} = 0 \quad \text{for individuals with } \textit{low} \text{ cognitive skills } \theta_c \text{ or low } y_0;$$

The analysis of heterogeneity in the effects of raising aspirations along the two dimensions of family income and cognitive skills can help to pin down which of these four cases best describes the reality of the UK higher education system.

1.4 Data and descriptive statistics

This paper exploits a wide range of data to test the impact of the WP initiatives, combining information about the supply side, in particular the funding received by the higher education institutions and their activities aimed at recruiting students from low socio economic background, with information about the demand side, such as students' family background and schooling decisions.

The first batch of data comes from HEFCE and provides the youth participation rate for the 1997-1999 cohorts (YPR) and the POLAR partition of the 2001 Census wards computed accordingly.[19]

[19]The YPR computed by HEFCE ranges from 7.8% to 145%, with a mean value of 35%, slightly above the actual national average.

The HEFCE data are then merged with a number of individual datasets on the basis of the 2001 Census ward where the individual lives.[20] The first individual dataset used is the UK Quarterly Labour Force Survey (QLFS[21]). This contains a large sample of UK households with detailed information on the household's composition, activities and assets.

I build a sample of individuals who have been in secondary school for at least one year during the WP POLAR system; these are those who reached college entry age from 2005 on (born later than august 1986) and were older than 18 at the time of survey. For these students I create an indicator variable for whether they stayed on in full time education after the compulsory school leaving age of 16 and another indicator for whether they further went to college at age 18.

Table 1.1 shows that the proportion of students who stayed on in full time education after 16 is around 68%, while the share of those getting into college around 34%. These numbers are in line with the Government official figures which estimate that, for example in 2006/2007, 64.9% of 17 year old youths were in full time education (Department for Education and Office for National Statistics, 2010), while 31.7% of students aged between 17 and 20 were in college (Department for Business, Innovation and Skills and Office for National Statistics, 2013).[22]

Table 1.1 also contains descriptive statistics for a number of individual and household's characteristics including ethnicity, household's location and parental income and education. Clearly, as highlighted in column (4) WP eligible students come from poorer and less educated households. Moreover the statistics indicate that they mainly come from urban settings but not from London.[23]

A second source of data is then the Longitudinal Study of Young People in England (LSYPE[24]), a panel dataset managed by the Department for Education (DfE), which fol-

[20] The information about the household's postcode has been accessed through the Secure Data Service, UK Data Archive, University of Essex.

[21] Office for National Statistics (2012)

[22] This number raises to 35.9% if one looks at the 17-30 age group while it is about 33% in the estimates of HEFCE (2010)

[23] HEFCE (2005), among others, documents that participation to higher education is lowest in the cities of the North East region, Durham, New Castle upon Tyne and Sunderland.

[24] Department for Education and National Centre for Social Research (2012)

lows a (sample of a) cohort of pupils from the age of 13 until 20 (as of 2013). Despite being smaller than the QLFS and covering a single cohort of students, the LSYPE brings a number of advantages to the researcher in that it contains very detailed information about the pupils' family background, their schooling achievements, including grades, and, most importantly, their attitudes and aspirations. These are captured by some questions about the child's plans for the future; in this paper I exploit the answers to a question that asks them to state how likely they feel they will go to college. The variable is coded on a 4 points scale ("not at all likely", "not very likely", "fairly likely" and "very likely") with a mean value of 2.88 (Table 1.1).

While all the main socio economic characteristics of the sampled households are in line with those of the QLFS, it is further interesting to notice the large gap in aspirations between eligible and non eligible pupils.

The LSYPE finally allows me to track progression in education of pupils at age 16 and 18 as the QLFS does, thus providing scope for a test of robustness of the results obtained with the QLFS.

As for the QLFS, the LSYPE is merged with the HEFCE data through the home address of the child's family linking each household to the corresponding Census ward and hence youth participation rate and eligibility status.

The last source of data I employ is the National Pupil Database (NPD[25]) that I use to test whether the policy had any impact on pupils achievements at Key Stage 5 (age 18).[26] The advantage of the NPD is that it covers the full population[27] thus giving us very robust results. On the other hand, these data do not contain any background information about the pupils' household but only a detailed record of their educational achievements. Some descriptive statistics from the NPD sample employed are reported in table 1.2. Once again they confirm that targeted students are poorer (there is indeed a higher share among them of free school meal eligible children) and obtain lower grades throughout all their school career.

[25] Department for Education (2012)

[26] These are equivalent to the US High School GPAs

[27] I have the data related to the cohort born in 1989/1990, the same from which a sample has been followed in the LSYPE.

1.5 Empirical Strategy

1.5.1 Identification

Aim of this paper is to estimate the effect of a "raise in aspirations" on a child's probability of eventually going to college. Consider indeed the following reduced form econometric specification:

$$S_{it+1} = \alpha + \beta\ A_{ict} + \epsilon_{ict} \tag{1.12}$$

where S_{ict+1} is a binary variable indicating whether child i, living in the census ward c, goes to college after leaving compulsory school (at $t+1$); A_{ict} is the child's aspirations when he is still at school, measured as his stated likelihood of going to college; and ϵ_{ict} is a stochastic error term representing all the observable and unobservable individual characteristics which affect the schooling choice S_{ict+1}. The coefficient β is the "structural" parameter of interest, i.e. $\frac{\partial f^*}{\partial \theta_n}$.

Clearly A_{ict} and ϵ_{ict} are likely to be correlated, as for example one would expect children with more highly educated parents to have both higher aspirations and better financial means to face the cost of college. To overcome this endogeneity problem I exploit the variation in aspirations generated by exposure to the WP policy interventions; let WP_{ct} be an indicator function for whether the census ward c where the child lives is a WP target area, I can obtain a system of simultaneous equations of the type:

$$\begin{aligned} S_{ict+1} &= \alpha + \beta\ A_{ict} + \epsilon_{ict} \\ A_{ict} &= a + b\ WP_{ct} + u_{ict} \end{aligned} \tag{1.13}$$

where the two error terms, ϵ_{it} and u_{it}, are still correlated because exposure to treatment is not random. I exploit the fact that the assignment rule of individuals to WP policy interventions is known exactly to solve this problem. The deterministic function that assigns children to the group of the WP target students is:

$$WP_{ct} = \begin{cases} 1 & \text{if } YPR_c \leq Q_2 \\ 0 & \text{otherwise} \end{cases} \tag{1.14}$$

where YPR_c is the *Youth Participation Rate* to Higher Education described in section 1.2.2 and Q_2 denotes the upper bound of the second quintile of its distribution. Children therefore are targeted if they reside in areas where the participation rate to higher educa-

tion of older cohorts is below the 40th percentile.

Knowledge of this assignment rule allows me to use a *(Sharp) Regression Discontinuity Design* as introduced by Thistlethwaite and Campbell (1960) and more recently largely employed in education economics (Angrist and Lavy, 1999; Hoxby, 2000; Lavy, 2009). The running variable determining assignment to treatment will be the measure of youth participation rate of the ward where the child lives YPR_c.
The heart of this design is to examine whether discontinuities in the WP funding at the predetermined cutoff point are mirrored by discontinuities in the outcome variables.
My estimating equations will be:

$$\begin{aligned} S_{ict+1} &= f(YPR_c) + \gamma\, WP_{ct} + \upsilon_{ict} \\ A_{ict} &= g(YPR_c) + c\, WP_{ct} + u_{ict} \end{aligned} \tag{1.15}$$

where $f(\cdot)$ and $g(\cdot)$ are unknown functions of the forcing variable YPR_c whose form will be discussed in section 1.5.2. Estimation of the conditional expectations of the outcome variables on the two sides of the cutoff Q_2 will return an unbiased estimate of the two reduced form parameters γ and c. The relationship between the estimated and the structural parameters is obtained by combining the two equations in 1.13. Estimation of 1.15 will thus return:

$$\begin{aligned} \hat{\gamma} = \widehat{(\beta \times b)}_{SRP} &= \lim_{YPR_c \to Q_2^+} E\left(S_{ict+1} | YPR_c = ypr_c\right) - \lim_{YPR_c \to Q_2^-} E\left(S_{ict+1} | YPR_c = ypr_c\right) \\ \hat{c} = \hat{b}_{SRP} &= \lim_{YPR_c \to Q_2^+} E\left(A_{ict} | YPR_c = ypr_c\right) - \lim_{YPR_c \to Q_2^-} E\left(A_{ict} | YPR_c = ypr_c\right) \end{aligned} \tag{1.16}$$

The empirical design just described allows me to retrieve an unbiased estimate of the structural parameter of interest $\hat{\beta} = \frac{\hat{\gamma}}{\hat{c}} = \frac{\widehat{(\beta \times b)}_{SRP}}{\hat{b}_{SRP}}$ at the point of discontinuity (i.e. for those students who live in a neighbourhood where the Youth Participation Rate to higher education is close enough to the 40th percentile) and to assess the effectiveness of the WP policy interventions in raising the aspirations of the youths ($\hat{b}$).

The estimates obtained, nevertheless, will need to be interpreted as a Local *Intention To Treat* (ITT) effect. Indeed while we have exact information on the criteria which rule the assignment to WP treatment, we know little about the actual treatment "subminis-

tration". Anecdotal evidence seems to suggest the existence of heterogeneity in the way Higher Education Institutions choose their target students: some colleges stick to the HEFCE POLAR criterion, while others just target the schools in the poorest neighborhoods nearby. Such imperfect compliance does not allow the researcher to estimate the actual effect of the treatment, but only that of the *assignment to treatment*, which can give particularly precious information to policy makers on the effectiveness of the policy design.[28]

1.5.2 Estimation

The intuition behind a SRD is that comparing the pool of individuals in a small enough neighborhood of the discontinuity is similar to a randomized experiment at the cutoff point because individuals below and above the cutoff point have essentially the same value of Youth Participation Rate.
In this paper I report estimates of c and γ based on both parametric and non parametric specifications of the conditional mean of the outcomes. As for the parametric specification, the use of a simple linear approximation on YPR_c, even allowing for the slope to be different on the two sides, will require to trim the data to a narrow enough window around the cutoff Q_2 such that a linear regression can well approximate the relationship between the two variables. Conversely, increasing the order of polynomial allows for a more flexible specification and thus for the use of a larger window. In the tables I present results for linear, quadratic and cubic specifications allowing the slope and the concavity of the function to change independently on each side of the cutoff. When using a first order polynomial I only use observations within 10 percentage points from the cutoff, whereas I use a 20 percentage points window for the quadratic specification and a 30 percentage points window for the third order polynomial.

My preferred estimates are instead those based on a non parametric specification, which allows me to relax most of the assumptions required by the parametric models. I follow Hahn et al. (2001) and employ a non parametric *local linear regression* (LLR) to

[28]The *Intention To Treat* parameter will approach the actual Treatment Effect as the rate of compliance increases. Bowes et al. (2013) report that the POLAR classification is used by more than 80% of the surveyed colleges. Yet, most colleges use also other criteria to identify the WP target students (for example they choose to target children from state schools).

approximate the functions $f(\cdot)$ and $g(\cdot)$ as the forcing variable approaches the cutoff point; as for the parametric case, the difference between the two functions at the cutoff point will provide the estimate of the treatment effect.
The LLR on the two sides of the cutoff is estimated using Triangular Kernel weights so that observations which are closer to the cutoff point will carry a larger weight: Fan and Gijbels (1996) proved that Triangular Kernel weighted local linear regression performs optimally at the window boundary and thus also at the cutoff where the SRD requires most precision.
The only choice required in the LLR estimation remains that of the bandwidth: a larger bandwidth would improve the precision of the estimates (lower variance) but return more biased estimates of the treatment effect. In this paper I will use the optimal bandwidth derived by Imbens and Kalyanaraman (2010) through a plug in method which minimizes the Expected Squared Error Loss around the cutoff point. Moreover, for robustness, results are always showed for a bandwidth equal to half and twice the optimal one too, while graphical analysis is used to explore the sensitivity of the estimated coefficient to the bandwidth chosen.
Finally, as the policy varies at the census ward level, I cluster standard errors at this level allowing for the possibility that these may be correlated among individuals living in the same ward.

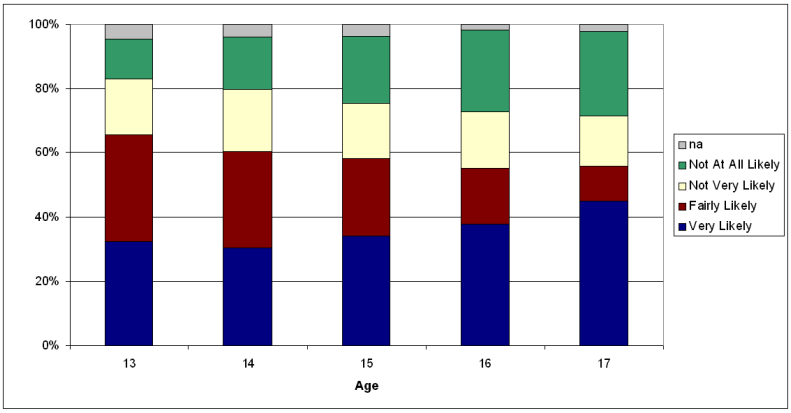
1.6 Results

1.6.1 Aspirations

I first proceed with the estimation of the parameter c as in equation 1.15.b and I use, as a measure of aspirations, the stated likelihood of applying to college. As explained in section 3.3, in each wave of the LSYPE, youths are asked to state how likely they are of applying to university and they are given four options: "very likely", "fairly likely", "not very likely" and "not at all likely". This question is asked to the pupils every year until they reach age 18 and their answers show a good variability over time, getting more polarized as they grow older (figure 1.2).

In order to estimate the structural parameter of interest (b), I reshape this "aspirations" variable as a dichotomous one, giving it value one if the pupil states she is either very or

Figure 1.2: Likelihood of applying to university at age 18. LSYPE waves 1-5.



fairly likely to apply and 0 if she says she is not very or not at all likely to apply and I pool observations over time for the same individual.[29]

Figure 1.4 shows the jump at the discontinuity in the probability of stating to be likely to apply to university of about 4.5 percentage points over a baseline probability of 52.7%. If aspiartions automatically translated into effective choices the magnitude of this effect would be very large: comparing it to the estimates of Dearden et al. (2009), a similar increase in the probability of enrollment would be equivalent to that generated by a grant of over 1,700 £.

Table 1.3 reports the detailed results, these are robust to functional form specification (order of polynomial and non parametric specification) and magnitude of the bandwidth. Indeed the results reported in table 1.3 employ an optimal bandwidth computed as in Imbens and Kalyanaraman (2010) together with its half and its double, and figure 1.5 shows the sensitivity of the result to the choice of the bandwidth, revealing how a small bandwidth returns more imprecise yet possibly less biased estimates.

1.6.2 Drop out at 16

I estimate the effect of aspirations on actual schooling choices both at 16, when students only have to decide whether to drop out of school or stay on in full time education and prepare to get into college, and at age 18 when they actually enroll to college.[30]

[29] The results are qualitatively similar but less precise if I estimate the treatment effect year by year.

[30] After 16, having passed the GCSE examinations, students can stay in education and obtain the A-levels which will allow them to get into university, obtain a degree of further education, or drop out of full

The advantage of looking at the choices made by students when they are 16 is that there are no barriers for them to stay in education at that time: education is still free and they do not need gain admission as they do for college, the UK Higher Education system being highly selective.

I thus estimate a version of equation 1.15.a in which the outcome is a binary variable that equals one if the student stays on in full time education after age 16 and 0 if he drops out. Such indicator is built from both the QLFS data and the LSYPE and presents a similar distribution in the two datasets (table 1.1).

The estimate of the effect of the WP policies obtained through regression discontinuity reveals a positive significant increase in the probability of staying on in education after age 16; as shown in the two panels of figure 1.6 this jump is slightly lower in the QLFS sample than in the LSYPE one, table 1.4 confirming that the effect amounts to 3.2 percentage points in the QLFS and 4.5 percentage points in the LSYPE, from a baseline of respectively 68.6% and 64.1% and is robust to the various specification checks (different functional form specifiactions and choice of bandwidth).

Following equation 1.16.a, I retrieve an estimate of the structural parameter β by dividing these numbers by the estimated increase in aspirations (as from section 1.6.1). This allows me to conclude that a 10 percentage points increase in aspirations (in terms of stated likelihood of going to college) would translate into a 7.2 percentage points increase in the likelihood of staying on in full time education after the compulsory school leaving age of 16. This means that three out of four pupils who want to apply to college decide to stay on in education after 16 so as to effectively get to college. Such a high proportion suggests that modifying aspirations can indeed be a very powerful measure to increase higher education participation.

1.6.3 Higher Education Participation

The final outcome of interest, the target of the WP policies, is then participation to full time college. I use again both the data from the QLFS and those from the LSYPE to estimate the effect of the policy on the probability of enrolling to university ($\hat{\gamma} = \widehat{(\beta \times b)}$).

time education.

As shown in figure 1.8, the jump generated by the policy is not anymore statistically significant, neither with the QLFS nor with the LSYPE data. Such jump is estimated to be around 0.6 to 1.5 percentage points on both datasets (respectively from a baseline of 39% and 36.6%). This translates into a non significant 1.3 to 3.4 percentage points increase in the probability of going to college for an increase of 10 percentage points in aspirations (equation 1.16.b).

This finding casts a shadow on the efficacy of the WP policies: it shows that increased aspirations may well translate into a lower rate of drop out at age 16, but do not automatically generate an increase in college attendance. It is therefore reasonable to expect there to be other factors hampering the participation to higher education of pupils from low socio economic background.

1.6.4 Analysis of heterogeneous effects

As predicted by the model in section 3.2, the final effect of a raise in aspirations on the accumulated level of human capital depends on the individual's level of accumulated cognitive skills and on his family background. The analysis of heterogeneity along these two lines in the effects of a raise in aspirations allows us to shed some light on the mechanisms that underlie the final average effect described above.
In order to distinguish among the four cases described in section 3.2, I first look at the distribution of the effects depending on parental income. Splitting the sample in income quantiles, I find that the increase in aspirations and continuation rates at age 16 is concentrated among pupils belonging to middle income families (those in the second and third quintiles of the parental income distribution,[31]) whereas participation to higher education at age 18 significantly increases only for those pupils who belong to high income families (6 percentage points more likely to enroll to university from a baseline of 33.2% in the QLFS and 15 percentage points from a baseline of 37.9% in the LSYPE).
This result allows us to exclude the possibility that the economy exhibits perfect credit markets and inputs in the production function of ability are substitutable (case 1 in the list described n section 3.2). On the other hand, the result by which a raise in aspirations generates a positive effect only on those with high income remains compatible with the

[31]The distribution of parental income in the LSYPE cannot be split in more than for quantiles because income is top coded and the highest bin contains about a quarter of the population.

other three options: that inputs are substitutable and some individuals are credit constrained, that inputs are not substitutable and everyone has access to credit, that inputs are substitutable and not everyone has access to credit. The analysis of heterogeneity in the effects depending on pre-accumulated cognitive skills and on the interaction between these and parental income can allow me to distinguish among these cases.

The LSYPE contains information on the history of the pupils' school achievements taken from the administrative data of the National Pupil database (NPD). In order to assess whether the policy had a differential impact depending on the level of cognitive skills, I split the sample according to their average score at Key Stage 2 tests. These tests are taken by all English pupils when they are 11, at the end of grade 6 (junior school).
The results in table 1.7 reveal that there is no clear pattern in the effect of the policy on neither aspirations nor school participation and reject the hypothesis that the effect is positive only for those with high cognitive skills. This finding rules out the possibility that cognitive skills are perfect complements to non cognitive skills and that there are no credit constraints (case 3 of section 3.2).

A final exercise I perform consists in pooling together the income and the ability distributions by splitting the sample in four groups (table 1.8): the first group is formed of individuals who fall in the two lowest quartiles of both the income and the ability distribution (Q1/Q2-P1/P2); the second of those who fall in the two lowest quartiles of the income distribution but whose KS2 scores were above the median (Q1/Q2-P3/P4); the third group are those whose parental income is above the median but whose KS2 scores below (Q3/Q4-P1/P2); and the last group is formed of those who fall in the two top quartiles of both the income and the ability distributions.
Having rejected the case that there are no credit constraints, I want to understand whether the fact that I find a positive final effect only on pupils coming from the most affluent families is only due to the fact that only them can borrow as much as they like or is further caused by the existence of a positive degree of substitutability between inputs in the ability production function (case 2 or 4 in section 3.2). Indeed if inputs were substitutable, the effect would be positive on both high and low ability students coming from well off families because the increase in non cognitive skills would more than compensate for the gap in cognitive skills; if instead inputs were perfect complements, the effect on those who

come from more affluent families but have low cognitive skills would be null.
The results in table 1.8 show that indeed among those whose parents have high income (Q3-Q4) there is no difference in the effects of the policy between those with high (P3-P4) and those with low (P1-P2) cognitive skills (columns 3 and 4) so that one would point at the existence of a positive degree of substitutability between cognitive and non cognitive skills in the production of ability and rule out the possibility that the difference in the effects of the policy between high and low income families is (partly) due to the fact that a raise in only one of the inputs of the ability production function (non cognitive skills) would have no effect on the resulting level of ability if children have low levels of either of the two other inputs, i.e. cognitive skills and family income.

1.6.5 Evidence on cross-productivity effects

The model described in section 3.2 is based on the assumption that an exogenous increase in non cognitive skills does not per se generate an increase in cognitive skills too. This is what Cunha et al. (2010) define "cross productivity effects" providing evidence that these are quite significant at early ages (6-7 to 8-9 year old) and decreases significantly later on so that at ages 10-11 to 12-13 the estimated cross productivity effect between non cognitive and cognitive skills is essentially null.

I investigate the presence and magnitude of cross productivity effects among the WP target pupils through the analysis of the NPD data; I use two measures of cognitive skills at age 18: the first is the number of A-level equivalent examinations taken, these are the academic qualifications obtained at the end of the thirteenth grade (at age 18) and their results are the main criterion for admission to college, students can decide how many and which A-level subjects to study and be examined on, most of them choose to sit three to four examinations. The second measure is instead the total point score the students obtain at grade 13, which gives a measure of their performance at the A-level examinations.
Estimating the treatment effect on pupils' achievements, I find that the policy did neither affect the number of A-levels obtained nor the total point score obtained by students at age 18 confirming that the possible cross productivity effects do not appear in late adolescence as suggested by Cunha and Heckman (2010). The results are illustrated in figures 1.10 and 1.11 and detailed in table 1.9.

1.7 Specification checks

In order for the Sharp Regression Discontinuity Design to yield consistent estimates we require the counter factual conditional distribution of the outcome variable to be smooth in the covariate YPR, i.e. that the probability of enrolling into higher education, in the absence of the policy, is "continuously" related to the youth participation rate of the census ward of residence.
While this assumption cannot be tested directly, it is common practice to assess its feasibility by checking that other variables which are usually associated to the outcome of interest do not also vary discontinuously at the threshold (Imbens and Lemieux, 2008). Figures 1.12 and 1.13 show that both mother's education and parental income do not exhibit any suspicious discontinuity at the cutoff point for both the QLFS and the LSYPE samples. Moreover analytic estimates of the discontinuities for these and several other variables are reported in table 1.10 and are indeed not significantly different from zero.

I finally run two falsification tests and reestimate all the main results at a "false" cut off point for the LSYPE sample and for an "older" cohort for the QLFS sample.
For the LSYPE, where only one cohort of pupils is surveyed, I "move" the cut off point "up" by 10 percentage points and check that there are no significant discontinuities there. The results, in table 1.11 , show no "effect" on any of the variables of interest.
The QLFS instead, with its household structure and its longer history, allows me to estimate the "effects" on a sample of individuals who reside in the same target areas but are too old to be themselves exposed to any WP initiative in that they finished secondary school between 1996/97 and 2000/2001.
The estimates reported in table 1.12 confirm that there was no effect of the WP policies on older cohorts and thus the discontinuities identified are not due to some unobserved feature of the population but only to the policy intervention.

1.8 Concluding Remarks

This paper contributes to the literature on human capital accumulation and, in particular, on the role of non cognitive abilities in shaping children's future providing a clear identification of the actual impact on educational achievements of a policy intervention that exogenously improves non cognitive abilities without affecting neither cognitive abilities

nor financial constraints.

The results revealed that students from low socio economic background do have lower aspirations and that this does hamper their chances of going to college. Indeed the activities carried out through Widening Participation significantly raised their motivation to go to college and consequently kept them in full time education after the compulsory school leaving age of 16.
Yet, the final effect on college attendance was modest. I showed that this is due to the existence of binding credit constraints rather than to the presence of strong complementarities between the inputs in the ability production function. Moreover the fact that the *gap* in test scores at age 18 between low and high SES students is not affected by the policy intervention proves that there are no cross-productivity effects in the production of ability of teenagers.

The results of this paper naturally have limited external validity because of the estimation strategy employed which does give very precise estimates, but only of a *local* effect (on individuals around the discontinuity point).
Still this paper provides very meaningful and new insights on the mechanisms which rule individuals' schooling choices being the first to test the impact of a nation wide program that aims at increasing education by acting uniquely on pupils' non cognitive traits, such as aspirations and motivation. The inclusion of these elements in a model of schooling choice seems to have been too long neglected by economists in contrast with the primary role that politicians have been assigning to them. The significant effects found in this paper confirm the need to put more attention on the role of non cognitive abilities and show that there is scope for policy makers to increase participation to higher education among teenagers from disadvantaged background by "manipulating" their non cognitive traits.
Nevertheless it remains clear that barriers to widening participation also include other factors and primarily access to financial resources, so that an optimal widening participation policy would need not to just "inspire" teenagers from low socio-economic status, but also to ensure that they have access to the financial means necessary to afford the costs of going to college.

1.9 Tables and Figures

Figure 1.3: Widening Participation activities carried out by a sample of colleges.

Source: Bowes et al. (2013)

Table 1.1: Descriptive Statistics for QLFS and LSYPE samples.

	QLFS				LSYPE			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full Sample	Eligible	Non Eligible	(2)-(3)	Full Sample	Eligible	Non Eligible	(6)-(7)
Female	0.497	0.500	0.495	0.005	0.485	0.489	0.480	0.009
	(0.500)	(0.500)	(0.500)		(0.500)	(0.500)	(0.500)	
White	0.849	0.843	0.854	-0.011	0.877	0.878	0.876	0.002
	(0.358)	(0.364)	(0.353)		(0.328)	(0.328)	(0.329)	
Urban	0.808	0.915	0.725	0.190***	0.796	0.907	0.69	0.216***
	(0.394)	(0.279)	(0.446)		(0.403)	(0.29)	(0.463)	
London	0.087	0.068	0.102	-0.034***	0.106	0.0721	0.139	-0.067***
	(0.282)	(0.251)	(0.303)		(0.308)	(0.259)	(0.346)	
Post 16 education	0.683	0.625	0.732	-0.107***	0.641	0.540	0.732	-0.192***
	(0.463)	(0.484)	(0.443)		(0.480	(0.498)	(0.443)	
Higher Education	0.352	0.337	0.363	-0.026**	0.399	0.284	0.499	-0.214***
	(0.477)	(0.473)	(0.484)		(0.490)	(0.450)	(0.451)	
log Parental Income	5.937	5.808	6.019	-0.211***	3.053	2.976	3.123	-0.147***
	(0.778)	(0.725)	(0.800)		(0.541)	(0.55)	(0.523)	
Father post-16 education	0.371	0.261	0.412	-0.151***	0.443	0.331	0.537	-0.206***
	(0.483)	(0.439)	(0.492)		(0.497)	(0.471)	(0.499)	
Mother post-16 education	0.427	0.298	0.507	-0.209***	0.369	0.273	0.46	-0.187***
	(0.495)	(0.458)	(0.500)		(0.482)	(0.445)	(0.498)	

Mean Coefficients. Standard Deviations in parentheses. Estimates in columns (4) and (6) clustered at census ward level.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

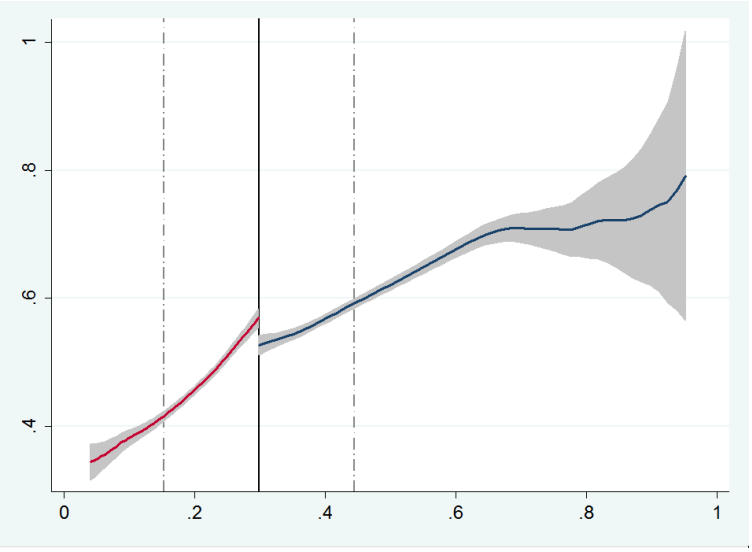
Table 1.2: Descriptive Statistics for NPD sample.

	(1) Full Sample	(2) Eligible	(3) Non Eligible	(4) (2)-(3)
N	661,265	315,843	345,422	
Female share	0.486	0.488	0.485	0.003**
	(0.500)	(0.500)	(0.500)	
White	0.806	0.819	0.792	0.026***
	(0.395)	(0.385)	(0.406)	
Free School Meal Eligibility	0.160	0.219	0.0976	0.118***
	(0.367)	(0.413)	(0.297)	
Number of A levels	2.722	2.306	2.886	-0.58***
	(1.606)	(1.667)	(1.526)	
Key Stage 4 A*	0.388	0.168	1.213	-0.362***
	(1.298)	(0.858)	(1.606)	
Key Stage 3 total points (of 141)	97.925	91.702	103.084	-11.382***
	(27.10)	(27.37)	(25.69)	
Key Stage 2 English mark	59.93	57.01	62.56	-5.56***
	(14.47)	(14.58)	(13.86)	

Mean Coefficients. Standard Deviations in parentheses

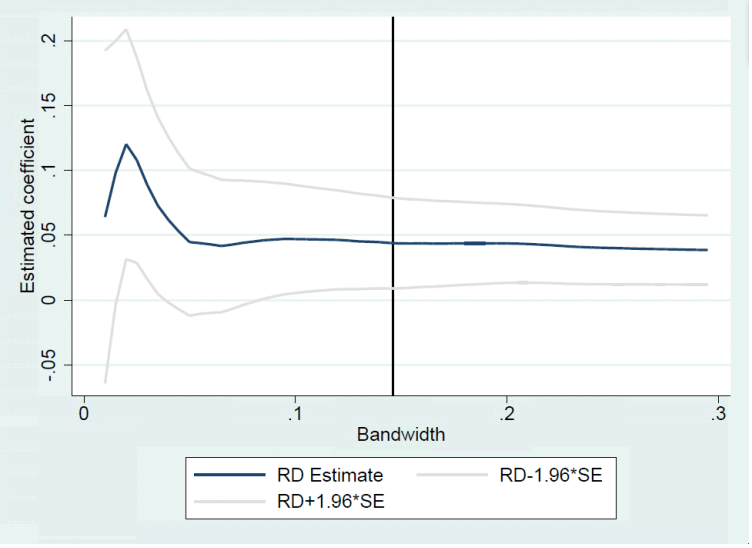
$^{*}p < 0.05,\ ^{**}p < 0.01,\ ^{***}p < 0.001.$

Figure 1.4: Aspirations: probability of stating to be likely to apply to university.



*The graph shows Local Linear Regression estimates with Triangular Kernel weights. The solid vertical line indicates the cutoff point. The dashed vertical lines indicate the boundaries determined by the optimal bandwidth as used in table 1.3.

Figure 1.5: Aspirations: WP effect by bandwidth. LSYPE.



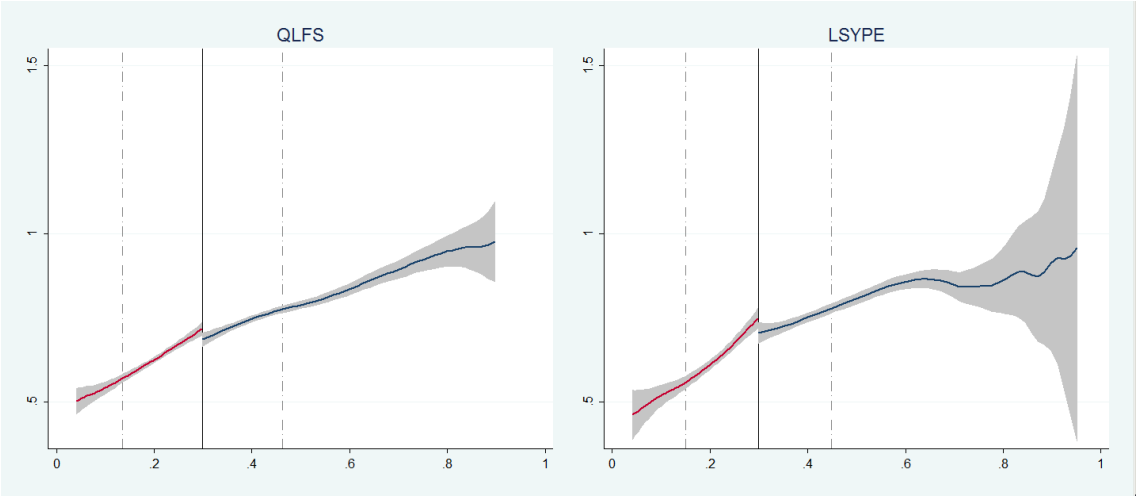
*The graph shows the estimated coefficient and its 95% confidence interval for varying values of bandwidth. The solid vertical line indicates the optimal bandwidth as used in table 1.3.

Table 1.3: Regression Discontinuity Results. Effect of WP policies on aspirations.

	Parametric specification			Non parametric specification		
	First Order Polynomial	Second Order Polynomial	Third Order Polynomial	Optimal Bandwidth	1/2 Optimal Bandwidth	2 Optimal Bandwidth
Aspirations (LSYPE)						
ITT	0.044**	0.044**	0.044**	0.0439**	0.0436*	0.0387***
	(0.017)	(0.019)	(0.022)	(0.0188)	(0.026)	(0.014)
Bandwidth	0.1	0.2	0.3	0.146	0.073	0.292
R-squared	0.0192	0.0194	0.0194			
Observations	31,555	52,937	60,452	63,338	63,338	63,338
Baseline (RHS)	0.599	0.598	0.597	0.527	0.520	0.519

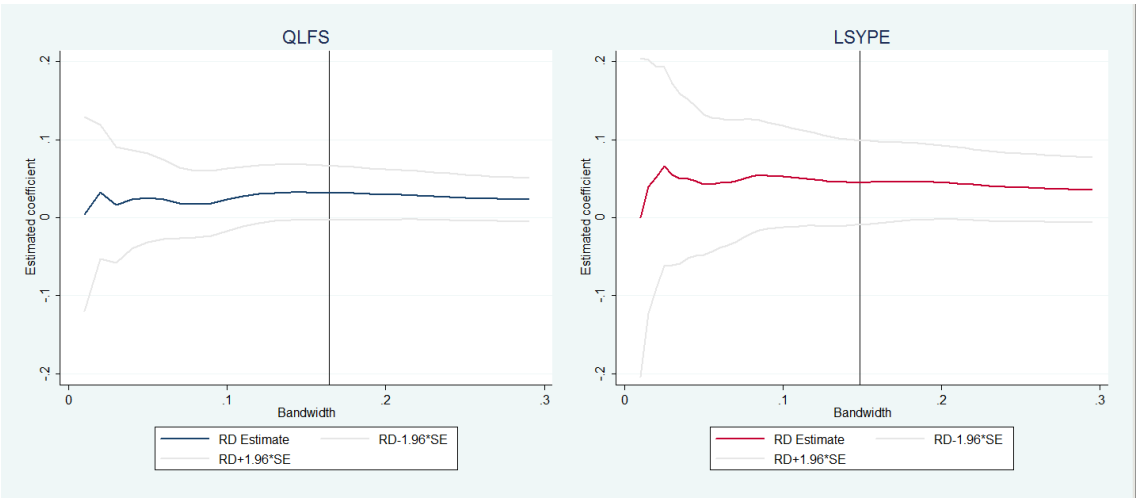
* Pooled panel sample. Standard Errors clustered at the census ward level in parentheses. Non parametric specification is Local Linear Regression with triangular Kernel weights. Optimal bandwidth is computed according to Imbens and Kalyanaraman (2010).

Figure 1.6: Probability of staying on in full time education at age 16, QLFS and LSYPE.



*The graphs show Local Linear Regression estimates with Triangular Kernel weights.The solid vertical line indicates the cutoff point. The dashed vertical lines indicate the boundaries determined by the optimal bandwidth as used in table 1.4.

Figure 1.7: Probability of staying on in full time education at age 16: WP effect by bandwidth. QLFS and LSYPE.



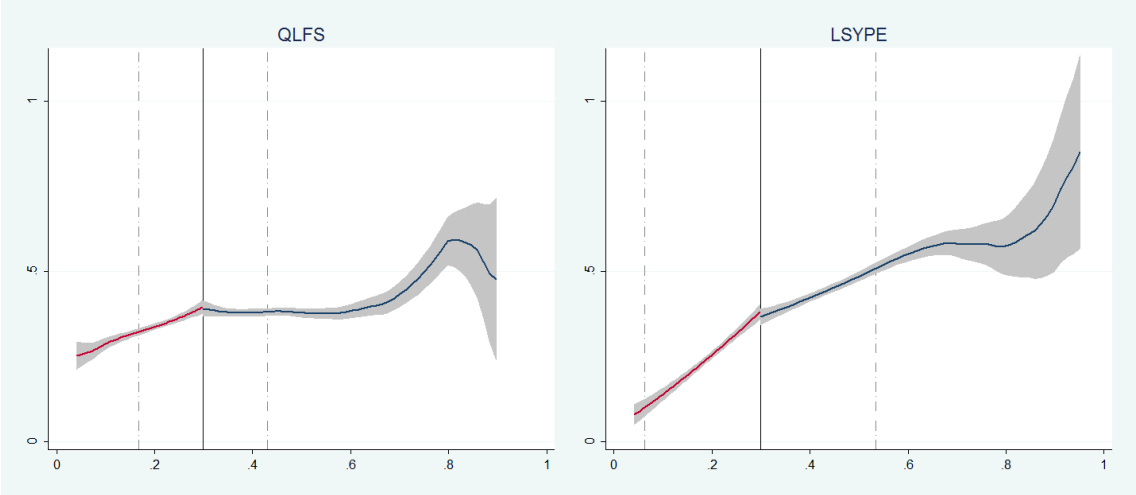
*The graphs show the estimated coefficient and its 95% confidence interval for varying choices of bandwidth. The solid vertical line indicates the optimal bandwidth as used in table 1.4.

Table 1.4: Regression Discontinuity Results. Effect of WP policies on Schooling Choices at 16.

	Parametric specification			Non parametric specification		
	First Order Polynomial	Second Order Polynomial	Third Order Polynomial	Optimal Bandwidth	1/2 Optimal Bandwidth	2 Optimal Bandwidth
FT School at 16 (QLFS)						
ITT	0.040*	0.038*	0.036*	0.032*	0.0157	0.022
	(0.021)	(0.023)	(0.027)	(0.020)	(0.028)	(0.015)
Bandwidth	0.1	0.2	0.3	0.164	0.082	0.328
R-squared	0.0059	0.0223	0.0285			
Observations	12,162	21,426	24,360	25365	25365	25365
Baseline (RHS)	0.685	0.682	0.680	0.686	0.696	0.694
FT School at 16 (LSYPE)						
ITT	0.050**	0.064**	0.063**	0.0452	0.0499	0.0356*
	(0.025)	(0.027)	(0.032)	(0.027)	(0.039)	(0.021)
Bandwidth	0.1	0.2	0.3	0.149	0.074	0.298
R-squared	0.0087	0.0287	0.0406			
Observations	5,477	9,211	10,543	11,071	11,071	11,071
Baseline (RHS)	0.705	0.703	0.704	0.641	0.644	0.632

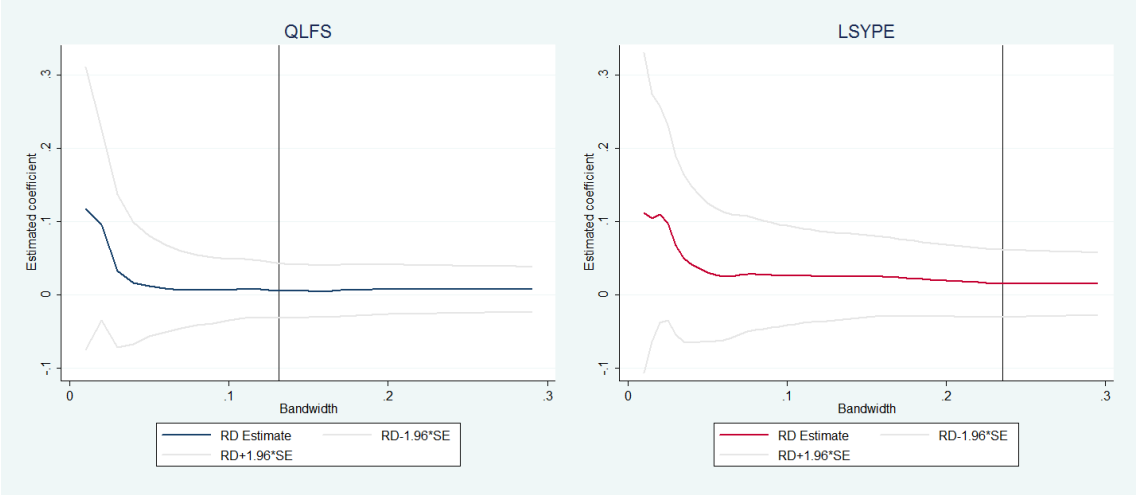
* Standard Errors clustered at census ward level in parentheses. Non parametric specification is Local Linear Regression with triangular Kernel weights. Optimal bandwidth is computed according to Imbens and Kalyanaraman (2010).

Figure 1.8: Probability of enrolling to a Higher Education Institution at age 18. QLFS and LSYPE.



*The graphs show Local Linear Regression estimates with Triangular Kernel weights.The solid vertical line indicates the cutoff point. The dashed vertical lines indicate the boundaries determined by the optimal bandwidth as used in table 1.5.

Figure 1.9: Probability of enrolling to a Higher Education Institution at age 18: WP effect by bandwidth.



*The graphs show the estimated coefficient and its 95% confidence interval for varying choices of bandwidth. The solid vertical line indicates the optimal bandwidth as used in table 1.5.

Table 1.5: Regression Discontinuity Results. Effect of WP policies on Schooling Choices at 18.

	Parametric specification			Non parametric specification		
	First Order Polynomial	Second Order Polynomial	Third Order Polynomial	Optimal Bandwidth	1/2 Optimal Bandwidth	2 Optimal Bandwidth
College at 18 (QLFS)						
ITT	-0.007	0.003	0.007	0.004	0.003	0.007
	(0.027)	(0.029)	(0.033)	(0.027)	(0.034)	(0.019)
Bandwidth	0.1	0.2	0.3	0.127	0.064	0.255
R-squared	0.0022	0.0035	0.0044			
Observations	13,923	24,444	27,965	29,210	29,210	29,210
Baseline (RHS)	0.393	0.396	0.400	0.390	0.388	0.382
College at 18 (LSYPE)						
ITT	0.040	0.029	0.035	0.015	0.025	0.016
	(0.028)	(0.032)	(0.037)	(0.025)	(0.034)	(0.021)
Bandwidth	0.1	0.2	0.3	0.236	0.118	0.472
R-squared	0.0093	0.0305	0.0478			
Observations	7,833	14,139	16,241	15,909	15,909	15,909
Baseline (RHS)	0.457	0.497	0.494	0.366	0.364	0.361

* Standard Errors clustered at census ward level in parentheses. Non parametric specification is Local Linear Regression with triangular Kernel weights. Optimal bandwidth is computed according to Imbens and Kalyanaraman (2010).

Table 1.6: Heterogeneous effects by income quantile.

	Non parametric specification				
	Q1	Q2	Q3	Q4	Q5
Likely to apply to university (LSYPE)	0.032	0.065*	0.056	0.041	
	(0.038)	(0.037)	(0.035)	(0.039)	
	[0.177]	[0.103]	[0.122]	[0.120]	
	12120	*12397*	*13245*	*10255*	
Continue Education at age 16 (QLFS)	0.031	0.031	0.148**	-0.003	0.040
	(0.070)	(0.063)	(0.070)	(0.047)	(0.046)
	[0.113]	[0.135]	[0.112]	[0.207]	[0.159]
	1727	*1720*	*1667*	*1883*	*2254*
Continue Education at age 16 (LSYPE)	0.033	0.096**	0.021	0.028	
	(0.056)	(0.048)	(0.050)	(0.046)	
	[0.231]	[0.180]	[0.145]	[0.162]	
	2040	*1888*	*2299*	*2267*	
Enrolled to University at age 18 (QLFS)	-0.012	-0.039	-0.032	-0.041	0.060
	(0.049)	(0.051)	(0.055)	(0.054)	(0.040)
	[0.227]	[0.186]	[0.138]	[0.110]	[0.287]
	2076	*2064*	*2023*	*2319*	*2909*
Enrolled to University at age 18 (LSYPE)	-0.025	0.053	0.014	0.153*	
	(0.079)	(0.067)	(0.054)	(0.080)	
	[0.0923]	[0.117]	[0.166]	[0.106]	
	2697	*2922*	*3593*	*3094*	

* Standard Errors clustered at census ward level in parentheses; optimal bandwidth computed according to Imbens and Kalyanaraman (2010) in brackets; number of observations in italics.

Table 1.7: Heterogeneous effects by cognitive ability quantile.

	Non parametric specification			
	P1	P2	P3	P4
Likely to apply to university (LSYPE)	0.047	0.073*	0.021	0.0004
	(0.032)	(0.040)	(0.033)	(0.024)
	[0.155]	[0.122]	[0.154]	[0.160]
	14763	*14701*	*14707*	*14600*
Continue Education at age 16 (LSYPE)	-0.062	0.118*	0.017	0.034
	(0.072)	(0.068)	(0.052)	(0.037)
	[0.096]	[0.101]	[0.145]	[0.122]
	2246	*2546*	*2674*	*2893*
Enrolled to University at age 18 (LSYPE)	-0.0157	0.0317	0.0534	-0.0336
	(0.045)	(0.049)	(0.056)	(0.054)
	[0.124]	[0.153]	[0.158]	[0.178]
	3398	*3688*	*3837*	*4011*

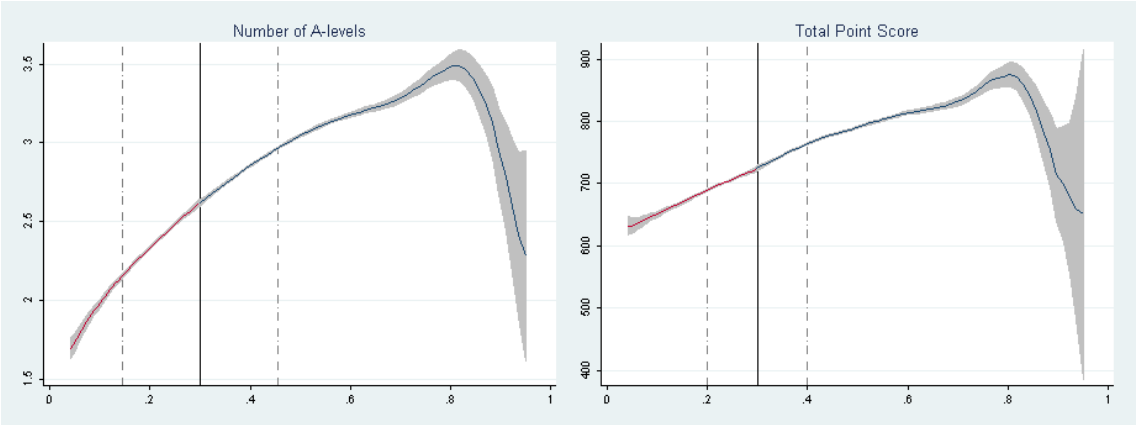
* Standard Errors clustered at census ward level in parentheses; optimal bandwidth computed according to Imbens and Kalyanaraman (2010) in brackets; number of observations in italics.

Table 1.8: Heterogeneous effects by income and cognitive ability quantile.

	Non parametric specification			
	Q1/Q2-P1/P2	Q1/Q2-P3/P4	Q3/Q4-P1/P2	Q3/Q4-P3/P4
Likely to apply to university (LSYPE)	0.096**	-0.023	0.052	0.043
	(0.044)	(0.034)	(0.060)	(0.035)
	[0.106]	[0.194]	[0.090]	[0.120]
	13442	*9386*	*8218*	*13524*
Continue Education at age 16 (LSYPE)	0.108	0.064	0.072	-0.006
	(0.071)	(0.074)	(0.071)	(0.038)
	[0.116]	[0.096]	[0.169]	[0.178]
	2057	*1642*	*1498*	*2755*
Enrolled to University at age 18 (LSYPE)	0.101*	-0.121	0.089	0.015
	(0.054)	(0.010)	(0.071)	(0.054)
	[0.106]	[0.068]	[0.095]	[0.192]
	2790	*2539*	*2052*	*4165*

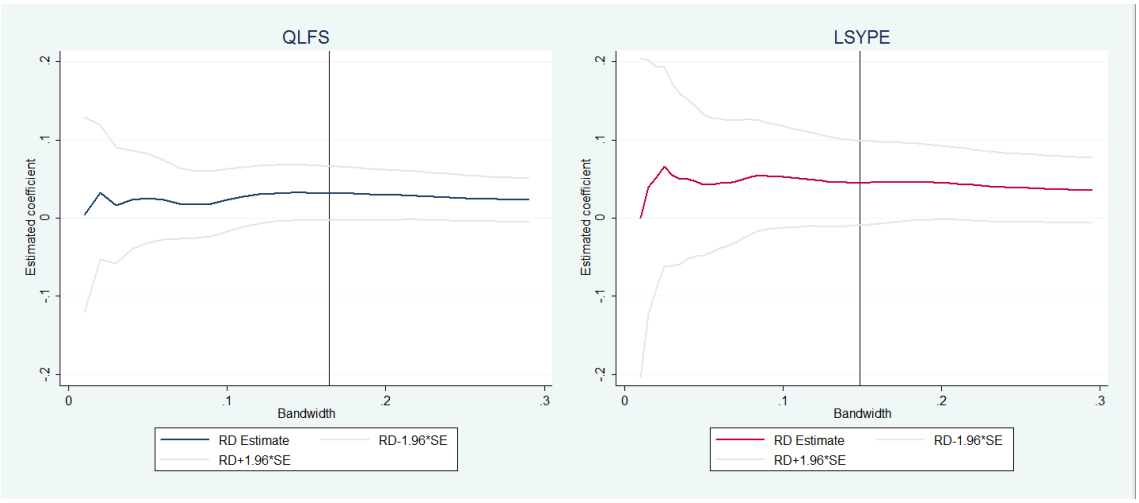
* Each column reports estimates for quartiles Q of income distribution and quartiles P of ability distribution. Standard Errors in parentheses; optimal bandwidth computed according to Imbens and Kalyanaraman (2010) in brackets; number of observations in italics.

Figure 1.10: Effect on academic achievements at age 18. NPD.



*The graphs show Local Linear Regression estimates with Triangular Kernel weights.The solid vertical line indicates the cutoff point. The dashed vertical lines indicate the boundaries determined by the optimal bandwidth as used in table 1.9.

Figure 1.11: Effect on academic achievements at age 18: WP effect by bandwidth.



*The graphs show the estimated coefficient and its 95% confidence interval for varying choices of bandwidth. The solid vertical line indicates the optimal bandwidth as used in table 1.9.

Table 1.9: Regression Discontinuity Results. Effect of WP policies on academic achievements at age 18. NPD.

	Non parametric specification					
	Optimal Bandwidth	1/2 Optimal Bandwidth	2 Optimal Bandwidth	Optimal Bandwidth	1/2 Optimal Bandwidth	2 Optimal Bandwidth
Outcome:	*Number of A levels*			*Total Point Score*		
ITT	0.0000115	0.016	0.003	1.600	4.329	1.997
	(0.026)	(0.035)	(0.003)	(5.931)	(8.270)	(4.346)
Bandwidth	0.1554	0.0777	0.3109	0.0998	0.0499	0.1997
Observations	236,283	236,283	236,283	236,283	236,283	236,283
Baseline (RHS)	0.599	0.598	0.597	0.5271		

* Pooled panel sample. Standard Errors clustered at census ward level in parentheses. Non parametric specification is Local Linear Regression with triangular Kernel weights. Optimal bandwidth is computed according to Imbens and Kalyanaraman (2010).
Number of A levels is total number of GCE/VCE A/AS Level and GCE AS/VCE Double Award Level passes (A Level equivalencies); Total Point Score is the sum of QVCA points obrained by student at Key Stage 5, for details:
http://www.education.gov.uk/schools/performance/archive/16to18_08/d4.shtml

Figure 1.12: Distribution of main covariates across the discontinuity threshold. QLFS.

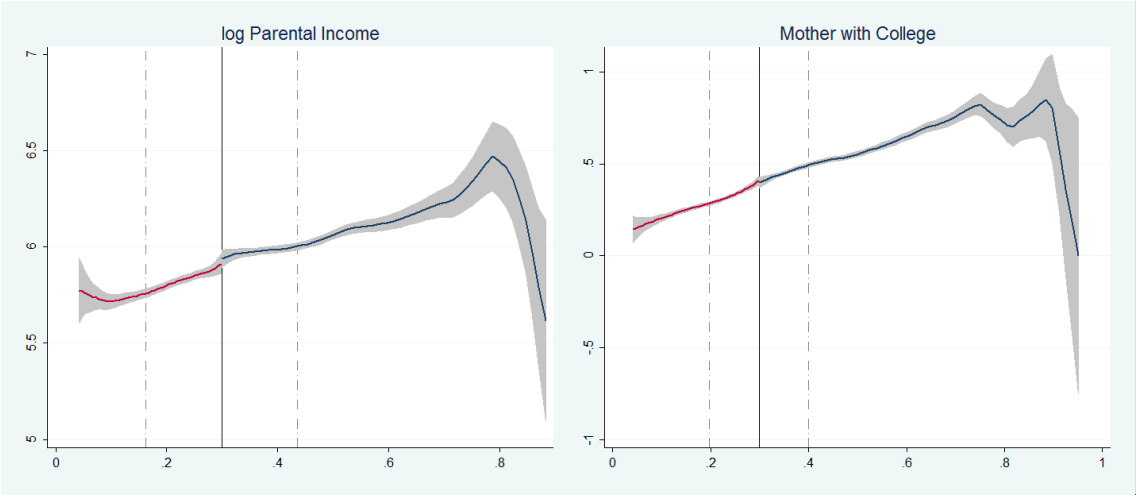


Figure 1.13: Distribution of main covariates across the discontinuity threshold. LSYPE.

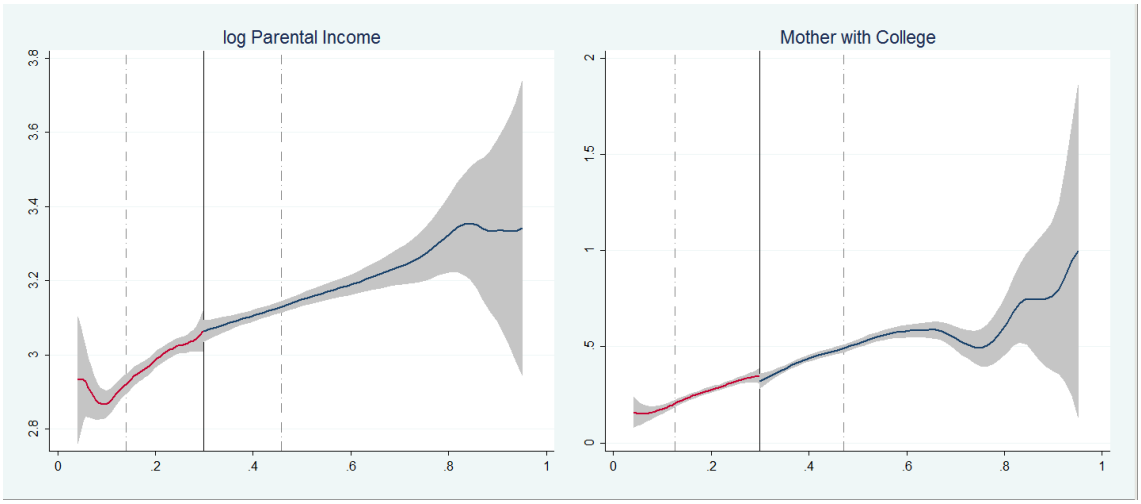


Table 1.10: Specification Checks: Distribution of main covariates across the discontinuity threshold. Non parametric Estimates.

	QLFS	LSYPE
Female	0.0241	0.0352
	(0.021)	(0.024)
	[25365]	[15419]
White	-0.0113	-0.0257
	(0.024)	(0.018)
	[25365]	[15732]
Household Size	0.050	0.0485
	(0.078)	(0.057)
	[25365]	[11713]
log Parental Income	-0.073	-0.149
	(0.047)	(0.461)
	[9251]	[11726]
Father with College	0.005	0.027
	(0.023)	(0.030)
	[14283]	[14739]
Mother with College	0.044	0.031
	(0.038)	(0.022)
	[12705]	[14197]

* Standard Errors in parentheses. Estimates are obtained through Local Linear Regression with triangular Kernel weights. Bandwidth is computed according to Imbens and Kalyanaraman (2010).

Table 1.11: Specification Checks: Falsification exercise. LSYPE.

	Optimal Bandwidth	1/2 Optimal Bandwidth	2 Optimal Bandwidth
Likely to apply to College			
ITT	-0.004	0.020	0.008
	(0.023)	(0.031)	(0.016)
Bandwidth	0.131	0.0655	0.262
Observations	63,338	63,338	63,338
Baseline (RHS)	0.556	0.546	0.564
Continue Education at age 16			
ITT	0.008	0.043	0.027
	(0.031)	(0.042)	(0.023)
Bandwidth	0.157	0.0785	0.314
Observations	11,071	11,071	11,071
Baseline (RHS)	0.684	0.670	0.693
Enrolled to University at age 18			
ITT	0.015	0.060	0.034
	(0.037)	(0.051)	(0.027)
Bandwidth	0.125	0.0625	0.250
Observations	15,909	15,909	15,909
Baseline (RHS)	0.423	0.411	0.410

* Standard Errors clustered at census ward level in parentheses; optimal bandwidth is computed according to Imbens and Kalyanaraman (2010).

Table 1.12: Specification Checks: Falsification exercise. QLFS.

	Optimal Bandwidth	1/2 Optimal Bandwidth	2 Optimal Bandwidth
Continue Education at age 16			
ITT	0.003	0.010	0.0005
	(0.017)	(0.023)	(0.013)
Bandwidth	0.09	0.045	0.18
Observations	53,749	53,749	53,749
Baseline (RHS)	0.680	0.682	0.686
Enrolled to University at age 18			
ITT	0.008	0.013	0.002
	(0.012)	(0.016)	(0.009)
Bandwidth	0.0894	0.0447	0.1788
Observations	55,090	55,090	55,090
Baseline (RHS)	0.119	0.116	0.125

* Standard Errors clustered at census ward level in parentheses; optimal bandwidth is computed according to Imbens and Kalyanaraman (2010).

1.10 Appendices

1.10.1 Proof that $\frac{\partial h^*}{\partial a} < 0$, in the case of binding credit constraints

Let: $F \equiv -u'(y_0 + w_0\ (1 - h^*) - \tau\ h^* + \bar{d})\ +\ \beta u'(w_1\ a\ f(h^*, a) - R\bar{d})\ w_1\ a\ f'_h$

i.e. the left hand side of the first order condition defined in equation 1.9

By implicit function theorem:

$$\frac{\partial h^*}{\partial a}\ =\ -\frac{\partial F/\partial a}{\partial F/\partial h^*}$$

I first study the sign of $\frac{\partial F}{\partial a}$:

$$\frac{\partial F}{\partial a}\ = \beta u'(c_1)\ \left[w_1\ a\ f''_{ha}\ + w_1\ f'_h\right]\ +\ \beta u''(c_1)\left[w_1\ a\ f'_a + w_1 f(h,a)\right] w_1\ a\ f'_h$$

The latter will be positive if:

$$-\frac{u'(c_1)}{u''(c_1)} > \frac{a\ f'_a + f(h,a)}{a\ f''_{ha}\ +\ f'_h} w_1\ a\ f'_h$$

I assume, to simplify the expression above, that:

$u(\cdot) = \log(\cdot)$ and $f(h,a) = a^{\alpha}\ h^{(1-\alpha)}$

(The results hold for any CES ability production function.)

Under such assumptions and after simplifying, the condition above becomes:

$c_1 > f(h,a)\ w_1\ a \Leftrightarrow$

$\Leftrightarrow\ f(h,a)\ w_1\ a - Rd\ >\ f(h,a)\ w_1\ a$

which is never satisfied because $d > 0$. Therefore:

$$\frac{\partial F}{\partial a}\ <\ 0 \qquad \text{for all credit constrained individuals.}$$

I now assess the sign of $\frac{\partial F}{\partial h^*}$:

$$\frac{\partial F}{\partial h^*}\ =\ u''(c_0)(w_0 + \tau)^2\ +\ \beta u''(c_1)\ (w_1 a f'_h)^2\ +\ w_1\ a\ f''_h\ \beta\ u'(c_1)$$

which is also negative because of the concavity of the utility and of the production function.

It thus follows that:

$$\frac{\partial h^*}{\partial a}\ =\ -\frac{\partial F/\partial a}{\partial F/\partial h^*}\ <\ 0 \qquad \text{for all credit constrained individuals, Q.E.D.}$$

1.10.2 Summary of effects of raising aspirations

1. **s>0 and perfect credit markets**:

	High y_0	Low y_0
High θ_c	+	+
Low θ_c	+	+

2. **s>0 and imperfect credit markets**:

	High y_0	Low y_0
High θ_c	+	+/-
Low θ_c	+	+/-

3. **s=0 and perfect credit markets**:

	High y_0	Low y_0
High θ_c	+	0
Low θ_c	0	0

4. **s=0 and imperfect credit markets**:

	High y_0	Low y_0
High θ_c	+	0
Low θ_c	0	0

Chapter 2

Home or Away? Gender differences in the effects of an expansion of tertiary education supply

Abstract

The objective of this work is to estimate the effects of the expansion of tertiary education supply onto schooling decisions of Italian young high school graduates. To do so I exploit a quasi-experimental setting given by the reform of the tertiary education system implemented in 2001. The reform was embraced at different points in time and with different degrees. I exploit this geographical variation through a difference-in-differences strategy to estimate the impact of the increase of tertiary education supply on enrollment and mobility decisions.

I find major gender differences: the increase of local tertiary education supply generated a significant increase in females' enrollment rates leaving unchanged those of males; men, on the other hand, switched from studying outside their province of residence to studying at the local university. I interpret these results as suggesting the existence of a relationship of *substitutability* between studying away from home and studying at the local university for boys, but not for girls. Evidence is provided that girls face a higher non pecuniary cost of moving away from home than boys.

The results are robust to various definitions of treatment areas and to different methodological approaches. They eventually lead to the conclusion that the increase of local tertiary education supply can provide a powerful tool to enhance females' educational attainment and thus better exploit the country's human capital potential.

2.1 Introduction

The analysis of investment in human capital and of its drivers is key for understanding the distribution of income across individuals in the society and "[..] explaining differences among regions, countries and time periods" (Becker and Chiswick, 1966). In all developed countries access to higher education is not equally distributed across the population: in the US 57% of individuals from the top household income quartile obtain a college degree, while the percentage for those from the bottom quartile is just 10% (Bailey and Dynarski, 2011); in the UK the percentage of 23 year olds holding a higher education degree is 46% for pupils whose parental income falls in the top 20%, while for those in the bottom 20% the percentage falls to 9% (Blanden and Machin, 2004); in Italy 90% of children whose father has a college degree enroll to college, whereas the figure halves for those whose father has less than secondary education (elaboration on ISTAT (2010a) data), similarly the proportion of those completing college is 65% for the first group and just 7% for the latter (Checchi et al., 1999).

Why is it that some people invest in college education and some do not if returns to this investment are large and positive? And why is it people from lower socio-economic background that invest less in education when their marginal returns from it would be higher?

Moving from the seminal works of Ben-Porath (1967) and Becker (1967), economists traditionally framed schooling choices in terms of a (current) cost versus (future) benefit analysis and argued that it would be mostly the presence of credit constraints that prevents individuals from less affluent families to pursue the optimal level of education (Acemoglu and Pischke, 2001; Kane, 2003). These pupils would lack the financial resources needed to face the costs of attaining a college degree (e.g. tuition fees, living expenses, books etc.) and would not manage to obtain them on the credit market.

A more recent strand of literature has rather stressed the importance of previously accumulated abilities in determining individuals' educational patterns and the resulting social inequalities: pupils who do not obtain a higher education degree would be those who lack a sufficiently high level of (cognitive and non cognitive) abilities to successfully attend college (Heckman, 1999; Heckman and Carneiro, 2003). The gaps in accumulated ability would be related to different *parental environments* (typically parental education) which,

in turn, are reflected into parental income (Cunha and Heckman, 2007).

A second widely known fact related to the present work, is that in all countries in the developed world the number of female students in college has outweighed that of men in spite of generally lower returns to education on the labor market (Jacobs (1996), Bailey and Dynarski (2011)).[1] This is associated with girls being better prepared and performing better at any school level in comparison to their male peers (Jacob (2002), Goldin et al. (2006), Lavy and Schlosser (2011)).[2] and also being more responsive than boys to most education policy interventions (Long, 2007; Dynarski, 2007; Angrist et al., 2009; Garibaldi et al., 2012)

This paper exploits a reform of the Italian university system that was implemented in 2001, to analyze the impact of geographically expanding the supply of tertiary education on individuals' schooling choices, focusing on the difference between the reactions of boys and girls and trying to identify the mechanisms which determine such reactions.
The contribution of the paper is thus twofold: on the one hand it fits into the existing literature about the determinants of schooling choices with the idea that the expansion of tertiary education supply to previously unreached or under supplied areas can lower the associated direct costs of attending college for individuals living in that area (Card, 1993) and thus can push into college some of those for whom the costs of education were outweighing the stream of future returns. In this spirit, recent works have analyzed the impact of geographically expanding the supply of primary (Duflo, 2001), or tertiary education (Card, 1993; Holzer, 2007) finding strong and significant positive effects for primary, while the results for tertiary education are not conclusive.
On the other hand, in the attempt of uncovering some of the mechanisms which lay behind the decision of attending college, the paper also delves into mobility choices (whether to study at the local university or move to a different city) so as to understand if there exist non financial costs associated with moving away from home which eventually prevent some individuals from obtaining a higher education degree. The literature on students' mobility

[1] Goldin (1998) and more recently Kaufmann et al. (2013), argue that this "female college enrollment puzzle" may partly be explained by the existence of large returns to college education on the marriage market.

[2] Some authors (Malamud and Schanzenbach (2007), Lavy (2004)) provide evidence that teachers tend to rate the performance of girls more generously than that of boys thus exacerbating the gender gap in school achievements.

choices is much less rich: some aspects are covered by studies on schooling choices (Hoxby, 2004), while Ordine and Lupi (2009) provide a contribution to the analysis of the Italian context.
Finally, by carrying out all the analysis in a gender perspective, the paper assesses whether boys and girls respond differently to the analyzed policy intervention and thus contributes to the above mentioned literature on gender and education.

From a policy perspective, finally, it is particularly interesting to look at the impact of expanding the supply of tertiary education in Italy in the light of the comparison with other OECD countries in terms of human capital production: Italy is characterized by low enrollment (48% versus 60% OECD average nas of 2011) and graduation rates (21% versus 28% OECD average)[3] coupled with extremely high drop out rates (55% versus 31% OECD average)[4] and these figures translate into the lowest values of stock of tertiary human capital among OECD countries.[5]

The chapter is structured as follows: Section 2.2 describes the Italian context and the reform of the university system of 1999; Section 2.3 introduces the data and provides some descriptive statistics; Section 2.4 outlines the identification and estimation strategies adopted; Section 2.5 describes the estimation results; Section 2.6 digs into the mechanisms that lie behind the results and finally Section 2.7 reports some specification tests and Section 2.8 concludes.

2.2 The Italian university system and the reform of 1999

The Italian university system has traditionally been organized centrally with the national government being responsible for the institution of new colleges, the hiring of new teachers, the design of the academic curricula and the allocation of public funds.
Moreover, admission to college has been free until 2012: any student with a secondary education degree could enroll into college without the need of passing a test or obtaining

[3] Graduation rate is computed as the number of graduates, regardless of their age, divided by population at typical graduation age; OECD (2012).
[4] OECD (2009).
[5] Martins et al. (2007).

particularly good grades at school.[6]

The system was progressively reformed in the course of the Nineties: after being granted a certain level of "autonomy" for what concerned their internal regulations (Law n. 168 of 1989), the design of the academic curricula (Law n. 341 of 1990) and the allocation of the budget (Law n. 537 of 1993), in 1998 colleges were given the possibility of opening (or closing) new schools (*facoltà*) and/or courses without central approval, conditional on self-financing the initiative (DPR n. 25 of 27/1/1998).
The slow and gradual geographical expansion of tertiary education supply that followed the reform of 1998, was strongly accelerated by a new and large reform of the university system that was passed in 1999 (Law n. 509 of 1999) and implemented in 2001. This reform substituted the traditional curricula of four to five years of length with a "two-step" mechanism in which students get a three year undergraduate degree first and a two year advanced degree after that.

The two reforms of 1998 and 1999 came as a response to a sharp declining trend in the rates of college enrollment that had been observed during the Nineties (according to the elaborations of Cappellari and Lucifora (2009), college enrollment rates in Italy had decreased by 8 percent between 1995 and 1998). Through the reform the Government intended to reduce both the direct costs of education by bringing university closer to the students, and the opportunity costs by shortening the duration of studies from five to three years.

This re-design of the curricula, accompanied by the institution of new funds for tertiary education, and combined with the possibility for colleges to open new schools without the approval of the central government, quickly translated into a massive expansion of tertiary education supply all over the country: whereas there were around 320 first level courses before the reform (of which about 170 were four year courses and 150 were three year diplomas), in 2001 the number of first level courses had increased to almost 1200 first level courses (figure 2.1).
This increase, nevertheless, was not uniform all across the national territory: the reform

[6]Some exceptions to this principle were Medical Schools and some other scientific schools which required small students numbers.

generated a significant expansion of smaller and peripheral universities which, supported by the local political authorities, grew substantially in the attempt of generating and sustaining local economic development, whereas the major and older universities, which were already offering all types of degrees, were just marginally affected.

Several authors evaluated the effects of the reform of 1999 on enrollment decisions and educational attainment (Cappellari and Lucifora (2009), Di Pietro and Cutillo (2006), Bratti et al. (2006)), on equality of access to tertiary education (Brunori et al., 2010), and on labor market outcomes (Bosio and Leonardi, 2010) focusing on the effects generated by the *shortening* of the duration of studies and finding that this generated a large and significant increase in enrollment rates but lowered the returns to college on the labor market. This paper expands the existing literature by analyzing the effects of the *geographical* expansion of college supply generated by the reform, looking at both enrollment and mobility choices and focusing on gender heterogeneities .

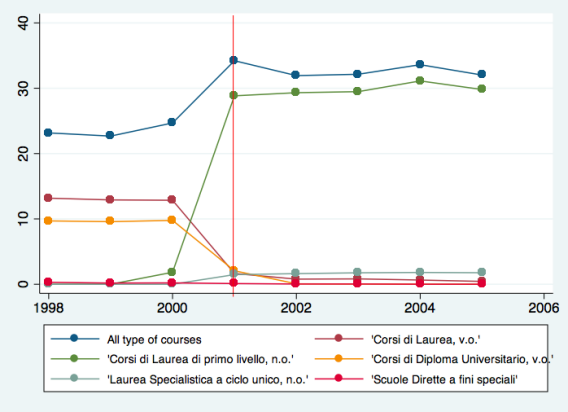
2.3 Data and descriptive statistics

This study mainly relies on three sources of data. The first are the records of the Ministry of Education (MIUR) which provide complete information about the changes that took place on the supply side. Starting from 1998 the Ministry has been collecting yearly data about all tertiary level courses available in each town of Italy. It is thus possible to precisely identify which courses are offered in which province even if the courses are provided by the university of another province (which is typically the case of decentralized campuses whose number has exploded in the Nineties).

The use of the MIUR data allows characterizing the alternatives provided to each single student after high school depending on her province of usual residence (where she attended high school). Depending on this, every student will be faced with a different degree of *intensity* of the change of educational supply induced by the reform; for example a student that lives in a small town may have seen the constitution of a new campus where there wasn't any, while a student living in a big metropolitan area would be faced with only a marginal increase of the education supply.

Figure 2.1 shows the trend of the number of first level degrees offered, the red vertical line represents the year of adoption of the reform. The blue line at the top is the aver-

Figure 2.1: Average number of degrees offered to high school graduates per province, by type of degree



age total number of degrees offered to high school graduates in each province per year. The figure shows a significant increase in the average supply of tertiary education to high school graduates. This increase is also split by type of course offered: it appears that the abolition of the old four or five year curricula (*Corsi di laurea*) and of the three year long Diplomas (*Diplomi Universitari*) was more than offset by the creation of the three year long first level degrees (*Corsi di laurea di primo livello*), while changes in the supply of other types of courses are irrelevant.

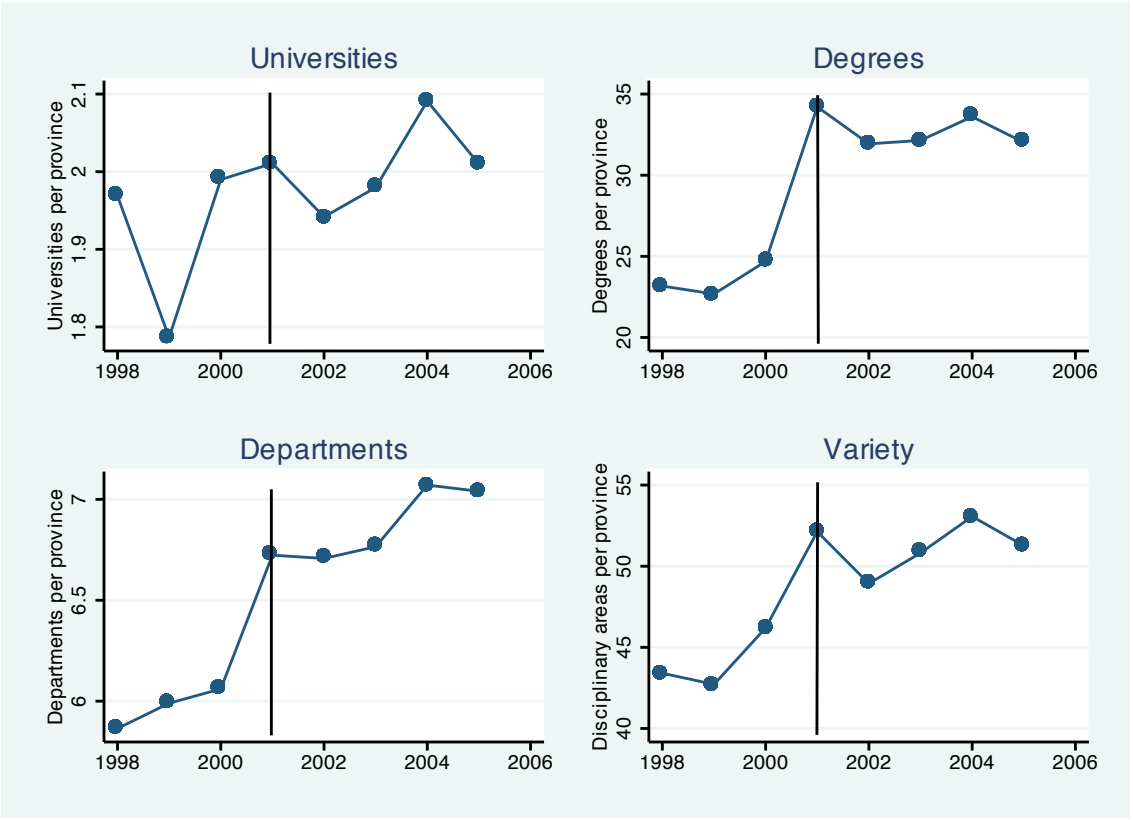
Despite its sharp increase in 2001, the number of degrees offered might be a spurious measure of the actual change in the supply of tertiary education as often one degree was split into two or more without any actual increase of human nor financial resources. Therefore alternative measures of educational supply have been considered: the number of colleges, the number of degrees, the number of departments (*facoltà*) and the number of subject areas, as coded by the OECD, covered by the degrees offered in each province.

The most relevant changes in the supply of tertiary education took place in provinces were new university campuses were opened. Figure 2.2 shows the trend in the number of university campuses (average number per province) existing in Italy between 1998 and 2005. The data gathered by MIUR reveal that between 1998 and 2005 14 new university campuses were opened in provinces were there previously was not any; nevertheless this process was not limited to the year of the reform but started earlier.

Another available measure of educational supply is the number of departments (*facoltà*) present in each province. This provides a good proxy of the financial and human resources effectively available. Its trend is shown in figure 2.2.

A final option is to look at the *variety* of courses available: the OECD classifies all tertiary level degrees into fifteen subject areas. The present work will consider that the actual supply of tertiary education has effectively increased whenever degrees belonging to a new disciplinary area are offered. The higher the number of subject areas covered by the degrees offered in a province, the higher the supply of tertiary education in that province. The trend of variety is also represented in figure 2.2. This last measure of educational supply will be the one I will focus on: the idea is that a student will effectively be attracted to university if she is offered the field of studies she likes.

Figure 2.2: Variation in the supply of tertiary education



The MIUR data show that a significant increase in the average variety of degrees offered by each province took place between 1999 and 2002, while the increase between 2002

and 2005 is only marginal (figure 2.2). Only eight provinces remained stable over 90% of variety of university supply and these were Turin, Milan, Padua, Rome, Florence, Naples, Bari and Palermo. Overall, as shown in figure 2.2, all reported measures of educational supply showed a significant increase between 1999 and 2005.

The second source of data used are the Istat surveys on high school graduates (Istat (2004), Istat (2007b), Istat (2010a)); these are conducted every three years on a nationally representative sample of high school graduates who are interviewed three years after completion of high school and asked about their working and educational experience in the past three years. The surveys contain detailed information about the students' family background and can be merged with the MIUR data on the basis of the province in which the student attended high school. This allows us to recover the exact local educational supply that each student was faced with before and after the reform.

Given that the reform has been adopted in 2001 (despite being approved in 1999) I use the surveys of 1998 and 2004 high school graduates, so as to have observations both before and after the reform, with a time window large enough not to be concerned about anticipation nor transitory effects.

Table 3.6 shows the main characteristics of the sample: the upper panel refers to individual characteristics, the lower panel to province characteristics; individuals and provinces are split into a "Treatment" and a "Control" group depending on the magnitude of the increase in tertiary education supply experienced, where provinces in which the number of subject areas covered by the degrees offered to new students increased by more than 25% will be defined as "Treatment" provinces, while provinces where the increase was below this threshold will form the "Control" group (see Section 3.4 for details).

Labor market characteristics are derived from the Italian Labor Force Surveys (Istat, 2008). Specifically, the regressions will include: a youth unemployment rate at province level for the age class of 15-24 so as to proxy for the opportunity cost of higher education and the employability premium for college versus high school graduates at the age of 35-39 to proxy for the returns to college. The reason why this specific age group is chosen is that Italy is characterized by a slow process of entrance of young people into the labor market which implies that the investment in tertiary education typically yields its full returns with

respect to stopping after high school only several years after graduation (appendix 2.10.1).

Table 2.2 reports the share of high school graduates who enrolled in college straight after completing high school revealing that no particular increase in enrollment rates took place in the year of the reform.[7] Yet the table shows that the pattern of women's enrollment rates differs significantly from that of men: while men's enrollment rates increased by 2.21 percentage points between 1998 and 2001 and by only 0.59 between 2001 and 2004, women's increased by around 6.5 percentage points both between 1998 and 2001 and between 2001 and 2004.

The second outcome variable of interest is the propensity to mobility of high school graduates, i.e. the probability of enrolling to a college outside the province of usual residence conditional on enrolling to college at all. Indeed if the reform changed the supply of tertiary education opportunities available locally, then, in order to evaluate the reform, it is crucial to understand how men and women changed their propensity to move away from home to attend university.
Table 2.3 shows that in terms of inter-regional mobility in 1998 girls were moving less than boys, no matter where they came from; their mobility though increased substantially between 1998 and 2004 so that the difference between boys and girls disappeared (except for the insular regions of Sicily and Sardinia). Looking at inter-province mobility (table 2.4), girls' mobility also increased relatively to boys' so that in 2004 they were eventually more likely than boys to attend university in a province different from that of high school.

2.4 Identification Strategy

The set of reforms to the university system which took place in Italy during the Nineties provide a source of exogenous variation to the supply side structure and thus can allow us to identify its causal impact on students' choices.

[7] The figures are very different if one considers all individuals who enrolled in college within *three* years from high school graduation rather than considering only those who enrolled straight after. Indeed in the first case the rates of enrollment exhibit a *jump* of about 10 percentage points between 1998 and 2001. Such marked difference is presumably due to the fact that the reform of 1999 further introduced a mechanism that allowed professionals of several sectors (typically employees of the public sector) to have their working experience recognized as course credits. This initiative brought to college a vast cohort of employed individuals, thus plausibly leading to a temporary inflation of the observed overall enrollment rates.

In this work the effects of the expansion of tertiary education supply will be estimated by exploiting the fact that the supply side shocks induced by the reform of 1999 were relatively larger in some areas than others. A *difference-in-differences* (DD) approach will thus be employed (Ashenfelter, 1978; Heckman and Robb, 1985; Blundell and Costa-Dias, 2009).

This work considers that high school graduates have been exposed to different shocks to tertiary education opportunities depending on their year of birth (year of high school diploma) and province where they attended high school; the exogeneity of such characteristics and the unexpected timing of the reform will ensure the identification of the effects of supply side changes. In fact, by pinning down the province of the individual as that in which he attended high school, we rule out the possibility of strategic migration, given that, at the time individuals had to choose high school, the reform of university could not be anticipated. The identification strategy thus relies on the comparison between the schooling decisions of individuals who graduated from high school before and after the enforcement of the reform, having attended high school in provinces where, due to the reform, the supply of tertiary education increased markedly (i.e. treatment group) and in provinces where the increase of supply was not significant (i.e. control group).

In order to define the treatment and control groups, this paper looks at the change in the number of subject areas (as described in Section 2.3) covered by first level degrees available to youths upon completion of high school. This can be held the most accurate measure of the effective magnitude of the change in the supply of tertiary education as disciplinary areas better proxy for the actual variety of the educational supply.[8]
Treated provinces are thus defined as those in which the number of subject areas covered by first level degrees available to high school graduates increased by more than 25% between 1998 and 2004.[9] These provinces are pictured in figure 2.3 and listed in appendix 2.10.2.

[8]Robustness checks in section 2.7 will extend the analysis to the other measures of higher education supply introduced in section 2.3.

[9]Section 2.7 also provides sensitivity analysis to the 25% threshold.

Figure 2.3: Treated and Control Provinces, by *Variety*

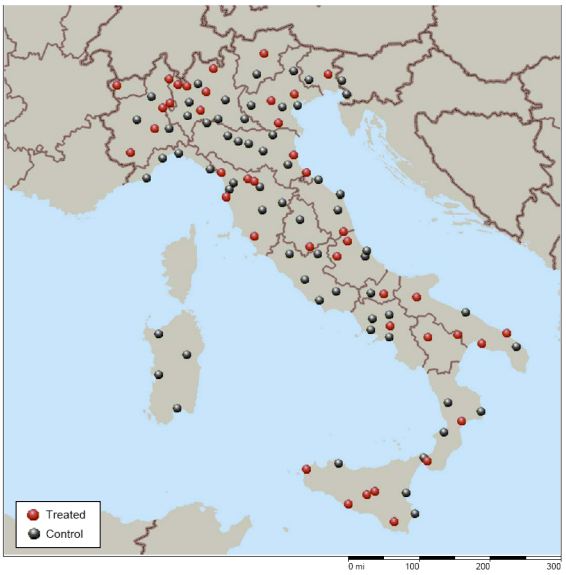
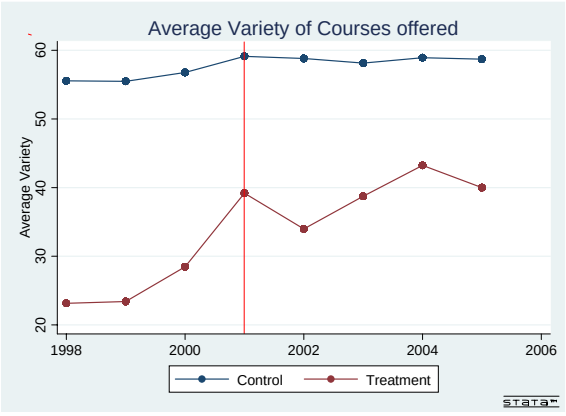


Figure 2.4 shows the average number of subject areas per province in the treatment and control groups between 1998 and 2004. By construction of the treatment group, the supply of tertiary education presents a kink in 2001 for treated provinces while it remains flat for the control ones.

Figure 2.4: Average Variety of Tertiary Education Supply in Treatment and Control Provinces



In order to get unbiased estimates the empirical strategy will rely on a key identifying assumption which is that, conditional on individual observed characteristics, the *change*

in average outcomes between before and after the reform for individuals in the treatment group would have been the same as for individuals in the control group if the reform had not taken place. This is equivalent to assuming that the treatment and the control group satisfy a common trend assumption by which the *slope* of the long-run trend is the same for both groups, whereas the level is not necessarily the same.
In the case considered, because treated provinces are by design of the policy intervention poorer than the control ones, the level of enrollment rates and of the other socio-economic observable variables will be lower; still what matters is that the slope is the same.[10]

The impact of the reform on the outcomes of interest will be estimated through equations of the following type:

$$Y_{ipt} = \beta_1 T_p + \beta_2 Post_t + \beta_3 (T_p \times Post_t) + \gamma_1 X_{ipt} + \gamma_2 Z_{pt} + \epsilon_{ipt} \tag{2.1}$$

where Y_{ipt} is the outcome of interest of individual i, who attended high school in province p, graduating at time t; $T_p = 1$ identifies treated provinces, $Post_t = 1$ indicates the wave after the reform, X_{ipt} are observable characteristics of individual i, in province p, at time t and Z_{pt} are province time-varying characteristics, while ϵ_{ipt} is the usual individual error term. The interaction term $(T_p \times Post_t)$ will give the effect of the reform on the individuals in the treatment group (*Average Treatment Effect on the Treated, ATET*).[11]

The same regressions will be run separately for men and women in order to evaluate whether the effects of such expansion of the supply of tertiary education were different depending on the gender of the student.

The first equation estimated is the probability of enrollment to university of individual i, who attended high school in province p, at time t, $Pr(E_{ipt} = 1)$; this will be estimated through probit because imposing linearity with a dichotomous outcome variable would likely yield predicted probabilities outside the [0,1] interval. A fully parametric linear

[10] This is equivalent to assuming that $E[\epsilon_{ipt}|Treat_p = 1, t] = E[(n_{ip}|Treat_p) + m_t]$ with $E[m_t|Treat_p = 1] = E[m_t|Treat_p = 0]$ being the common trend component. This assumption will ensure that $E[\epsilon_{ipt_1} - \epsilon_{ipt_0}|Treat_p = 1] = E[\epsilon_{ipt_1} - \epsilon_{ipt_0}|Treat_p = 0]$ which is a first difference version of the usual error independence assumption.

[11] Alternatively the estimating equation will include province fixed effects ϕ_p and drop the collinear treatment dummy: $Y_{ipt} = \phi_p + \beta_2 Post_t + \beta_3 (T_p \times Post_t) + \gamma_1 X_{ipt} + \gamma_2 Z_{pt} + \epsilon_{ipt}$.

index model with normally distributed error terms is employed and linearity in the index is imposed.

A second outcome of interest is then the possible substitution effect between studying out of one's province of residence and studying locally: in other words we expect that students will partially switch from studying in another province to studying in the local university once this is significantly expanded.
I thus estimate $Pr(M_{ipt} = 1)$, i.e. the probability that individual i, who attended high school in province p, at time t enrolled to university in a province different from p ($M_{ipt} = 0$ will instead mean that she enrolled at the local university).
This probability will be estimated through standard probit first and then through a Heckman Two Step procedure (Heckman, 1979) to account for selection into enrollment (i.e. only for those who actually enrolled to university can we observe the choice of where to study). In this case the type of school attended is used as an instrument for selection into university assuming therefore that this does affect the probability of enrolling to university but not directly that of studying locally rather than away from home. The reason why having attended a *liceo* is associated to a higher probability of going to college is mainly an historical one: until 1969 only students who graduated from this type of school could access college; while this restriction is not in place anymore, the *licei* have remained the schools that traditionally prepare for college. Yet, as the probability of attending a *liceo* is positively correlated with family income, one may be worried that the excludability restriction is not satisfied; table 2.5 provides evidence that the vast majority of pupils who enroll to college have attended a *liceo* and generally come from more affluent families than those who do not go to college, on the other hand among them there are no differences between those who choose the local university and those who move neither in terms of type of school attended nor in terms of family background.

2.5 Results

The use of a DD approach allows us to isolate the effects of the reform from any time invariant characteristic as well as from those characteristics which do vary over time but do so in the same way in the treated and control provinces.
As table 2.1 shows, treated and control provinces do systematically differ on observable

characteristics, but this difference tends to be stable over time. Nevertheless, to rule out the possibility that some of these characteristics may bias the estimates, all econometric specifications will include both individual and province time varying characteristics. Moreover I allow for the possibility that standard errors are correlated among individuals living in the same province and therefore will cluster them at the province level in all regressions.

Table 2.6 reports the probit estimation results for the probability of enrolling to college straight after high school. The first line presents the marginal effect of the $(T_p \times Post_t)$ term, i.e. the $ATET$, the second and third rows respectively report the coefficients associated to the time common trend $(Post_t)$ and the treatment group fixed effect (T_p); the coefficients associated to the control variables instead are not reported for brevity but all have the predicted signs: both individual characteristics and family background seem to play a crucial role in determining the probability of attending university, with students from *licei* being by far the most likely to enroll; moreover intergenerational mobility seems to be very weak as there appears a very strong positive correlation between parents' and children's education. On the other hand, students living in areas where the rate of youth unemployment is higher show a higher propensity to enrol to university, thus confirming the idea that they face a lower opportunity cost of staying out of the labor market.

The estimates in table 2.6 show a significant gender differential in the effects of the local expansion of tertiary education opportunities: while men's demand for education turns out to be inelastic to changes on the supply side, women have responded to the increase in educational supply with a significant increase in enrollment rates.[12]

It further appears that the treated provinces are associated with lower enrollment rates (negative treatment fixed effect, T_p), and that for both male and female students there was a positive common trend in enrollment rates (positive coefficient of $Post_t$). The ATET estimates show that over and above such trend there was a positive and significant effect of the reform on female enrollment rates: an increase of the variety of local tertiary education supply by at least 25% between 1998 and 2004 translated into an increase of women's enrollment rates between 6.2 and 7.8 percentage points, while men's enrollment rates did

[12]The analysis has been carried out separately for enrollments within three years from high school graduation and the results, omitted for brevity, are not qualitatively different, the effect on females ranging between 4.8 and 5.4 percentage point (table 2.16).

not show any significant increase.

Table 2.6 has so far shown that the average effect of the reform on girls from the treated provinces was an increase in the propensity to enroll to university of about 6 to 7 percentage points. Turning to the analysis of mobility choices I will be able to identify the effect of the reform on boys: Table 2.7 shows the results of the probit estimation of M_{ipt}.

All the specifications in table 2.7 include local labor market characteristics as control variables: columns 1-3 use the absolute values of the province employability premium, unemployment rate and per capita GDP, while columns 4-6 include them in terms of difference to the respective top quartile values with the idea that the decision to move will crucially depend on the *relative attractiveness* of the destination with respect to the place of departure.

The probit regressions show a strong decrease in the mobility of male students and no effects on women. The ATET indicates that exposure to the increase of local educational supply by more than 25% decreased the propensity of male students to study away from home by between 6 and 7.7 percentage points.

This, coupled with the previous results on enrollment decisions, would suggest that men substituted "education away" with "education at home", while women who did not have a tertiary education facility nearby tended to drop out of education after high school.

The results on mobility reported in table 2.7 may be biased because of sample selection: students who are faced with the decision about whether to study "at home" or "away" are only those who have already decided to get into tertiary education, therefore the coefficients estimated in the probit regression above are likely to overestimate the magnitude of the effect (downward bias).[13] Yet, as the results in table 2.6 showed that the policy had no impact on boys' enrollment rates, we would expect the results for girls to be biased rather than those for boys.

[13]This is because those who decide to select into tertiary education represent a positive selection of the student population, i.e. it is the most capable and/or motivated students. On the other hand it is likely that there would be a positive correlation between ability/motivation and the decision of studying away, therefore not taking into account the selection process would overestimate the effect of the policy (as the effect is negative, we will have downward bias).

Still, to correct this bias, I employ a Heckman two-step procedure in which a dummy variable for whether the student has attended a *liceo* or another type of school enters in the specification of the probability of enrolment but is excluded from the mobility equation.

The results of the Heckman two step estimation, reported in Table 2.8, confirm the qualitative results previously found in Table 2.7, even taking into account that enrolment is not exogenous. They therefore support the idea for which the increase in the local supply of tertiary education decreased the probability of studying away only for male students who substituted "studying away" with "studying at home". The magnitude of such effect ranges between 3.2 and 4.3 percentage points, depending on whether one controls for the absolute values of labor market characteristics or for the difference between local labor market conditions and those of the highest quartile.

2.6 Mechanisms: the role of financial and cultural constraints

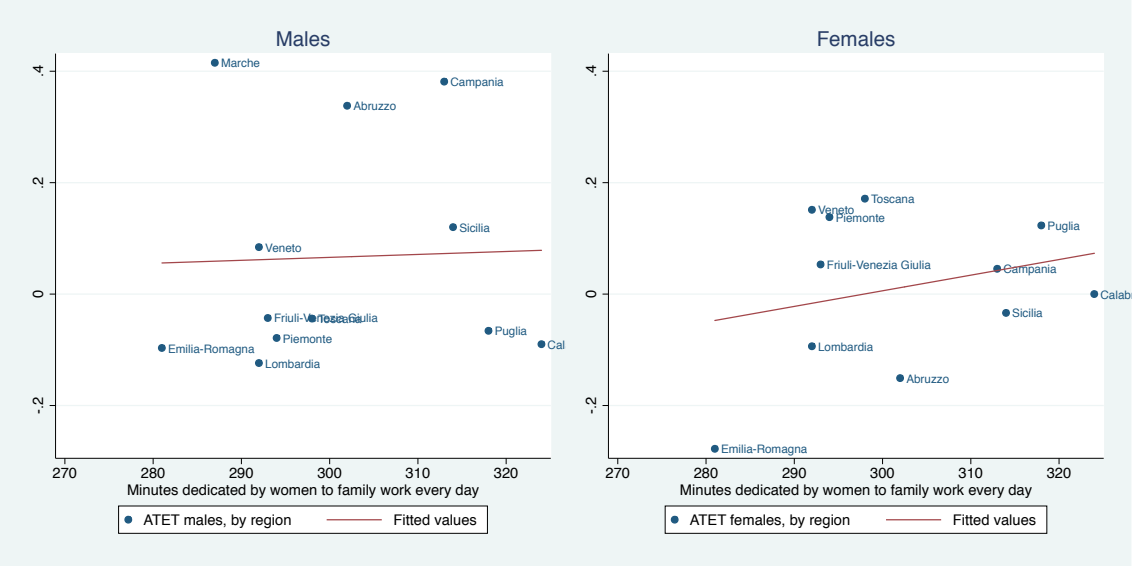
While the results presented in section 2.5 show that there was a significant and systematic difference between the effects of the reform on male and female students, it is crucial to understand what are the underlying mechanisms determining such outcomes.
In particular, being able to disentangle the effect of financial constraints from that of non financial ones would highlight what are the possible policy implications of the results found in section 2.5. To do so I interacted the effect of the reform with two characteristics of the household: whether the student's father is a manager, to proxy for the household's economic status, and whether the mother has been to college, to proxy for the role of the maternal model.

The results for enrollment decisions, which are presented in table 2.10, do not show any clear pattern of difference between boys and girls in terms of enrollment decisions, indeed neither for boys nor for girls are the interaction terms between the treatment effect and the two family background characteristics significant.
Table 2.11, instead shows the interaction between the effects of the reform, maternal models and family income on mobility decisions. Here different patterns emerge depending on the gender of the student: the marginal effects of the reform for girls whose father is

a manager indicate that girls coming from more affluent families were significantly more likely to *switch* from college away from home to college close by whereas no similar pattern of income heterogeneity emerges for boys.
This finding would suggest suggest that what prevents girls from moving away from home is not budget constraints but rather some non financial costs that they take into account when choosing whether and where to study.

To shed some more light on the nature of such costs I compare the effects of the reform with an indicator of women's role inside the family. The data provided by the Istat survey on time use for 2003 (Istat, 2007a) are used, and the average time women spend everyday on family care is compared with the region-wise estimated ATET for enrollment decisions. Figure 2.5 shows the relation for men and women: while there appears to be no correlation at all for men, the effect of the reform on female enrollment rates seems to be larger in regions where women usually spend more time on family care.[14]

Figure 2.5: The role of cultural models: time use and the effects of the reform on enrollment rates.



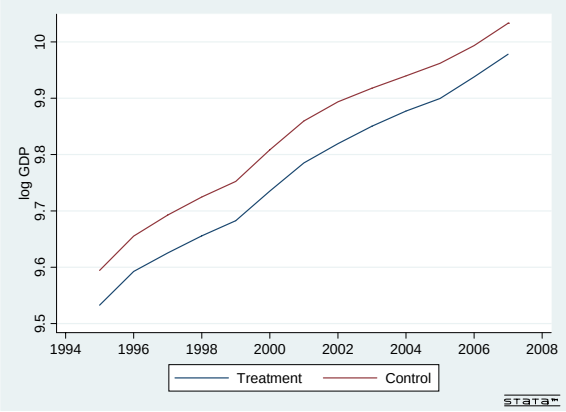
[14]It would not be possible to include the regional heterogeneity in terms of time women spend on family care in a regression like that in table 2.10 because this indicator does not vary over time.

Despite being far from conclusive, the relations identified in this section seem to point at the existence of a link between cultural factors and females' costs of attending tertiary education: in areas where women traditionally spend more time on family care, the expansion of tertiary education supply can significantly enhance girls' educational attainment suggesting that the possibility of attending university without having to move away from the family would decrease the perceived cost of schooling for these girls.

2.7 Specification checks

Common Trend Assumption The first type of concern that arises when using a DD approach is that the underlying common trend assumption might not hold. (footnote 10) Figure 2.4 showed that before 1998 and after 2004 the variety of tertiary education supply was stable and followed the same trend in treated and control provinces. More importantly, table 2.1 has proved that the differences in observable characteristics between treated and control groups did not significantly change between before and after the reform: the difference-in-difference estimates for individual characteristics were essentially null and no significant change in trend was detected with respect to the local economic indicators (employability premium, unemployment rate and GDP per capita). As a matter of fact figure 2.6 shows that the treated provinces did not experience any extraordinary growth nor significant transitory shock that might have pushed up average educational attainment.[15]

Figure 2.6: Specification checks: common trend in log GDP per capita.



[15]Had this been the case we would be facing the so called 'Ashenfelter's dip': selection into treatment is driven by unobserved temporary shocks (Ashenfelter, 1978).

In order to test the common trend assumption the same regressions are run on a different time window: the treated and control provinces identified in section 2.4 are thus compared over the time window 1995 to 1999. The results of this *placebo* exercise are reported in tables 2.12 and 2.13: there is no effect on enrollment decisions and no difference between boys and girls.

When looking at mobility decisions instead it appears that the treated provinces were characterized by an excess decrease in mobility already before 2001, nevertheless there was no difference between boys' and girls' behaviors.

Instrumental Variables Approach One may be concerned that the selection of provinces into treatment might be demand driven and thus endogenous. In other words, the expansion would have increased the educational supply only in areas where there was anticipated unmet demand and thus the results would only be driven by such mechanism. The fact that I find no effect on boys' enrollments would suggest that this was not the case: indeed had the government decided to increase the supply of tertiary education in under supplied areas, then the increase in enrollments would have been positive for boys as well.

Nevertheless, to cast away any concern of this type, I also perform an IV estimation to account for the possible endogeneity of selection of provinces into treatment.

In order to find a valid and excludable instrument I use the toolkit of political economics and decide to follow a strategy similar to that of Levitt (1997)[16] and exploit proximity to provincial elections at the time of the reform as an instrument for the increase in local educational supply. The idea is that when local elections approach, local politicians will want to expand the supply of visible public services to gain the public favor.

Table 2.14 shows the results of the IV regression, where the excluded instrument is a dummy variable for whether provincial elections were held in 2001 or 2002. The first stage shows a strong positive relationship between this variable and the likelihood of having increased the supply of local tertiary education by more than 25% (i.e. the treatment variable defined above).

In terms of effects on enrollments, the coefficients of the IV are similar to those of the DD estimation in table 2.6 though not significant . Their similarity anyway reassures us

[16] Levitt (1997) estimates the effects of police control on crime exploiting the exogenous increase in the number of policemen that usually takes place as local elections approaches.

about the validity of the quasi experiment exploited in this paper.
With respect to mobility[17] instead the coefficients are quite different from the previously estimated ones (table 2.8). The positive sign of these coefficients is likely due to the omission of the province fixed effects (which would be collinear with the instrument); nevertheless the difference between the effect on boys and the effect on girls is very close to the results of table 2.8.

Excluding big cities The same regressions have been run taking out of the sample the students residing in the three biggest cities: Milan, Rome and Naples. This choice is driven by the concern that these cities, which all belong to the comparison group, might draw the average effect of the reform in the control group down and thus artificially expand the effect on the treated provinces.
The exclusion of these cities did not imply any relevant change in the estimates with the coefficients associated to the $ATET$ remaining almost identical both in magnitude and in statistical significance (table 2.15).

Different Thresholds According to the definition introduced in Section 2.4, "treated provinces" are those in which the increase in the variety of courses between 1998 and 2004 was larger than 25%. Such threshold is clearly arbitrary and corresponds to the 63^{rd} percentile in the distribution of the change in the variety of courses among the provinces. Because the choice of this threshold is arbitrary, one might be concerned that the results may be driven by this choice. For this reason this threshold has been shifted down to the median and up to the 75^{th} percentile.

Tables 2.16 and 2.17 show the results of this exercise: the effect of the increase in tertiary education supply on female students' enrollments is larger the higher the threshold, i.e. the bigger the increase in supply. On the other hand, in all three cases there are no effects on male students' enrollments.

With respect to mobility choices then, boys' propensity to choose the local university rather than moving away from home increases proportionally with the threshold only in the probit specification with labor market controls expressed in relative terms. In all other

[17]The Two Stage Least Squares are combined with the Heckman selection model by including the in the IV regression the Inverse Mills Ratio calculated from the probit estimation of the Selection Equation (Wooldridge, 2001).

specifications the effect on boys is stable and always larger than that on girls, which is never distinguishable from zero.

Different Treatments One might also be concerned that the results may be driven by the definition of treatment chosen. For this reason the same estimation exercise has been run under different definitions of treatment group. Increases in the number of universities, in the number of departments (*facoltà*), and finally in the number of degrees available to first year students at the time of enrollment have all been analyzed; as in the main specification, the treatment is always defined for increases of more than 25% between 1998 and 2004.

Tables 2.18 and 2.19 show the results under these alternative definitions of treatment, respectively for enrollment and mobility decisions.

The main results are robust to such different definitions of treatment, and in particular those on enrollment rates, where, no matter how we define the increase in local educational supply, girls respond to it with a significant increase in enrollment rates while boys don't. This is true in all specifications except the last two: effects of the increase in the number of departments and in the number of degrees on enrollments within one year from high school graduation. In the first case a positive strong effect is found on both boys and girls decisions, while in the latter no effect is found on either group.

The results on mobility are less significant but maintain the direction indicated in the main specification, with boys substituting education away from home with local education while girls not.

Effects on *quality* of students An aspect which has not been fully analyzed in this work regards the possibility that the reform and the consequent increase in enrollments might have brought to university less capable students who eventually did not reach graduation and crowded universities without making enough progress on their studies. To address this concern estimates of the effects of the policy on the probability of interrupting the studies, on the probability of attending classes regularly and on the number of exams passed after three years from the beginning of the studies are presented. The results are reported in table 2.20. Unfortunately these results are not fully informative because do not take into account the sample selection problem entailed; nevertheless they point to

the absence of any negative effect of the policy in terms of educational achievements.

2.8 Concluding Remarks

This paper analyzed the effects of an expansion of tertiary education supply on schooling decisions of high school graduates. The idea is that the provision of local educational facilities can represent a major cut to the individual cost of attending tertiary education and thus generate an increase in the rates of enrollment to university of high school graduates. This is of particular relevance in Italy, where tertiary enrollment rates are below the OECD average and the value of tertiary human capital is the lowest among OECD countries (Martins et al., 2007; OECD, 2010).

A Difference in Difference estimation strategy was employed to compare the schooling decisions of high school graduates between provinces which, following to the reform of 1999, experienced a significant increase of tertiary education supply, and those where this change was negligible. The two main outcomes analyzed are the decision of enrolling to university at all and that of enrolling to the local university rather than to one that is farther away. While the first probability was estimated via a DD probit, the second required a two-step Heckman estimation to account for sample selection (i.e. only those who did enroll to university are observed in their choice of attending university locally or away).

This analysis has been implemented in a gender perspective, believing that the cost of moving away from home might be different for boys and girls. Indeed the finding that the provision of local tertiary education generated an increase in the number of girls that enrolled to university whereas boys tended to substitute education away from home with local education, confirms the idea that girls are faced with a higher cost of moving away from home and that thus the lack of local educational facilities leaves a significant fraction of them out of education. A crucial consequence of this finding further relates to the *quality* of females' education: given the extra constraints they face when taking their schooling decisions, they are likely to end up attending higher education institutions of relatively lower quality than those attended by their male peers.

This work also suggested that the most relevant constraint to girls' mobility (and thus schooling) is a non financial one, as girls coming from more affluent families were more likely to switch from attending college in a province different from that of residence to attend the local college. Moreover, evidence was provided that the effect of the reform on female enrollment rates was larger in areas where women are reported to dedicate more of their time to family care.

Some caveats need to be pointed out: spillover effects between treated and control areas cannot be ruled out. Still, their existence would imply that people in control provinces should respond to the treatment of the other provinces; so for example students living in a control province but on the border with a treated province might respond to the increase in educational supply in the treated province by switching from not enrolling to college to enrolling, vice versa, those living in a treated province but close to a control province university, may attend college anyway. Then, if either of these was the case, the difference between treatment and control areas would be underestimated and thus the estimated treatment effect would be a lower bound of the actual effect of the reform. With respect to mobility decisions, on the other hand, it is very unlikely that students from the control provinces moved to the treatment provinces in response to the increased supply of tertiary education in the latter because the difference between treatment and control provinces in terms of educational supply and quality of institutions remained very large despite the reform.

A second caveat concerns the possibility of general equilibrium effects that might lower the returns to tertiary education: if more people attend higher education this is likely to lower the expected returns from such choice. If the reference labor market was the same for both treated and control provinces this would not be an issue. If instead the reference labor market is local, which is plausible, then again the actual effect of the reform would be mitigated by the anticipated counterbalancing general equilibrium effects. The study by Bosio and Leonardi (2010) reassures us on this respect. They show that the reform increased the probability of employment of young graduates with a larger effect on men than on women. If they were anticipating general equilibrium effects, women should then have increased their enrollments less than boys. Moreover the same authors find a wage

penalty for young graduates after the reform as would be predicted by a general equilibrium model, but this was again larger for girls than for boys.

To conclude, while the results obtained in this paper clearly have limited *external validity*, this work provides a valuable tool of policy evaluation for its *internal validity*: the most recent educational reforms in Italy are aiming at a more "efficient" use of the financial resources, which should entail a strong centralization of the tertiary educational system and the dismissal of all small satellite campuses. This work showed that such an intervention, if not coupled with other instruments that can increase women's propensity to move, would leave a large slice of the female population out of the educational system, given that there exist significant differences in the perceived cost of moving away from home between men and women.

2.9 Tables and Figures

Table 2.1: Descriptive Statistics by Variety Treatment

	- 1998 Graduates -			- 2004 Graduates -			
	Control	Treatment	C-T	Control	Treatment	C-T	DD
Female	0.529	0.544	-0.015	0.512	0.520	-0.008	0.007
	(0.499)	(0.498)		(0.500)	(0.500)		
Liceo	0.296	0.293	0.003	0.315	0.280	0.035	0.032
	(0.457)	(0.455)		(0.465)	(0.449)		
Grade High School	75.44	75.28	0.16	78.24	77.88	0.36	0.2
	(12.00)	(11.69)		(13.16)	(13.06)		
Father has college degree	0.0976	0.0810	0.0166	0.119	0.0948	0.0242**	0.0076
	(0.297)	(0.273)		(0.324)	(0.293)		
Mother has college degree	0.0833	0.0582	0.0251***	0.102	0.0885	0.0135	-0.0116
	(0.276)	(0.234)		(0.303)	(0.284)		
Father manager	0.147	0.135	0.012	0.147	0.134	0.013	0.001
	(0.354)	(0.342)		(0.354)	(0.340)		
Mother manager	0.0545	0.0645	-0.01	0.0533	0.0467	0.0066	0.0166
	(0.227)	(0.246)		(0.225)	(0.211)		
Mother housewife	0.564	0.559	0.005	0.489	0.492	-0.003	-0.008
	(0.496)	(0.497)		(0.500)	(0.500)		
Number of Colleges	2.016	1.439	0.577***	2.145	1.805	0.34	-0.237
	(1.577)	(0.803)		(1.756)	(1.071)		
Employability Premium	5.811	7.766	-1.955*	3.068	4.233	-1.165	0.79
	(7.969)	(6.750)		(5.560)	(7.538)		
Unemployment Rate	30.82	32.09	-1.27	23.42	25.06	-1.64	-0.37
	(20.85)	(21.09)		(14.07)	(16.19)		
log GDP per capita*	9.714	9.649	0.065*	9.931	9.868	0.063*	-0.002
	(0.283)	(0.266)		(0.256)	(0.260)		

Standard Deviations in parentheses. Standard Errors of estimated differences clustered at province level in upper panel.

* Source: Istat (2010b).

Table 2.2: Rates of Enrollment within same year of high school graduation

	1998 Graduates			2001 Graduates			2004 Graduates		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
North-West	36.52	40.00	38.37	37.39	44.78	41.32	41.13	56.32	49.14
North-East	32.25	37.34	34.96	39.81	43.11	41.58	42.76	53.66	48.56
Centre	40.79	44.07	42.56	40.62	50.74	45.85	41.74	54.44	48.21
South	37.30	44.37	41.01	39.27	52.08	45.73	36.82	55.45	46.06
Islands	34.06	39.85	37.19	36.29	46.66	41.66	36.16	52.88	44.85
Italy	36.62	41.70	39.33	38.83	48.10	43.64	39.42	54.79	47.32

Table 2.3: Regional Mobility Rates by Gender and Geographical Area

	Attended University in a region different from that of high school								
	1998 Graduates			2001 Graduates			2004 Graduates		
	Males	Females	M-F	Males	Females	M-F	Males	Females	M-F
North-West	15.16	14.07	1.09	9.95	11.15	-1.2	11.21	15.32	-4.11***
North-East	19.45	18.07	1.38	16.35	15.99	0.36	18.5	17.44	1.06
Centre	15.21	7.56	7.65***	13.3	11.19	2.11	12.41	12.91	-0.5
South	21.8	17.83	3.97***	24.62	24.09	0.53	24.64	24.84	-0.2
Islands	8.51	8.46	0.05	16.15	10.9	5.25**	14.96	8.52	6.44***
Total	17.08	13.73	3.35***	16.95	15.9	1.05***	17.07	17.12	-0.05

Table 2.4: Inter-province Mobility Rates by Gender and Geographical Area

	Attended University in a province different from that of high school								
	1998 Graduates			2001 Graduates			2004 Graduates		
	Males	Females	M-F	Males	Females	M-F	Males	Females	M-F
North-West	40.58	40.74	-0.16	46.33	41.07	5.26**	42.85	46.97	-4.12**
North-East	66.11	61.62	4.49	53.33	55.84	-2.51	57.77	61.86	-4.09***
Centre	41.89	36.58	5.31**	37.38	43.14	-5.76***	44.43	41.9	2.53
South	48.19	45.09	3.10	48.87	50.65	-1.78	46.91	48.06	-1.15***
Islands	35.98	39.96	-3.98	46.31	39.91	6.4**	40.3	42.88	-2.58
Total	46.29	44.01	2.28**	46.47	46.53	-0.06	46.26	47.95	-1.69**

Table 2.5: Individual characteristics by enrollment and mobility status

	Enrolment			Mobility		
	(1)	(2)	(3)	(4)	(5)	(6)
Liceo	0.527***			-0.0115		
	(0.00857)			(0.0240)		
Father Manager		0.0178*			-0.0102	
		(0.0105)			(0.0210)	
Mother Manager			0.0450*			-0.00444
			(0.0268)			(0.0293)
Observations	69,332	47,643	22,810	31,741	22,215	11,149
R-squared	0.245	0.007	0.009	0.000	0.002	0.001

Year Fixed Effects included.
Robust standard errors clusterd at province level in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Determinants of the probability of enrollment and mobility.

Table 2.6: Effect of the increase in the variety of courses supplied. Probit difference-in-differences estimation.

	Probability of Enrollment Within Same Year					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
$T_p \times Post_t$	0.055*	0.026	0.078***	0.042*	0.011	0.062**
	(0.028)	(0.040)	(0.029)	(0.022)	(0.035)	(0.026)
$Post_t$	0.034***	0.000	0.069***	0.186***	0.198***	0.157**
	(0.013)	(0.015)	(0.017)	(0.056)	(0.057)	(0.065)
T_p	-0.025	-0.010	-0.040			
	(0.021)	(0.024)	(0.025)			
Controls*	yes	yes	yes	yes	yes	yes
Province F.E.				yes	yes	yes
Observations	48,248	22,112	26,136	48,248	22,112	26,136
Pseudo R^2	0.310	0.331	0.287	0.316	0.341	0.297

Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.
* Controls: Type of High School, Grade High School, Father's and Mother's Education, Mother Housewife, Number of Universities in Province, log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate.

Table 2.7: Effect of the increase in the variety of courses supplied. Probit difference-in-differences estimation.

	Probability of Attending University in a Province different from that of High School					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
$T_p \times Post_t$	-0.028	-0.060	-0.013	-0.039	-0.077**	-0.025
	(0.029)	(0.037)	(0.040)	(0.027)	(0.032)	(0.038)
$Post_t$	0.253**	0.276**	0.259**	0.048	-0.011	0.063*
	(0.100)	(0.119)	(0.113)	(0.035)	(0.060)	(0.037)
Controls*	yes	yes	yes	yes	yes	yes
Labor Market Controls, absolute values	yes	yes	yes			
Labor Market Controls, relative values**				yes	yes	yes
Province F.E.	yes	yes	yes	yes	yes	yes
Observations	18,592	7,396	11,196	18,592	7,396	11,196
Pseudo R^2	0.330	0.333	0.340	0.329	0.332	0.339

Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.
* Controls: Type of High School, Grade High School, Father's and Mother's Education, Mother Housewife, Number of Universities in Province, log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate.
** Labor Market Controls, Absolute Values: log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate;
Relative values: difference to highest quartile.

Table 2.8: Effect of the increase in the variety of courses supplied. Heckman 2-Step difference-in-differences estimation.

	Probability of Attending University in a Province different from that of High School					
	(1) All	(2) Males	(3) Females	(4) All	(5) Males	(6) Females
$T_p \times Post_t$	-0.013	-0.032	-0.006	-0.017	-0.043*	-0.011
	(0.016)	(0.025)	(0.023)	(0.016)	(0.025)	(0.022)
$Post_t$	0.113**	0.127**	0.111**	0.020	-0.021	0.030*
	(0.047)	(0.059)	(0.051)	(0.018)	(0.035)	(0.018)
Controls*	yes	yes	yes	yes	yes	yes
Labor Market Controls, absolute values	yes	yes	yes			
Labor Market Controls, relative values**				yes	yes	yes
Province F.E.	yes	yes	yes	yes	yes	yes
Observations	47,107	21,588	25,519	47,107	21,588	25,519
Wald test of indep. eqns. ($\rho = 0$)	16.83	10.81	10.90	16.19	9.901	10.96
$Prob > \chi^{2***}$	4.10e-05	0.00101	0.000963	5.74e-05	0.00165	0.000930

Standard Errors Robust to Province Clustering in parentheses.
* Controls: Grade High School, Father's and Mother's Education, Mother Housewife, Number of Universities in Province.
** Labor Market Controls, Absolute Values: log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate;
Relative values: difference to highest quartile.
*** Excluded variable: type of high school attended is *Liceo*.

Table 2.9: Correlation Coefficients

	Mother Housewife	Mother with College Degree	Father Manager	Father Blue Collar
Mother Housewife	1			
Mother with College Degree	-0.2135*	1		
Father Manager	-0.0138*	0.002	1	
Father Blue Collar	0.0245*	-0.0036	-0.4061*	1

* Statistically Significant at 1% level.

Table 2.10: The mechanisms: Enrollment Decisions. Probit difference-in-differences estimation.

	Probability of Enrollment Within Same Year		
	(1)	(2)	(3)
	All	Males	Females
$T_p \times Post_t$	0.025	-0.017	0.053*
	(0.025)	(0.037)	(0.031)
$Post_t$	0.212***	0.229***	0.166**
	(0.060)	(0.062)	(0.073)
Father Manager $\times T_p \times Post_t$	0.056	0.142	-0.018
	(0.054)	(0.094)	(0.074)
Father Manager $\times Post_t$	0.007	-0.043	0.047
	(0.032)	(0.050)	(0.036)
Father Manager $\times T_p$	-0.075*	-0.142**	-0.003
	(0.044)	(0.060)	(0.062)
Father Manager	0.019	0.051	-0.006
	(0.028)	(0.049)	(0.032)
Mother with College degree $\times T_p \times Post_t$	0.117	0.097	0.143
	(0.092)	(0.160)	(0.119)
Mother with College degree $\times Post_t$	-0.109***	-0.091**	-0.117*
	(0.040)	(0.038)	(0.063)
Mother with College degree $\times T_p$	-0.052	-0.015	-0.094
	(0.073)	(0.139)	(0.086)
Mother with College degree	0.209***	0.184***	0.222***
	(0.034)	(0.047)	(0.034)
Controls*	yes	yes	yes
Province F.E.	yes	yes	yes
Observations	47,099	21,529	25,570
Pseudo R2	0.306	0.329	0.288

Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.
Controls and Province Fixed Effects included.
* Controls: Type of High School, Grade High School, Number of Universities in Province, log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate.

Table 2.11: The mechanisms: Mobility Decisions. Heckman 2-Step difference-in-differences estimation.

	Probability of Attending University in a Province different from that of High School					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
$T_p \times Post_t$	0.001	-0.028	0.012	-0.003	-0.040	0.007
	(0.021)	(0.031)	(0.029)	(0.022)	(0.033)	(0.028)
$Post_t$	0.105**	0.113*	0.109**	0.016	-0.035	0.030*
	(0.048)	(0.059)	(0.051)	(0.019)	(0.036)	(0.018)
Father Manager $\times T_p \times Post_t$	-0.084**	-0.032	-0.109***	-0.082**	-0.030	-0.110***
	(0.040)	(0.085)	(0.039)	(0.041)	(0.086)	(0.039)
Father Manager $\times Post_t$	0.031	0.026	0.030	0.031	0.026	0.030
	(0.034)	(0.067)	(0.022)	(0.033)	(0.067)	(0.022)
Father Manager $\times T_p$	0.112***	0.082	0.120***	0.111***	0.081	0.121***
	(0.037)	(0.079)	(0.039)	(0.037)	(0.079)	(0.039)
Father Manager	-0.021	-0.033	-0.009	-0.021	-0.033	-0.010
	(0.031)	(0.064)	(0.019)	(0.031)	(0.064)	(0.019)
Mother with College degree $\times T_p \times Post_t$	-0.024	-0.007	-0.034	-0.023	-0.006	-0.032
	(0.046)	(0.073)	(0.048)	(0.045)	(0.072)	(0.048)
Mother with College degree $\times Post_t$	0.013	0.051*	-0.018	0.013	0.050	-0.018
	(0.016)	(0.031)	(0.022)	(0.016)	(0.031)	(0.022)
Mother with College degree $\times T_p$	0.036	-0.014	0.080**	0.035	-0.015	0.077*
	(0.039)	(0.058)	(0.041)	(0.039)	(0.058)	(0.040)
Mother with College degree	0.003	-0.008	0.013	0.004	-0.007	0.013
	(0.019)	(0.029)	(0.019)	(0.019)	(0.029)	(0.019)
Controls*	yes	yes	yes	yes	yes	yes
Labor Market Controls, absolute values	yes	yes	yes			
Labor Market Controls, relative values**				yes	yes	yes
Province F.E.	yes	yes	yes	yes	yes	yes
Observations	46,500	21,315	25,185	46,500	21,315	25,185
Wald test of indep. eqns. ($\rho = 0$)	16.19	9.739	12.70	15.73	8.780	12.81
$Prob > \chi^{2***}$	5.73e-05	0.00180	0.000365	7.31e-05	0.00305	0.000345

Standard Errors Robust to Province Clustering in parentheses.

* Controls: Grade High School, Number of Universities in Province.

** Labor Market Controls, Absolute Values: log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate;
Relative values: difference to highest quartile.

*** Excluded variable: type of high school attended is *Liceo*.

Table 2.12: Placebo Test: Effect of the increase in the variety of courses supplied between 1995 and 1999. Probit difference-in-differences estimation.

	Probability of Enrollment Within Same Year					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
$T_p \times Post_t$	0.003	-0.007	0.011	0.006	-0.005	0.017
	(0.021)	(0.033)	(0.024)	(0.021)	(0.035)	(0.025)
$Post_t$	-0.030**	-0.022	-0.034**	-0.055	-0.094	-0.014
	(0.014)	(0.017)	(0.016)	(0.047)	(0.064)	(0.069)
T_p	-0.027*	-0.009	-0.045**			
	(0.016)	(0.020)	(0.020)			
Controls*	yes	yes	yes	yes	yes	yes
Province F.E.				yes	yes	yes
Observations	40,639	18,406	22,233	40,639	18,396	22,233
Pseudo R^2	0.337	0.363	0.315	0.343	0.372	0.326

Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.
* Controls: Type of High School, Grade High School, Father's and Mother's Education, Mother Housewife, log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate.

Table 2.13: Placebo Test. Effect of the increase in the variety of courses supplied between 1995 and 1999.

	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
A. Probability of Attending University away from home - Probit						
$T_p \times Post_t$	-0.060	-0.060	-0.048	-0.114***	-0.122***	-0.110***
	(0.048)	(0.073)	(0.051)	(0.035)	(0.041)	(0.041)
$Post_t$	0.083**	0.104**	0.087**	-0.038	-0.015	-0.027
	(0.038)	(0.049)	(0.037)	(0.034)	(0.047)	(0.044)
Controls*	yes	yes	yes	yes	yes	yes
Labor Market Controls, absolute values	yes	yes	yes			
Labor Market Controls, relative values**				yes	yes	yes
Province F.E.	yes	yes	yes	yes	yes	yes
Observations	15,210	5,997	9,213	12,706	4,910	7,746
Pseudo R^2	0.227	0.252	0.224	0.383	0.399	0.383
B. Probability of Attending University away from home - Heckman						
$T_p \times Post_t$	-0.054**	-0.051*	-0.052*	-0.061**	-0.059**	-0.055*
	(0.024)	(0.027)	(0.028)	(0.024)	(0.028)	(0.029)
$Post_t$	0.005	-0.023	0.027	-0.018	-0.011	-0.026
	(0.045)	(0.058)	(0.054)	(0.018)	(0.025)	(0.024)
Controls*	yes	yes	yes	yes	yes	yes
Labor Market Controls, absolute values	yes	yes	yes			
Labor Market Controls, relative values**				yes	yes	yes
Province F.E.	yes	yes	yes	yes	yes	yes
Observations	39,833	18,076	21,757	39,833	18,076	21,757
Wald test of indep. eqns. ($\rho = 0$)	15.25	10.73	8.360	15.18	11.55	8.290
$Prob > \chi^2$	9.43e-05	0.00106	0.00384	9.75e-05	0.000677	0.00399

For Probit Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.
* Controls: Type of High School, Grade High School, Father's and Mother's Education, Mother Housewife, Number of Universities in Province.
** Labor Market Controls, Absolute Values: log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate;
Relative values: difference to highest quartile.

Table 2.14: Instrumental Variables Estimates

	Enrollment			**Mobility**[†]		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
T_p	0.016	-0.020	0.045	0.407*	0.278	0.476*
	(0.034)	(0.049)	(0.032)	(0.241)	(0.226)	(0.262)
Controls[*]	yes	yes	yes	yes	yes	yes
Labor Market Controls, absolute values	yes	yes	yes			
Labor Market Controls, relative values[**]				yes	yes	yes
Province F.E.	no	no	no	no	no	no
Observations	25,880	11,841	14,039	15,009	6,079	8,930
R^2	0.342	0.347	0.321	0.239	0.261	0.232
F Statistic of excluded instrument	7.607	8.247	6.731	6.621	6.665	6.105
p-value	0.0069	0.005	0.0109	0.0115	0.0113	0.0151
			First Stage			
Elections in 2001 or 2002	0.379***	0.393***	0.360**	0.376***	0.392***	0.353**
	(0.137)	(0.137)	(0.139)	(0.137)	(0.137)	(0.139)
R^2	0.149	0.152	0.157	0.148	0.151	0.155

Sample is only 2004 high school graduates.
Standard Errors Robust to Province Clustering in parentheses.
[†] IV estimation combined with Heckman selection.
[*] Controls: Type of High School, Grade High School, Father's and Mother's Education, Mother Housewife, Number of Universities in Province.
[**] Labor Market Controls, Absolute Values: log GDP in Province, Employability Premium for College Graduates, Youth Unemployment Rate;
Relative values: difference to highest quartile.

Table 2.15: Robustness Checks: Excluding Big Cities. *ATET*.

	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
A. Probability of Enroling to University within same year - Probit						
$T_p \times Post_t$	0.053*	0.024	0.075***	0.041*	0.012	0.062**
	(0.027)	(0.039)	(0.028)	(0.023)	(0.036)	(0.026)
Controls	yes	yes	yes	yes	yes	yes
Province F.E.	yes	yes	yes	yes	yes	yes
Observations	42,349	19,481	22,868	42,349	19,481	22,868
Pseudo R^2	0.307	0.325	0.286	0.313	0.336	0.297
B. Probability of Attending University away from home - Probit						
$T_p \times Post_t$	-0.003	-0.038	0.013	-0.017	-0.058	0.003
	(0.036)	(0.045)	(0.049)	(0.032)	(0.039)	(0.045)
Controls	yes	yes	yes	yes	yes	yes
Labor Market Controls, absolute values	yes	yes	yes			
Labor Market Controls, relative values				yes	yes	yes
Province F.E.	yes	yes	yes	yes	yes	yes
Observations	15,814	6,291	9,523	15,814	6,291	9,523
Pseudo R^2	0.304	0.301	0.321	0.303	0.300	0.320
C. Probability of Attending University away from home - Heckman						
$T_p \times Post_t$	-0.001	-0.018	0.002	-0.004	-0.026	-0.000
	(0.017)	(0.027)	(0.025)	(0.017)	(0.025)	(0.025)
Controls	yes	yes	yes	yes	yes	yes
Labor Market Controls, absolute values	yes	yes	yes			
Labor Market Controls, relative values				yes	yes	yes
Province F.E.	yes	yes	yes	yes	yes	yes
Observations	41,296	18,990	22,306	41,296	18,990	22,306
Wald test of indep. eqns. ($\rho = 0$)	16.70	10.78	8.833	15.77	10.03	8.663
$Prob > \chi^2$	4.37e-05	0.00103	0.00296	7.16e-05	0.00154	0.00325

For Probit Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.

Table 2.16: Sensitivity to threshold. Enrollment Decisions. Probit difference-in-differences estimation. *ATET.*

	Probability of Enrollment within same year					
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
Breakpoint at Median	0.010	-0.021	0.032	0.030	0.002	0.058**
	(0.020)	(0.029)	(0.023)	(0.019)	(0.028)	(0.023)
Breakpoint at 63^{rd} percentile* 0.055*	0.026	0.078***	0.042*	0.011	0.062**	
	(0.028)	(0.040)	(0.029)	(0.022)	(0.035)	(0.026)
Breakpoint at 75^{th} percentile	0.036**	0.002	0.056***	0.038	-0.009	0.077**
	(0.017)	(0.027)	(0.021)	(0.029)	(0.045)	(0.031)

Estimated Marginal Effects at the mean reported.
Treatment dummies included in columns (1)-(3), province fixed effects in columns (4)-(6).
Standard errors robust to province level clustering in parentheses.
* Breakpoint at 63^{rd} percentile is the main definition of treatment as in Table 2.6.

Table 2.17: Sensitivity to threshold. Mobility Decisions. *ATET.*

	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
A. Probability of Attending University away from home - Probit						
Breakpoint at Median	-0.016	-0.069*	0.025	-0.019	-0.076**	0.019
	(0.030)	(0.040)	(0.039)	(0.031)	(0.038)	(0.040)
Breakpoint at 63^{rd} percentile*	-0.028	-0.060	-0.013	-0.039	-0.077**	-0.025
	(0.029)	(0.037)	(0.040)	(0.027)	(0.032)	(0.038)
Breakpoint at 75^{th} percentile	-0.010	-0.055	0.003	-0.047	-0.097***	-0.027
	(0.039)	(0.045)	(0.046)	(0.031)	(0.030)	(0.042)
B. Probability of Attending University away from home - Heckman						
Breakpoint at Median	-0.005	-0.047	0.026	-0.011	-0.060*	0.019
	(0.019)	(0.030)	(0.025)	(0.018)	(0.030)	(0.024)
Breakpoint at 63^{rd} percentile*	-0.013	-0.032	-0.006	-0.017	-0.043*	-0.011
	(0.016)	(0.025)	(0.023)	(0.016)	(0.025)	(0.022)
Breakpoint at 75^{th} percentile	-0.012	-0.033	-0.008	-0.020	-0.049*	-0.015
	(0.016)	(0.026)	(0.021)	(0.016)	(0.026)	(0.022)

For Probit Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.
* Breakpoint at 63^{rd} percentile is the main definition of treatment as in Tables 2.7 and 2.8.

Table 2.18: Results under different definitions of Treatment. Probit difference-in-differences estimation. *ATET*.

	Enrollment within three years			Enrollment within same year		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
Variety Treatment	0.055*	0.026	0.078***	0.042*	0.011	0.062**
	(0.028)	(0.040)	(0.029)	(0.022)	(0.035)	(0.026)
Universities Treatment	-0.000	-0.010	0.002	0.085*	0.035	0.117**
	(0.031)	(0.035)	(0.035)	(0.044)	(0.059)	(0.046)
Departments Treatment	0.090***	0.091*	0.092***	0.081***	0.081*	0.079**
	(0.034)	(0.047)	(0.035)	(0.031)	(0.046)	(0.036)
Degrees Treatment	-0.021	-0.018	-0.022	-0.028	-0.018	-0.038
	(0.022)	(0.028)	(0.027)	(0.020)	(0.027)	(0.027)

Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.
Controls and Province fixed effects included in all regressions.

Table 2.19: Results under different definitions of Treatment. *ATET*.

	(1) All	(2) Males	(3) Females	(4) All	(5) Males	(6) Females
A. Probability of Attending University away from home - Probit						
Variety Treatment	-0.028	-0.059	-0.013	-0.039	-0.077**	-0.026
	(0.030)	(0.037)	(0.040)	(0.027)	(0.032)	(0.038)
Universities Treatment	0.018	-0.059	0.063	0.002	-0.095	0.042
	(0.062)	(0.086)	(0.082)	(0.061)	(0.085)	(0.075)
Departments Treatment	-0.014	-0.061	0.016	0.000	-0.059	0.013
	(0.031)	(0.042)	(0.040)	(0.034)	(0.048)	(0.046)
Degrees Treatment	-0.025	-0.036	-0.031	-0.031	-0.052	-0.040
	(0.034)	(0.054)	(0.046)	(0.034)	(0.059)	(0.046)
B. Probability of Attending University away from home - Heckman						
Variety Treatment	-0.013	-0.032	-0.006	-0.017	-0.043*	-0.011
	(0.016)	(0.025)	(0.023)	(0.016)	(0.025)	(0.022)
Universities Treatment	0.003	-0.063	0.041	-0.001	-0.082	0.032
	(0.038)	(0.065)	(0.051)	(0.039)	(0.069)	(0.050)
Departments Treatment	0.006	-0.001	0.002	0.004	-0.008	-0.004
	(0.014)	(0.021)	(0.017)	(0.014)	(0.021)	(0.019)
Degrees Treatment	-0.010	-0.019	-0.010	-0.012	-0.024	-0.013
	(0.020)	(0.033)	(0.027)	(0.020)	(0.035)	(0.027)

For Probit Estimated Marginal Effects at the mean reported.
Standard Errors Robust to Province Clustering in parentheses.
Controls included; Labor Market Controls: Absolute Values in columns (1)-(3) and Relative Values in columns (4)-(6).

Table 2.20: Educational Achievements. *ATET.*

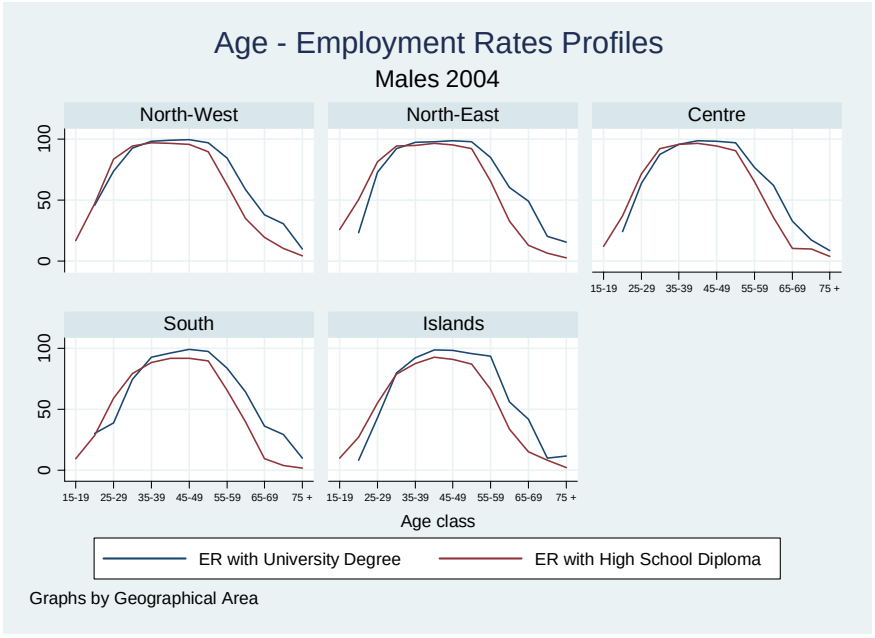
	No Province F.E.			With Province F.E.		
	(1)	(2)	(3)	(4)	(5)	(6)
	All	Males	Females	All	Males	Females
Drop Out	-0.016	-0.027	-0.006	-0.013	-0.017	0.003
	(0.015)	(0.018)	(0.021)	(0.014)	(0.018)	(0.018)
Attendance	0.007	-0.021	0.031*	0.004	-0.006	0.027
	(0.017)	(0.028)	(0.018)	(0.016)	(0.024)	(0.018)
Number of Exams	0.525	0.749	0.205	-0.225	0.239	-1.046
	(0.650)	(0.623)	(0.833)	(0.440)	(0.451)	(0.680)

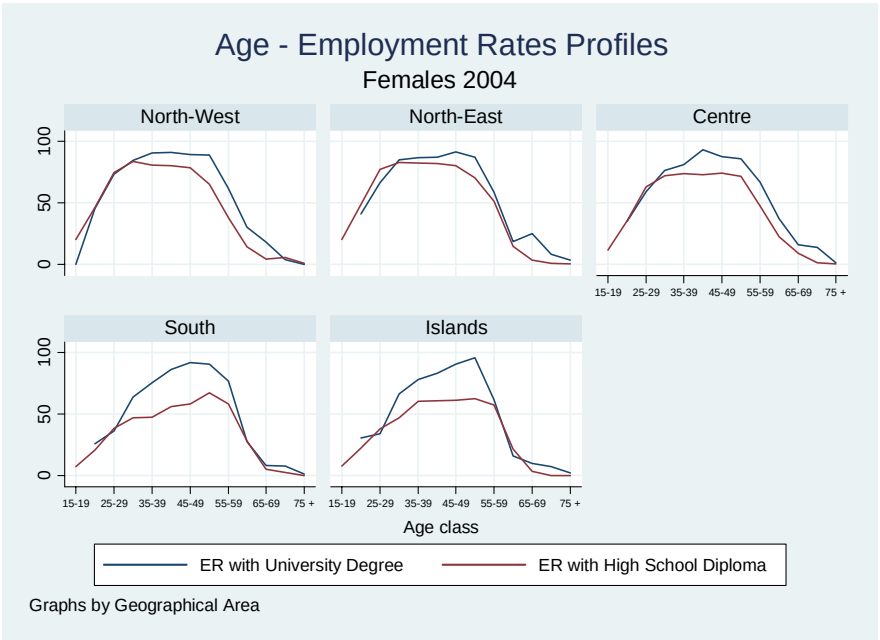
Drop Out, Attendance: Probit Estimates, marginal effects at the mean reported. Number of Exams: Ordered Probit Estimates.
Sample includes only students who enrolled immediately after high school degree.
Standard Errors robust to province clustering in parenthesis.

2.10 Appendices

2.10.1 Labor Market Characteristics

Figure 2.7: Employment Rates by gender and educational attainment. Source: Istat, Labour Force Survey, 2004.





2.10.2 Partition of Provinces

Table 2.21: Treated Provinces according to different definitions of treatment.

Variety		Departments	Universities	Degrees	
Agrigento	Varese	Ascoli Piceno	Aosta	Agrigento	Padova
Aosta	Verbania	Asti	Arezzo	Alessandria	Palermo
Ascoli Piceno	Vercelli	Avellino	Ascoli Piceno	Aosta	Parma
Asti	Vicenza	Bergamo	Asti	Ascoli Piceno	Perugia
Avellino		Bolzano/Bozen	Avellino	Asti	Pesaro e Urbino
Bergamo		Brindisi	Benevento	Avellino	Pescara
Bolzano/Bozen		Campobasso	Bergamo	Bari	Piacenza
Brindisi		Chieti	Biella	Belluno	Pistoia
Caltanissetta		Cuneo	Bologna	Bergamo	Potenza
Campobasso		Enna	Bolzano/Bozen	Bologna	Prato
Catanzaro		Grosseto	Campobasso	Bolzano/Bozen	Ragusa
Como		Livorno	Chieti	Brescia	Ravenna
Cuneo		Lodi	Cuneo	Brindisi	Reggio di Calabria
Enna		Massa-Carrara	Enna	Cagliari	Reggio nell'Emilia
Foggia		Pistoia	L'Aquila	Campobasso	Rimini
Grosseto		Prato	La Spezia	Caserta	Roma
L'Aquila		Ragusa	Lecce	Chieti	Rovigo
Livorno		Rimini	Lodi	Como	Sassari
Lodi		Rovigo	Matera	Cosenza	Siena
Massa-Carrara		Sondrio	Pesaro e Urbino	Cremona	Siracusa
Matera		Terni	Potenza	Enna	Sondrio
Novara		Treviso	Roma	Ferrara	Taranto
Pistoia		Verbania	Rovigo	Firenze	Teramo
Potenza			Salerno	Foggia	Terni
Prato			Treviso	Gorizia	Trapani
Ragusa			Venezia	Grosseto	Trento
Ravenna			Verbania	Isernia	Treviso
Reggio di Calabria			Vercelli	Latina	Udine
Rimini				Lecce	Varese
Rovigo				Livorno	Venezia
Sondrio				Lodi	Verbania
Taranto				Macerata	Vercelli
Teramo				Massa-Carrara	Verona
Terni				Matera	Vicenza
Trapani				Messina	Viterbo
Treviso				Milano	
Udine				Novara	

Chapter 3

When the cat's away... The effects of spousal migration on investments on children

Abstract

This paper analyzes the effects of parental migration on children left behind in order to understand whether and how the effects of migration on children depend on which of their parents migrates. I describe the migration of one of the spouses as a sequential game in which the spouse who migrated chooses how much to send back to the spouse left behind in the form of remittances and then the latter decides how to allocate her total available budget within the household. A similar mechanism generates no difference in the share of total household income devoted to investment on children no matter which of the parents migrates, even when the two spouses have different preferences. These predictions are tested using data from Indonesia, where female migration is particularly widespread.

To solve the selection problems entailed in the comparison between households with migrant fathers and households with migrant mothers, I focus on households that have at least one migrant parent and develop a model in which the decision about whether to send the man or the woman eventually depends on the expected returns and risk associated to each of the two choices. These measures will provide me with a set of instrumental variables to test the theoretical model.

In accordance with the predictions of the model I find that the difference in children related expenditure is not significant between households in which mothers migrate and households in which fathers do. On the other hand I find that in households with migrant mother a significantly larger share of income is devoted to adult goods consumption;this difference reflects the difference in tastes for investment on children between men and women.

3.1 Introduction

In a context of global increase of international migration of workers, a relatively more recent phenomenon is represented by the sharp increase in female independent migration. This phenomenon, sometimes referred to as *feminization of migration*, regards the migration of female workers on their own without their families.
The most significant flows of female migrants are probably those of women from less developed countries who migrate to more developed ones to work as domestic workers and remain in the destination country for a few years before going back to their country of origin and rejoin their families. Scholars have suggestively labeled such phenomenon as "the servants of globalization" (Parrenas, 2001) or "the global nanny chain" (Lan, 2006) or "the globalization of household production" (Kremer and Watt, 2006).
Because the phenomenon is relatively recent and because these migrants often elude the official patterns and thus do not appear on the records, the economic literature has so far given them little attention. Nevertheless the everyday experience shows how massive some of these flows are: the Romanian women migrating to western European countries, those coming from the Philippines and Indonesia, as well as those migrating to the US from Latin America or even those migrating within Latin America such as the Peruvians to Chile.
While some studies have looked at the impact of migrant inflows on the destination countries' labor markets (Card, 1990; Altonji and Card, 1991; Borjas, 1994, 1999; Kremer and Watt, 2006), considerably fewer have analyzed the impact of such phenomena on the sending country and on the households of origin.

The present work aims at analyzing the differential effects of parental migration on investments on children depending on whether it is the mother of the child that leaves or the father. Several studies have showed that women have stronger preferences for investing on children than men (Duflo, 2001; Thomas, 1990; Qian, 2008). Therefore the change in the structure of the household that is caused by migration is likely to have different effects depending on who migrates (see Chen (2009) on migration, but also a similar reasoning applies to the paper by Gertler et al. (2004)). Understanding whether and how migration of the father or of the mother differently affects the children left behind can have important policy implications: for instance it can help governments as well as non governmental organizations decide about how to target financial and non financial support to the families of migrants,[1] or provide useful insights for the regulation of migration both in sending and

[1] UNICEF, for example, promotes policy research on migration and children left behind with a special focus on gender issues

receiving countries; indeed while receiving countries increasingly adopt policies that allow the immigration of female domestic workers from developing countries to face the aging of their population and to encourage the labor force participation of the local women,[2] sending countries are starting to perceive the dangers entailed by the massive outflows of local women and react by putting legal limits to emigration, the most impressive example being that of Sri Lanka, which in 2008 passed a law to ban the international migration of mothers of children under the age of five.

The existing literature has prominently used the existence and the structure of migrants' networks to predict migration decisions (Bansak and Chezum, 2009; Hanson and Woodruff, 2003; Hildebrandt and McKenzie, 2005; Mansuri, 2006) and thus retrieve the effects of parental migration on the household left behind.
Much less numerous are then the contributions of the literature to the choice of female migration; to the best of my knowledge there currently are only two: Lauby and Stark (1988) and de la Briére et al. (2002). Both suggest that female migration would be a means to provide the family left behind with a more stable and reliable source of income than what would be in case of male migration, this because the jobs chosen by migrant women are typically less risky than those chosen by men (Lauby and Stark, 1988) and because women are intrinsically more attached to the family left behind and thus send more remittances (de la Briére et al., 2002).

I will build on this literature to design a model where female migration arises whenever the income for women at destination is either higher or less volatile than that of men and where the consequent allocation of resources will take into account the difference in preferences between men and women over investment on children.

The chapter is structured as follows: section 3.2 describes the model of migration choice and of intra-household allocation of resources of the household; section 3.3 introduces the data employed; section 3.4 is dedicated to the identification and estimation strategy; section 3.5 shows the estimation results; finally section 3.6 provides some robustness checks and section 3.7 concludes.

[2]Similar policies are for instance in place in Hong Kong and Singapore, as analyzed in Kremer and Watt (2006)

3.2 A model of household migration choice

3.2.1 The choice of the migrant

I model the migration choices of the household building on the intuition given by Lauby and Stark (1988) for whom female migration would represent a *safer* investment than male migration for the twofold reason that women are more reliable in sending back remittances, because they are typically more attached to the household of origin, and that the jobs that women get upon migration usually provide more stable streams of income.
In this setting, I will imagine that a rational, utility optimizing, risk averse household is faced with a risky source of income and thus decides to gain control of this risk through the diversification of its income sources. I assume that such diversification will take place through the placement of the "best suited" member of the household in a different location where income streams are not correlated with those at the original location.
I further rely on the assumption that the household decides *who* migrates but does not decide *where* the migrant will go, I will only assume that men and women would migrate to different places. Although it might be interesting to also model the decision of where to go, it is widely documented that migrants tend to show very little variation in the choice of their destinations, following instead quite stable patterns of migration from one place to the other.

What the household has to decide is who to send away between the two spouses, given the assigned gender-specific destination. To model this decision I will borrow the terminology of Modern Portfolio Theory (Markowitz, 1952): I imagine therefore that "woman migrates" and "man migrates" are two risky assets that can each be coupled with another risky asset which consists in "man stays" and "woman stays". The combination of such assets therefore generates four types of *portfolios*:

1. Man migrates and woman stays
2. Woman migrates and man stays
3. Both spouses stay in their original location
4. Both spouses migrate to an alternative location

What I want to model is the choice of the household between portfolio 1 and portfolio 2.

As in Modern Portfolio Theory, I assume that each asset's returns are normally distributed and define risk as the standard deviation of return. A portfolio will thus be a

linear combination of assets.
Therefore the returns associated to each migration portfolio will be a weighted average[3] of the constituent assets' returns, while portfolio risk (volatility) will be a linear combination of each component asset's own volatility and their covariance.
The expected returns of portfolios 1 (man migrates and woman stays) and 2 (woman migrates and man stays)[4] are thus:

$$\begin{aligned} E(R_m) = &\quad \frac{1}{2}E(w_m^d) + \frac{1}{2}E(w_f^h) \\ E(R_f) = &\quad \frac{1}{2}E(w_f^d) + \frac{1}{2}E(w_m^h) \end{aligned} \tag{3.1}$$

where $E(w_m^d)$ represents expected wages for men upon migration (at destination) and $E(w_f^h)$ the expected wages for women if they do not migrate (at home); symmetrically then $E(w_f^d)$ are expected wages for women upon migration and $E(w_m^h)$ the expected wages for men if they do not migrate.
The risk associated to the two portfolios will instead be:

$$\begin{aligned} \sigma_m^2 = &\quad \frac{1}{4}Var(w_f^h) + \frac{1}{4}Var(w_m^d) + \frac{1}{2}Cov(w_m^d, w_f^h) \\ \sigma_f^2 = &\quad \frac{1}{4}Var(w_m^h) + \frac{1}{4}Var(w_f^d) + \frac{1}{2}Cov(w_f^d, w_m^h) \end{aligned} \tag{3.2}$$

I assume that the household's utility is increasing in the expected returns of the portfolio chosen and decreasing in the associated risk. I also consider that household's degree of risk aversion (β_h) will amplify their taste for risk and in some cases determine which one is the preferred portfolio.

Indeed, let's consider the case in which:

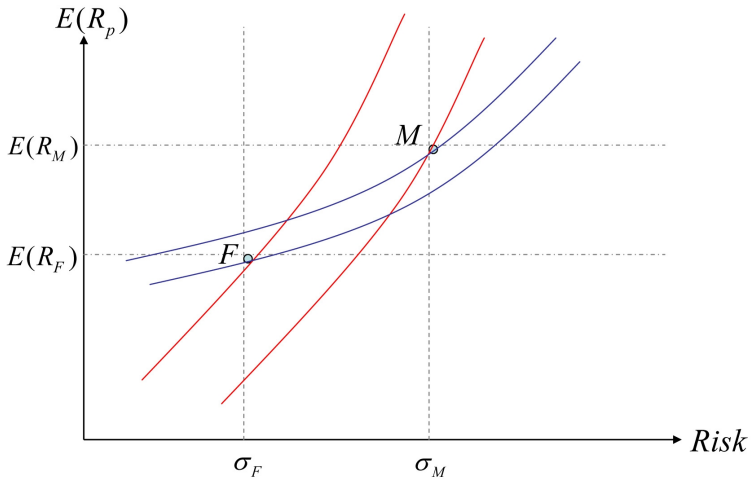
1. $E(w_m^d) > E(w_f^d)$: Men earn on average more than women at destination;
2. $Var(w_m^d) > Var(w_f^d)$: Men's income is more volatile than women's upon migration.

Under such conditions we get that portfolio 1 (man migrates and woman stays) entails higher expected returns , but also higher risk, than portfolio 2 (Figure 3.1).

[3] Given the particular nature of the problem we are examining in which the only possible diversification is to allocate the two spouses to different sources of income the weights assigned to the two component assets will necessarily be 1/2 and 1/2

[4] I will denote portfolio 1 (man migrates and woman stays) by subscript m to indicate that it is the man that migrates whereas I will use subscript f for portfolio 2 to indicate that it is the female spouse who migrates.

Figure 3.1: Returns-Risk Profiles of Migration Portfolios



In Figure 3.1 the red indifference curves are those of a more risk averse household whereas the blue ones are those of a less risk averse one. The graph shows that in a similar case more risk averse households (red indifference curves) will prefer female migration (portfolio 2) whereas less risk averse households (blue indifference curves) will prefer male migration (portfolio 1).
The maximization problem faced by the household will thus be that of maximizing expected returns holding risk fixed and minimizing risk holding expected returns fixed.

3.2.2 The allocation of resources within the household

Having decided together which member of the household should migrate so that the expected returns are maximized while risk is minimized, the spouses are faced with two types of decisions: the migrant has to decide how much to remit to the household left behind, while the spouse who stayed at home has to decide how to allocate resources within the household. These two decisions are taken sequentially: first the migrant spouse decides how much to remit; then the spouse left behind decides how to allocate his total available budget, which will consist of his own income and the remittances received.

The household is composed of the two spouses who earn some positive income and decide on the allocation of the household budget and by kids who do not earn any income and do not participate in the decision making process. The man and the woman's prefer-

ences are such that each i gets utility from the consumption of some private good X_i and from that of a common good Z which instead yields utility to both spouses.
Call X_f the vector of the woman's private goods and X_m that of the man's. We imagine that Z, the vector of common goods, contains all children related expenditure, i.e. both parents benefit from investment on children. However preferences are such that the woman always weighs expenditure on children more than the man in her utility functions.[5]

Assuming Cobb-Douglas preferences,[6] I can express the preferences of men and women in the following way:

$$\begin{aligned} U_m &= \alpha \log X_m + (1-\alpha) \log Z \\ U_f &= \beta \log X_f + (1-\beta) \log Z \end{aligned}$$

where the fact that men have a stronger preference for personal consumption over investment on children than women do is simply captured by imposing:

$$\alpha > \beta \tag{3.3}$$

With income pooling and equal weights assigned to the spouses, the utility maximization problem the household wishes to solve when no migration occurs will be the following:

$$\begin{aligned} \max_{X_f, X_m, Z} \quad & \alpha \log X_m + (1-\alpha) \log Z + \beta \log X_f + (1-\beta) \log Z \\ s.t.: \quad & X_m + X_f + Z = Y_m + Y_f \end{aligned}$$

Which simply yields the following optimal allocations:[7]

$$\begin{aligned} X_m^0 &= \frac{\alpha}{2}(Y_m + Y_f) \\ X_f^0 &= \frac{\beta}{2}(Y_m + Y_f) \\ Z^0 &= \left(1 - \frac{\alpha+\beta}{2}\right)(Y_m + Y_f) \end{aligned} \tag{3.4}$$

[5] The fact that women have stronger preferences for investing on children than men has been showed in many papers among which Duflo (2001), Thomas (1990), Qian (2008).
[6] The results derived in this section are robust to any CES utility function specification.
[7] These are pareto-efficient (Chiappori and Donni, 2009).

Suppose now that the woman migrates: she will have to decide how much to send back in the form of remittances (R). Once the husband receives the remittances from his wife, he decides how to spend the total budget available.
This non-cooperative Nash-Stackelberg equilibrium model can be solved through backward induction: the husband decides how to allocate the budget available to him according to his own preferences; the wife anticipates this allocation and incorporates the husband's choice in her decision problem to choose how much of her income to send back in remittances.

The problem is thus a two-stage one where at the second stage the man solves:

$$\begin{aligned} \max_{X_m, Z} \quad & \alpha \log X_m + (1-\alpha) \log Z \\ s.t.: \quad & X_m + Z = Y_m + R \end{aligned}$$

Solving this yields:

$$\begin{aligned} Z^* &= (1-\alpha)(Y_m + R) \\ X_m^* &= \alpha(Y_m + R) \end{aligned} \tag{3.5}$$

In the first stage of the game the migrant wife anticipates the husband's choice and decides how much to send back through remittances by solving:

$$\begin{aligned} \max_{R} \quad & \beta \log X_f + (1-\beta) \log Z \\ s.t.: \quad & X_f = Y_f - R \\ & Z = Z^* = (1-\alpha)(Y_m + R) \end{aligned}$$

She will hence choose to send remittances:

$$R^* = Y_f - \beta(Y_m + Y_f)$$

The equilibrium allocations of the sequential game described are therefore:

$$\begin{aligned} X_m^* &= \alpha(1-\beta)(Y_m + Y_f) \\ X_f^* &= \beta(Y_m + Y_f) \\ Z^* &= (1-\alpha)(1-\beta)(Y_m + Y_f) \end{aligned} \tag{3.6}$$

It is straightforward to solve the symmetric problem for the case in which it is the husband that migrates and sends back remittances. In this case we would get the following equilibrium allocations:

$$\begin{aligned} X_m^{**} &= \alpha(Y_m + Y_f) \\ X_f^{**} &= \beta(1-\alpha)(Y_m + Y_f) \\ Z^{**} &= (1-\alpha)(1-\beta)(Y_m + Y_f) \end{aligned} \tag{3.7}$$

with remittances sent by the husband being:

$$R^{**} = Y_m - \alpha(Y_m + Y_f)$$

Because of the the ability of the migrant to anticipate the allocation that will be chosen by the spouse left behind, the model predicts that the share of household income devoted to children will be the same no matter which one of the spouses migrates. This is because the non-migrant parent wants to shift away resources from children onto his private consumption, but this can be offset by the migrant parent through remittances. Denote with small letters the share of income devoted to each type of consumption goods, we have:

$$z^* \quad = \quad z^{**}$$

the share of total household income spent on expenditure on children will be the same no matter which of the parents migrates (where $z^* = \frac{Z^*}{Y_m+Y_f}$ and $z^{**} = \frac{Z^{**}}{Y_m+Y_f}$).

On the other hand, the person who migrates is always better off than the person left behind whose level of private consumption will depend on the "generosity" of the migrant spouse. For example a comparison between shares of total household income spent for consumption of the husband's private goods when he migrates and when instead it is the wife who migrates shows that:

$$x_m^{**} - x_m^* = \alpha - \alpha(1-\beta) = \alpha\beta$$

which means that the "loss" that the non migrant spouse experiences is proportional to the degree of "selfishness" of both himself and the migrant spouse (where $x_m^{**} = \frac{X_m^{**}}{Y_m+Y_f}$ and $x_m^* = \frac{X_m^*}{Y_m+Y_f}$).

It further appears that the spouse who migrates is always better off than when nobody migrates, for example for men:

$$x_m^{**} - x_m^0 = \alpha - \frac{\alpha}{2} = \frac{\alpha}{2} \quad > \quad 0$$

while the one left behind gains from migration of the spouse only when the latter is "generous enough"; for example the man left behind gets a larger share of total household income when his wife migrates compared to the case in which nobody migrates if $\beta < \frac{1}{2}$:

$$x_m^* - x_m^0 \;=\; \alpha(1-\beta) - \frac{\alpha}{2} \quad > \quad 0 \qquad\qquad \text{for } \beta < \frac{1}{2}$$

Finally the share of income spent on children is always lower than in the case in which both parents remain in the household: this is because the parent left behind will always have an incentive to shift resources away from the children onto his own private consumption whenever his spouse is away.

$$z^0 \quad > \quad z^*, z^{**} \qquad\qquad \text{for any } \alpha, \beta$$

3.3 Data

This paper uses the data on Indonesian families provided by the Indonesia Family Life Survey (IFLS).[8] The IFLS is an ongoing longitudinal survey of Indonesian households which started in 1993 and contains a sample that is representative of about 83% of the total Indonesian population, containing over 30,000 individuals living in 13 of the 27 provinces of Indonesia.

These data give me the possibility of tracking individuals over time and thus to detect migration. Indeed for all individuals who appeared in the first wave of the survey the IFLS roster provides information on where they currently are (if they are not in the household anymore), why and when they left and how much they earned in the past twelve months. Using this information, I define migrants as those adult people who have left the household and are reported to having done so for work reasons or explicitly to help the family. Table 3.1 shows that the share of migrants has steadily increased over time: from the time of the first interview in 1993, fourteen years later more than one household out of four had at least one member that had migrated (and not come back), while among all the individuals

[8] For an introduction to the dataset see Thomas et al. (2010)

surveyed, migrants represented about 9%.

Table 3.1: Migration in the IFLS.

Wave	Individuals	Migrants	%	Households	Migrant Households	%
1993	33,081	-	-	7,224	-	-
1997	39,714	1,701	4.28	7,699	1,304	16.94
2000	54,991	2,835	5.16	10,435	2,022	19.38
2007	73,016	6,352	8.70	13,536	3,787	27.98

Table 3.2, moreover, shows the gender partition of Indonesian migrants: almost two thirds of migrants are men, but women are more than twice as likely as men to migrate internationally and this is particularly true for mothers versus fathers. On the other hand women, especially those who are mothers of children left behind, tend to stay away for a period of time that is significantly shorter than that of men.

Table 3.2: Migrants by gender. IFLS 2007.

	Number	% of total migrants	% international	Migration spell (months)
Migrants	6,352	-	11.04	64.93
Men	4,046	63.70	7.74	66.75
Fathers	840	13.22	7.63	69.81
Fathers of children under 18 left behind	297	4.68	16.55	53.04
Women	2,306	36.30	16.99	61.72
Mothers	488	7.68	29.65	60.37
Mothers of children under 18 left behind	191	3.01	60.32	39.44

I am interested in comparing households with children in which the mother migrated and the father stayed with the children, with households in which the father migrated and the mother stayed. Thus, for every child under the age of 18, I check whether his father or mother migrated and assign the child to the relative group. Table 3.3 shows the actual partition of households with children in the 2007 IFLS sample,[9] while table 3.6 shows

[9]Notice that the total number of households with either a father or a mother that migrated leaving

descriptive statistics for the two types of households of interest.

Table 3.3: Migration portfolio choices of households with kids. IFLS 2007.

	Woman Migrates	Woman Stays
Man Migrates	40	258
Man Stays	152	9,186

Finally, data from the Indonesian Statistical Office (BPS, 2007) give a hint of what jobs the Indonesian migrants perform when they migrate internationally. There is strikingly little variation in the types of jobs of the Indonesian migrants at destination: 53% of migrants who were abroad in 2007 worked as domestic helpers, while 42% as either construction, factory or plantation workers.
Although I am not able to split such information by the gender of the migrant, I can still see a difference between typical female jobs and typical male jobs: domestic workers are very likely to be the female migrants, whose total percentage is in fact around 55% of total international migrants, while the construction, factory and plantation workers are likely to be the men.

3.4 Estimation Strategy

I want to estimate an equation in which I look at the shifts in the shares of total household expenditure from one category of consumption goods to another. A similar equation represents the direct translation into estimation equation of the model introduced in section 3.2.2. Indeed, we will think that there are some types of expenditure, such as that for education or food, which well proxy for household's investment on children (Z in the model of section 3.2.2).

I will estimate an equation of the following type:

$$w_{ih} = \alpha_{ih} + \beta \ln n + \gamma F_h + \delta X_h + u_{ih} \tag{3.8}$$

their children under the age of 18 behind is slightly smaller than the sum of migrant fathers and mothers reported in table 3.2, because there are households that include more than one family unit.

where on the left hand side I have the share of total household income allocated to expenditure for commodity i, and on the right hand side I have the number of members in the household n together with household's observable characteristics X_h, and a term F_h which indicates that the household is one in which the mother of the children in the household has migrated, while the father did not, F_h will be zero if instead it was the father who migrated and the mother remained with the children.
The coefficient of interest is thus γ, associated to the term F_h; this will provide us with a measure of the *difference* between the budget allocation of households with migrant mothers and households with migrant fathers. Given that households belonging to the two groups of interest do not differ with respect to their structure, it is possible to compare them to retrieve the effects of migration of one of the spouses.

Estimating the effects of migration and how they differ depending on the gender of the migrant spouse entails problems of endogenous selection into treatment of two types: first there is a problem of *selection into migration* as households that decide to send some member out for migration will likely differ from the others on both observable and unobservable characteristics; secondly there is a problem of *selection into female migration* because households from which it is the mother that migrates are likely to differ from those from which the father migrates in a number of unobservable factors that might as well influence the variables of outcome we are looking at.
These ideas are confirmed by Table 3.6, which shows that households with no migrants are on average smaller, richer, more from urban areas, more educated and with younger children than households from which either the mother or the father migrated. Moreover households from which it is the mother that migrated appear to be more rural, less educated and poorer than those from which it is the father that migrated. It is therefore very likely that these households differ on other unobservable characteristics as well.

This paper relies on the assumption that the decision of *selection into migration* and that of *selection into female migration* are not taken jointly: the household decides whether someone should migrate first and then decides which member.
With respect to the first choice, i.e. *selection of households into migration*, I will simply condition on households having decided to send out a member for migration and focus on the decision of which member should migrate.

This estimation choice, nevertheless, comes at a cost in terms of identification: indeed, following this approach, I will not be able to separately estimate the effect of female ver-

sus male migration from the effect of migration per se; in other words I will only identify the effect of female migration in households in which either the woman or the man have migrated but not in households in which no one has migrated.
Such identification issue, though, should not affect the reliability of my estimates because there is no theoretical reason to expect migration of mothers from non migrant households to have opposite effects than migration of mothers from migrant households; so, as long as this assumption holds, the sign of the coefficients I estimate will be correct, although the true parameters would be smaller in absolute value.

In order to control for *selection into female migration*, I will exploit the intuition of the model described in section 3.2 and thus find a set of instrumental variables that may influence the decision of migrant households about which of the spouses to send out for migration but will not have any direct effect on the outcome variables of equation 3.8.

The model of section 3.2 is translated into the data by first assigning a destination to each individual. To do so I identify for each household the year in which the migration decision has been taken as that in which the migrant (whether the man or the woman) has departed; I then look at the destinations chosen by the previous migrants from the same village and take the destination that was most popular among female migrants as destination for women and the one that was most popular among male migrants as destination for men.
This choice is justified by the finding that migrants from the same village tend to choose the same destination (Table 3.4); this can be interpreted both as the consequence of the formation of *networks of migrants*, which is also well documented in the migration literature (Bartel, 1989; Altonji and Card, 1991; Patel and Vella, 2007; Lafortune and Tessada, 2012), but also can be justified by the widespread use in South Asia of recruiting agencies which are connected to other agencies in a foreign country and therefore tend to send all the people of the village they visit to the same destination (Suradji, 2004). Table 3.8 shows the gender specific destinations assigned to each household.

Once I have assigned a destination to each household, I exploit again the information about previous migrants. Thus I generate, for every destination and year of migration decision, a measure of expected returns and risk by taking the mean and standard deviation of the incomes of all male and female migrants that migrated to that destination, and then I combine them as in equations 3.1 and 3.2. For what regards the covariance between income at home and income at destination, instead, I exploit the longitudinal dimension

Table 3.4: Migrants per village. IFLS 2007.

	Men	Women
Adults per village	55.31	58.70
	[40.99]	[42.29]
Migrants per village	15.64	9.39
	[14.002]	[9.185]
% Migrants at same destination	.617	.622
	[0.231]	[0.234]

*Standard deviations reported in brackets

of the data, and compute the covariance for every village-destination pair across waves.

The case suggested in Section 3.2, in which female migration is on average associated with lower but more certain expected wages than male migration is confirmed in the data:

Table 3.5: Expected Returns and Risk from Migration Portfolios (log).

	Men	Women
$E(w_i^d)$	16.218	15.945
	[.516]	[.360]
$Var(w_i^d)$	16.390	15.912
	[.881]	[.556]
$Cov(w_i^d, w_j^h)$	32.051	32.030
	[1.235]	[.902]
$E(R_i)$	16.029	16.046
	[.408]	[.347]
σ_i	16.177	16.106
	[.788]	[.566]

*Standard deviations reported in brackets

Table 3.5, as well as Figures 3.2 and 3.3, show that while the expected value and variance of wages of female migrants at destination are stochastically dominated by the expected value and variance of wages of male migrants, once we combine the assets into portfolios as described above the difference becomes much less significant.

In line with the model of section 3.2, I will introduce in the regressions a measure of risk aversion, which will be included as a control variable on its own and then as an instrumental variable when interacted with the level of risk of respectively male and female

Figure 3.2: Expected Wages and Returns from Migration Portfolios

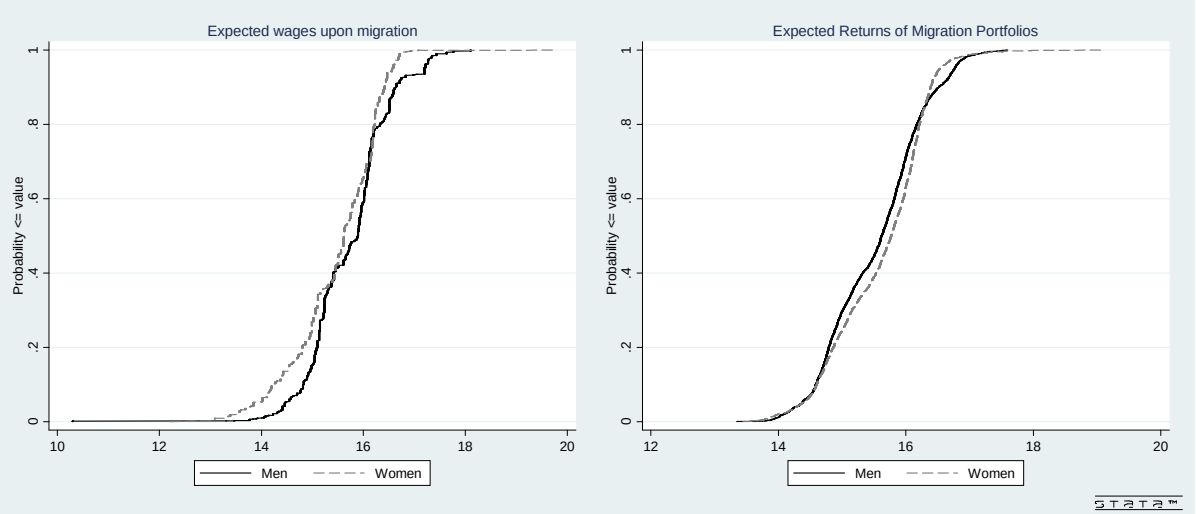
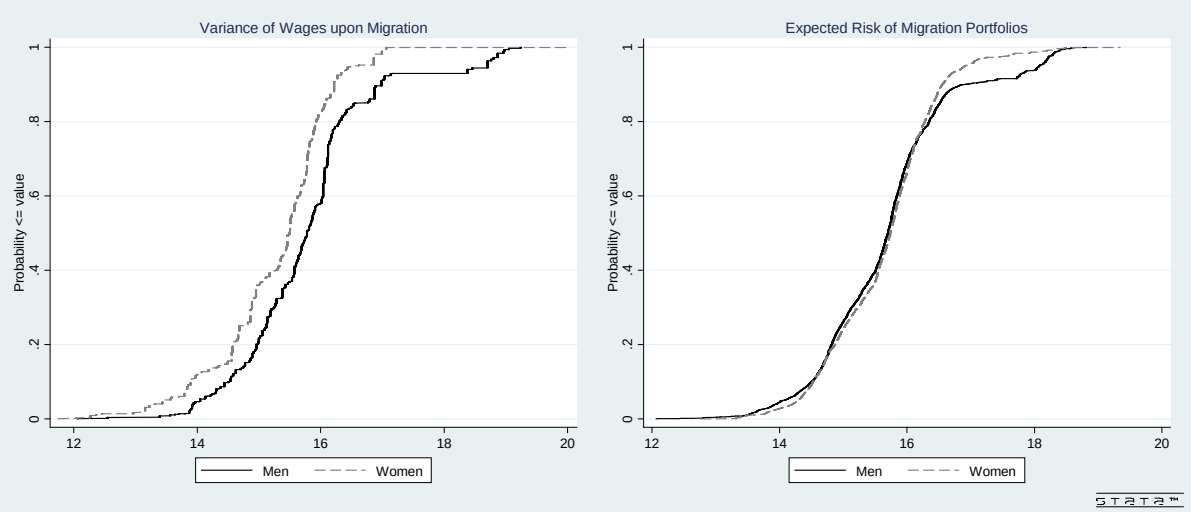


Figure 3.3: Expected Risk from Migration Portfolios



migration. Risk aversion is captured in the IFLS through a number of questions in which individuals are faced with a series of lotteries with hypothetical high stakes and, depending on the path of answers they give, they are assigned a level of risk aversion between 0 and 4. Assuming that decisions are taken jointly by the spouses and that there is assortative matching on risk aversion, I use the level of risk aversion of the head of the household or, if that is missing, I take the level of risk aversion of the spouse.

In terms of validity of these instruments I imagine that households will make their migration decision based on the information they have about the possibilities they might have at destination, thus it is reasonable to believe that the experience of previous migrants best represents the information set available to potential migrants.

On the other hand, the excludability of these instrumental variables is less straightforward: in order for the wages of previous migrants not to be directly correlated with the outcome variables, I will need to assume that they are not influenced by unobserved characteristics of the migrant but are somehow exogenous and thus non migrants would be faced with the same wages if they migrated. Such assumption is supported by the data reported by the Indonesian Statistical Office (BPS, 2007) about jobs of international migrants which I mentioned in section 3.3 : there is very little variation in the type of jobs that migrants get upon migration and they are all low skilled jobs, for this reason we can reasonably assume that the wages are fixed and exogenous. Moreover, at least for women, there is vast anecdotal evidence that they are hired to go work abroad as domestic workers under standard contracts that specify the same wage and duration of employment for all (Suradji, 2004; Patel and Vella, 2007).

3.5 Results

In order to estimate Equation 3.8, I first need to to create a measure of total household income. To do so I follow Dai et al. (2011) who have estimated the distribution of household income using the same data from the fourth wave of the IFLS. As in their study, income is computed as the summation of five components: labor income; income from agricultural business; income from non agricultural business; household non labour income (scholarships, pensions, other transfers); household assets income.
Following Dai et al. (2011) I have also estimated income for households for which it was missing using a two step Heckman procedure that exploits a dummy variable for whether the respondent is the head of the household to predict the probability of response in the first stage. Table 3.7 shows descriptive statistics for the levels of household income (actual and predicted) and expenditure for households with migrant fathers and households with migrant mothers, together with the shares of (predicted) income allocated to the various types of commodities.

Equation 3.8 is first estimated through OLS, the results are reported in Table 3.9 and show that households in which mothers have migrated spend significantly more on adult goods.[10] The shift is about six percentage points, while the difference on expenditure on other types of goods is not significant. The results are robust to the inclusion of a set of control variables derived from table 3.6.

If households from which mothers migrate are poorer, more rural and less educated than households from which fathers migrate (table 3.6), then for example the OLS coefficient associated to non food items or that associated to education will likely be downward biased. For this reason, in order to control for the possibility that households from which mothers migrate differ from those from which it is the father who leaves, I proceed to estimate equation 3.8 by Two Stage Least Squares (TSLS).

Table 3.10 shows the results of the First Stage regression: columns (1)-(3) use only the *destination side* of the migration portfolios and show that female migration arises when it is associated with higher expected returns and lower variance than male migration; columns (4)-(6) then use the measures of expected returns and risk of migration portfolios constructed according to equations 3.1 and 3.2. The signs still confirm the existence of a trade off between expected returns and expected risk.

For all specifications, the last three rows of the table report the values of the Cragg Donald F Statistic of excluded instruments (Cragg and Donald, 1993) and of the Hansen J test of overidentifying restrictions (Hansen, 1982) with its p-value for the cases in which the number of instruments exceeds the number of endogenous variables (all columns except 1 and 4). A first look at these values convinces us that the best set of instruments to employ is that of columns (2)-(3), i.e. the relative measures of profitability and riskiness of female versus male migration, as the F statistic is highest and the test of overidentifying restrictions does not reject the null hypothesis that all instruments are exogenous.

Table 3.11 then shows the results of the TSLS estimation of equation 3.8. If we compare these results with those of the OLS, we observe that the increase in adult expenditures is larger than it was in the OLS, while the decrease of non food items becomes non significant. The results are in line with what the model in section 3.2.2 predicts: the difference in the share of household income devoted to investment on children (here expenditure on

[10] These are coffee, tea, tobacco and alcohol. The use of adult goods to detect son preferences has been suggested by Deaton (1997)

food, health and education) is not significantly different between households from which the man migrated and households from which it was the woman that migrated. This was due to the possibility of the migrant spouse to control the amount of remittances to send back home in a way so as to offset the shifts in the allocation of the household budget that would be made by the spouse left behind.

On the other hand, the model was predicting that the share of household income devoted to adult's private consumption when the woman migrated was $x_m^* = \alpha(1-\beta)$ while the share of household income devoted to adult private consumption when it was the man that migrated was $x_f^{**} = \beta(1-\alpha)$.
The coefficient estimated in column (5) of table 3.11 is thus the difference between the two shares: $\alpha(1-\beta) - \beta(1-\alpha) = \alpha - \beta > 0$.
The associated positive sign thus confirms that men have a larger preference for private consumption over investment on children than women and that this difference ranges between 13.6 and 18.6 percentage points. In other words men's preferences are such that they would like to spend around 15 percentage points more than women on private consumption rather than on expenditure on common goods.

I compare these estimates with the existing literature on models of intra household allocation to verify their validity. Many authors have provided robust evidence that women have stronger preferences for consumption on common goods than men do: Thomas (1990), Lundberg et al. (1994), Duflo (2001), Qian (2008), Ashraf (2009) all show that income accruing to women generates larger benefits for children than that accruing to men. Unfortunately it is generally difficult to compare the magnitude of their estimates with those found in this paper because typically both the outcome and the explanatory variables are defined differently. Nevertheless I believe that there are at least two papers which contain comparable estimates as they use as outcome variables the shifts in the shares of household expenditure like I do. Aggregating their shares in a way that is comparable to the one used in this paper, Hoddinott and Haddad (1995) show that the shares of the household budget allocated to adult goods are between 3.2 and 6.6 percentage points lower in the case in which the woman earns the whole household budget with respect to the case in which it is the man. Similarly Attanasio and Lechene (2002) find that a 100% increase of the woman's household income share generates a decrease in the share of expenditure allocated to alcohol and tobacco between 19 and 40 percentage points. The two papers just cited do not provide an exact test of the model introduced in this paper because the presence of the spouse, even when she does not contribute to the household's income at

all, is likely to affect the choice of how to allocate it.
Another paper I would like to relate my results to is then Ashraf (2009): she uses an experimental setting in the Philippines to test whether husbands and wives have different preferences over the allocation of the household budget and how information and communication affect their choices. Interestingly, she shows that in situations in which one of the spouses receives a temporary shock to income and the other spouse is not able to control how he spends this extra budget (in the setting of her experiment this is the "Private" treatment), 60.4% of men versus 52.1% of women choose to deposit that money on their own private account rather than converting it into food vouchers. This is a rough test of the difference in the "generosity" parameters included in the parents' utility functions described in section 3.2: this difference can be interpreted as $\alpha - \beta = 8.3\%$, a number quite close to the estimates of table 3.13.

3.6 Robustness Checks

The first concern I have relates to the possibility that the instruments employed might be *weak*: if they do not have enough explanatory power in the first stage then TSLS estimates risk to be biased towards the corresponding OLS estimates.
A general test of the weakness of the instruments is based on the analysis of the F-statistic (Stock and Yogo, 2002): it can be proved that whenever this gets small, the bias of TSLS approaches that of OLS. In order to assess whether the F statistic of the excluded instruments is big enough, I follow Stock and Yogo (2002) and compare the value of the Cragg Donald F Statistic with the threshold values they tabulated. I find that the Cragg Donald F statistic of my TSLS only exceeds the critical value corresponding to 20% size of test.

The bias in TSLS is an increasing function of the number of instruments employed, while the just identified TSLS is approximately unbiased. For this reason my first test of the robustness of the coefficients estimated consists in estimating equation 3.8 using only the most powerful instrument I have, namely $E(w_f^d)/E(w_m^d)$. Results are reported in Table 3.12: the F Statistic is now high enough to exceed the 15% critical value as tabulated by Stock and Yogo (2002); the difference between households with migrant mothers and households with migrant fathers in their allocation of the household budget to adult goods is now larger than in the baseline TSLS, which confirms that the latter is slightly biased towards the OLS estimator. Nevertheless none of the coefficients estimated in this table is statistically different from those of table 3.11 as the test in the last row confirms.

In the case of overidentified models, the Limited Information Maximum Likelihood Estimator (LIML) is median-unbiased. This estimator performs particularly well in small samples and whenever the number of instruments is large. Stock et al. (2002) have compared the critical values for the weak instrument test based on the first stage F Statistic for a number of estimators and showed that, whenever the model is overidentified, the LIML is the estimator with the lowest threshold values for the F Statistic. They also show that LIML and Fuller-k estimator (with $\alpha = 1$) generally have smaller critical values than TSLS. For this reason, in table 3.13, I have reestimated the model using a set of alternative estimators for which the critical values for the F Statistic are lower. In the table I also report the corresponding critical values tabulated by Stock and Yogo (2002). As expected, the LIML estimates are the most unbiased ones as the value of the F Statistic exceeds the 10% critical value of 8.68.

Table 3.13 also includes estimates with two Fuller-k estimators (Fuller, 1977). When errors are normally distributed and instruments are fixed, the Fuller-k with $\alpha = 1$ is best unbiased to second order (Rothenberg, 1984). While the critical values for the F Statistic are not significantly lower than those for TSLS, this estimator has been proved to yield more precise estimates than both TSLS and LIML when instruments are weak. Fuller (1980) has shown that for an estimator of the coefficients in the linear model, the value $\alpha = 4$ yields smaller mean squared error than any smaller value of α, while $\alpha = 1$ gives a nearly unbiased estimator. Both Fuller estimators anyway generate a substantial reduction in the mean square error (MSE) relative to TSLS and LIML. In table 3.13 both these estimators produce coefficients that are very close to the TSLS and LIML ones, with the Fuller-k with $\alpha = 1$ being closer to the LIML and the Fuller-k with $\alpha = 4$ almost equal to the TSLS.

As predicted by Blomquist and Dahlberg (1999), the absolute magnitude of the coefficients estimated through LIML is slightly larger than the TSLS estimates, as are the standard errors, but the fact that the difference between the coefficients estimated with the different procedures is negligible reinforces our hypothesis that the instruments have enough predictive power. Indeed, if they were weak, the TSLS estimates would have been much closer to the OLS ones than to the LIML ones.

Although the test of overidentifying restrictions has systematically not rejected the hypothesis that the instruments are not directly correlated to the outcome variables, I have performed a further test of exogeneity of the instruments. As specified in section 3.4,

the instruments I am employing are essentially time (of migration) and village specific. One might therefore be concerned that some villages have unobserved characteristics that have traditionally pushed their migrants to a certain destination and therefore, while the wages at destination are exogenous, the destination itself would not. For example it might be the case that a village that is very badly connected through infrastructures has less probability of sending its migrants overseas. In particular one needs to make sure that it is not the case that poorer villages systematically send women to more attractive destinations than men. If that was the case then I may well be concerned about the fact that my results are driven by village specific unobserved characteristics (for example lack of schools and other infrastructures). I thus regress a number of village specific characteristics on our instruments to check that there is no correlation between the two. The results are reported in table 3.14 and show no clear pattern of correlations which gives us enough confidence about the actual exogeneity of our instruments.

As a last check I performed some Montecarlo simulations to assess the robustness of the estimates. I have drawn 1000 random samples, adequately calibrated to reproduce the correlation between endogenous and outcome variable of the real sample, and I have estimated the TSLS and the LIML coefficients for each drawn.
Table 3.15 reports the averages and standard deviations of the coefficients estimates, together with the corresponding Cragg Donald F Statistic, the p-value of the test of overidentifying restrictions and the confidence interval corresponding to the test of equality between the coefficient estimated from the simulated sample and the ones estimated from the real sample and reported in table 3.13. The coefficients estimated are very similar to those of table 3.11, I do not reject that they are equal in more than 95% of the cases (*coverage*). Moreover the F Statistic is now systematically larger than 10, which is above the 20% level of the Stock and Yogo (2002) critical values for the TSLS, and above the 10% one for the LIML estimator. Finally, the test of overidentifying restrictions leaves us little doubt about the possibility that the instruments are not exogenous.

3.7 Concluding Remarks

In this paper I looked at the effects of parental migration on investments on children left behind. The main concern is that migration of one of the spouses may be associated with a shift of resources away from the children due to a moral hazard problem; as the migrant would lose the ability to observe the behavior of the spouse left behind, this would create for the latter incentives to shift away resources from the common good (investment on

children) onto the private ones. I find that when the migrant decides how much to send back home in the form of remittances and, subsequently, the spouse left behind chooses how to allocate the available budget within the household, the Subgame Perfect Nash equilibrium is one in which the share of total income devoted to children is the same no matter which of his parents migrates. This is because remittances act as a device in the hands of the migrant for controlling the decisions of the spouse left behind.

In order to account for the problems of endogenous selection implied, I modeled the decision of the household with regard to which member to send out for migration as a returns/risk comparison and I showed that households prefer to send the member who is expected to earn more upon migration and whose earnings will be less volatile (less risky). For this reason households which are more risk averse will prefer to send away for migration the spouse whose earnings upon migration are expected to be less uncertain, even if lower; this is generally the case of female migration.
I tested the predictions of this model on data from Indonesia, where female migration is particularly high, and showed that the share of total income devoted to children related expenditure does not change significantly between the case in which the father migrates and that in which it is the mother that leaves.
I also proved that the difference in the share of total household income devoted to private adult consumption between the case in which the mother migrates and that in which it is the father is positive and reflects the difference in tastes for private consumption, as predicted by the model of section 3.2. The difference between fathers' and mothers' "generosity" is around 15 percentage points.

The findings of this paper indicate that female migration has no detrimental effects on their children, compared to migration of the father, as long as the migrant mothers have the possibility of sending remittances in an efficient way. For this reason it is crucial to improve the quality of remittance services as only this allows migrant women to ensure that their children receive all the cares they desire.

Further research should broaden the research question addressed in this paper to estimate the *total* effect of parental migration on children by comparing children with one migrant parent with children with none. Finally studying the effects of the *feminization of migration* on children left behind should include some analysis of the behaviors of female migrants upon return to their country of origin and to their household. The experience acquired by such women during their migration spell will presumably induce significant

changes in the household's decision making process, changes which might eventually generate further benefits for the children.

3.8 Tables and Figures

Table 3.6: Households' Characteristics. IFLS 2007.

	(1) Non Migrant Households	(2) Migrant Father	(3) Migrant Mother	(4) Difference (2) - (3)
Size of Household	4.012	4.574	4.605	-0.031
	(1.981)	(1.944)	(1.798)	
Rural	0.451	0.519	0.671	-0.152***
	(0.498)	(0.501)	(0.471)	
Muslim	0.890	0.930	0.958	-0.028
	(0.313)	(0.255)	(0.202)	
Number of Children (< 18)	1.237	2.043	2.072	-0.029
	(1.183)	(1.113)	(1.055)	
Age of Children	8.749	9.722	10.41	-0.688*
	(4.797)	(3.749)	(3.303)	
Gender of Children	0.495	0.475	0.500	-0.025
	(0.406)	(0.364)	(0.361)	
Years of Education Mother	8.280	7.638	7.027	0.611*
	(3.841)	(3.648)	(2.762)	
log Total Expenditure	15.36	15.18	14.95	0.23***
	(1.034)	(0.875)	(0.688)	

Standard deviations reported in parenthesis

Table 3.7: Household income levels and shares

	(1) Migrant Father	(2) Migrant Mother
log Total Income	15.67	15.895
(actual values)	(1.287)	(1.081)
	[193]	[133]
log Total Income	16.251	16.264
(predicted values)	(0.717)	(0.621)
	[254]	[147]
log Total Expenditure	15.15	14.93
	(0.905)	(0.659)
	[255]	[148]
Shares of total income spent on:		
Food	0.764	0.582
	(0.858)	(0.667)
	[254]	[147]
Non Food	2.025	0.398
	(14.923)	(0.435)
	[254]	[147]
Education	0.171	0.137
	(0.304)	(0.157)
	[254]	[147]
Health	0.058	0.027
	(0.292)	(0.094)
	[254]	[147]
Adult	0.06	0.107
	(0.133)	(0.133)
	[254]	[147]

Standard deviations reported in parentheses.
Number of observations reported in brackets.
Non food items include: Electricity, Water, Fuel, Telephone, Personal Toiletries, Household items, Domestic Services, Recreation and Entertainment, Transportation, Sweepstakes, Clothing for children and adults, Household Supplies and Furniture, Ritual Ceremonies, Charities and Gifts, Taxes, Others such as Cars, Television Sets, Mobile Phones, etc..

Table 3.8: Household gender specific destinations, 2007

Destination Assigned	Men		Women	
	No.	%	No.	%
Sumatra	1	0.01		
N Aceh Darussalem	4	0.03	9	0.07
North Sumatra	824	6.16	702	5.3
West Sumatra	264	1.97	302	2.28
Riau	99	0.74	51	0.39
Jambi			0	0
South Sumatra	526	3.93	406	3.06
Bengkulu	2	0.01		
Lampung	594	4.44	389	2.93
Riau Islands	1	0		
Jakarta	1,609	12.02	1655	12.49
West Java	3,237	24.19	2583	19.49
Central Jawa	1,798	13.43	1909	14.41
Yogyakarta	249	1.86	251	1.89
East Jawa	2,301	17.2	2616	19.74
Banten	46	0.35	13	0.1
Bali	289	2.16	246	1.86
West Nusa Tenggara	307	2.29	259	1.96
Central Kalimantan	12	0.09		
South Kalimantan	279	2.08	273	2.06
East Kalimantan	24	0.18	65	0.49
Central Sulawesi			37	0.28
Nort Sulawesi	15	0.11		
South Sulawesi	401	3	389	2.94
Southeast Sulawesi	32	0.24		
West Sulawesi	1	0.01		
Irian Jaya	2	0.02		
Malaysia	459	3.43	263	1.98
Singapore			4	0.03
Taiwan			3	0.02
Saudi Arabia	2	0.01	749	5.65
Timor Leste	4	0.03		
United Arab Emirates			74	0.56
Total	13,380	100	13249	100

Table 3.9: OLS Estimation. Household Level.

	Shares of Total Household Income spent on:				
	(1)	(2)	(3)	(4)	(5)
	Food	Non Food	Education	Health	Adult
A. No controls					
Migrant Mother	-0.206**	-1.961	-0.038	-0.028	0.056***
	(0.096)	(1.382)	(0.030)	(0.020)	(0.017)
Size of Household	-0.402***	1.515	0.103	-0.456	-0.003
	(0.104)	(2.575)	(0.178)	(0.300)	(0.078)
Observations	337	337	337	337	337
R^2	0.053	0.009	0.023	0.051	0.045
B. Controls included					
Migrant Mother	-0.104	-0.632	-0.012	-0.019	0.062***
	(0.079)	(0.724)	(0.022)	(0.019)	(0.017)
Size of Household	-0.032	3.861*	-0.036	-0.080	0.000
	(0.099)	(2.077)	(0.031)	(0.052)	(0.019)
Observations	337	337	337	337	337
R^2	0.376	0.338	0.097	0.064	0.078

Controls are: Rural Household, Education of Mother, log Total Household Expenditure

Standard errors robust to village level clustering in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Table 3.10: First Stage Regression.

	Migrant Mother							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$E(w_f^d)/E(w_m^d)$	0.149***	0.297***	0.315***	0.308***				
	(0.057)	(0.101)	(0.101)	(0.099)				
$Var(w_f^d)/Var(w_m^d)$		-0.092*	-0.089*	0.039				
		(0.048)	(0.048)	(0.106)				
$RA \times Var(w_f^d)/Var(w_m^d)$				-0.032				
				(0.026)				
$E(R_f)/E(R_m)$					0.059	0.241	0.365**	0.383**
					(0.069)	(0.185)	(0.180)	(0.174)
σ_f/σ_m						-0.089	-0.114	0.003
						(0.081)	(0.079)	(0.128)
$RA \times \sigma_f/\sigma_m$								-0.030
								(0.031)
Observations	379	372	337	321	377	369	334	318
R^2	0.026	0.046	0.081	0.090	0.002	0.010	0.053	0.066
F Statistic	10.03	8.604	9.374	6.437	0.746	1.919	4.017	3.317

Controls are: Rural Household, Education of Mother, log Total Household Expenditure

Standard errors robust to village level clustering in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Table 3.11: Two Stage Least Squares Estimation. Household Level.

	Shares of Total Household Income spent on:				
	(1)	(2)	(3)	(4)	(5)
	Food	Non Food	Education	Health	Adult
A. No controls					
Migrant Mother	0.026	-3.190	-0.082	0.089	0.165**
	(0.335)	(5.009)	(0.112)	(0.150)	(0.083)
Size of Household	-0.419***	-1.450	-0.074***	-0.114	-0.027
	(0.102)	(1.289)	(0.023)	(0.070)	(0.022)
Observations	337	337	337	337	337
Uncentered R^2	0.443	0.0208	0.278	0.0163	0.162
F Statistic	8.604	8.604	8.604	8.604	8.604
Hansen J Statistic	0.847	1.290	1.025	1.018	0.812
p-value	0.357	0.256	0.311	0.313	0.367
B. Controls included					
Migrant Mother	-0.293	-8.203	-0.082	0.082	0.149**
	(0.337)	(7.552)	(0.102)	(0.135)	(0.074)
Size of Household	-0.027	4.077*	-0.034	-0.083	-0.002
	(0.102)	(2.316)	(0.030)	(0.054)	(0.021)
Observations	337	337	337	337	337
Uncentered R^2	0.633	0.262	0.329	0.0652	0.230
F Statistic	9.374	9.374	9.374	9.374	9.374
Hansen J Statistic	0.723	0.908	0.775	0.771	0.637
p-value	0.395	0.341	0.379	0.380	0.425

Controls are: Rural Household, Education of Mother, log Total Household Expenditure

Standard errors robust to village level clustering in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Table 3.12: Robustness Checks: IV Estimates, only one instrument

	Shares of Total Household Income spent on:				
	(1) Food	(2) Non Food	(3) Education	(4) Health	(5) Adult
Migrant Mother	-0.153	-5.750	-0.017	0.150	0.186**
	(0.342)	(6.156)	(0.126)	(0.158)	(0.087)
Size of Household	-0.031	4.007*	-0.036	-0.085	-0.003
	(0.100)	(2.226)	(0.029)	(0.057)	(0.022)
Observations	337	337	337	337	337
Uncentered R^2	0.639	0.309	0.341	-0.000855	0.155
F Statistic	14.03	14.03	14.03	14.03	14.03
χ^2 test	0.17	0.11	0.41	0.26	0.24
p-value	0.677	0.745	0.521	0.612	0.623

Controls are: Rural Household, Education of Mother, log Total Household Expenditure

Excluded Instrument: $E(w_f^d)/E(w_m^d)$

Robust standard errors in parentheses

χ^2 test: null is that coefficients estimated are not statistically different from those of table 3.11

*** p<0.01, ** p<0.05, * p<0.1

Table 3.13: Robustness Checks: Weak Instruments

	Shares of Total Household Expenditure					Cragg -Donald F Statistic	Stock-Yogo weak ID test critical values		
	(1) Food	(2) Non Food	(3) Education	(4) Health	(5) Adult		10%	20%	30%
OLS	-0.104	-0.632	-0.012	-0.019	0.062***				
	(0.079)	(0.724)	(0.022)	(0.019)	(0.017)				
TSLS	-0.293	-8.203	-0.082	0.082	0.149**	9.374	19.93	8.75	7.25
	(0.337)	(7.552)	(0.102)	(0.135)	(0.074)				
IV	-0.153	-5.750	-0.017	0.150	0.186**	14.03	16.38	6.66	
	(0.342)	(6.156)	(0.126)	(0.158)	(0.087)				
LIML	-0.299	-8.498	-0.086	0.088	0.154**	9.374	8.68	4.42	3.92
	(0.348)	(7.873)	(0.107)	(0.143)	(0.078)				
Fuller ($\alpha = 1$)	-0.288	-8.063	-0.081	0.082	0.149**	9.374	10.89	9	7.49
	(0.329)	(7.400)	(0.101)	(0.135)	(0.073)				
Fuller ($\alpha = 4$)	-0.262	-6.995	-0.071	0.067	0.136**	9.374	10.89	9	7.49
	(0.282)	(6.277)	(0.087)	(0.116)	(0.062)				

Controls: Rural Household, Education of Mother, log Total Household Expenditure

Standard errors robust to village level clustering in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Table 3.14: Robustness Checks: Exogenous Instruments

	(1) % of Households with electricity	(2) Elementary Schools	(3) Junior High Schools	(4) Number of Midwives	(5) Health Posts	(6) Distance to Coach Station	(7) Distance to Post Office
$E(w_f^d)/E(w_m^d)$	-5.901	-0.599	0.316	-0.115	0.950	23.984	-0.950
	(4.430)	(0.499)	(0.283)	(0.106)	(1.233)	(21.131)	(1.940)
$Var(w_f^d)/Var(w_m^d)$	3.782**	0.293	-0.336**	0.015	0.264	-11.480	-1.190
	(1.815)	(0.226)	(0.163)	(0.048)	(0.540)	(8.781)	(0.872)
Observations	12,217	12,766	12,686	8,796	12,190	9,229	10,183
R^2	0.0188	0.0046	0.0217	0.0056	0.0155	0.0105	0.0299

Unit of observation is household

Standard errors robust to village level clustering in parenthesis

*** p<0.01, ** p<0.05, * p<0.1

Table 3.15: Robustness Checks: Montecarlo Simulations

	Shares of Total Household Expenditure				
	(1) Food	(2) Non Food	(3) Education	(4) Health	(5) Adult
OLS	-0.104	-0.623	-0.011	-0.020	0.062
	(0.079)	(1.171)	(0.033)	(0.028)	(0.016)
TSLS	-0.113	-2.556	-0.084	0.068	0.14
	(0.348)	(4.922)	(0.141)	(0.124)	(0.075)
Coverage	[0.969]	[0.962]	[0.964]	[0.964]	[0.951]
Cragg Donald F	10.669	10.693	10.723	10.719	10.624
Hansen J Statistic - pvalue	0.502	0.503	0.503	0.502	0.504
LIML	-0.113	-2.744	-0.092	0.074	0.146
	(0.393)	(5.571)	(0.164)	(0.139)	(0.084)
Coverage	[0.968]	[0.968]	[0.965]	[0.968]	[0.956]
Cragg Donald F	10.669	10.693	10.723	10.719	10.624
Hansen J Statistic - pvalue	0.504	0.505	0.506	0.505	0.508

Standard Deviations in parenthesis

Number of iterations = 1,000

Coverage is the frequency with which the hypothesis of equality between coefficient estimated from actual sample and coefficient estimated from simulated sample has not been rejected

Controls included

Standard errors robust to village level clustering

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